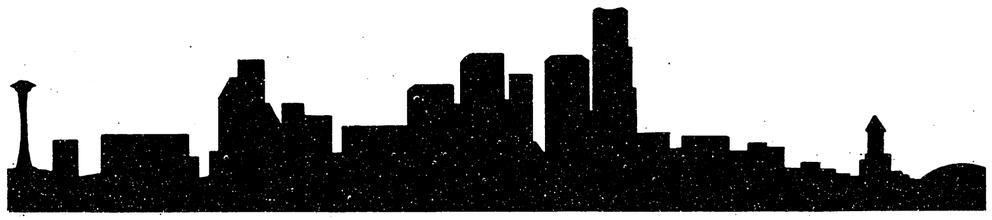
1989 Seattle Standard Specifications



1989
City of Seattle
Standard Specifications
for Road, Bridge, and
Municipal Construction

CITY OF SEATTLE
1989 STANDARD SPECIFICATIONS
FOR
ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION

Prepared By
Seattle Engineering Department
Gary Zarker, Director

Examined and Approved
by the
Board of Public Works
February 10, 1989

Board of Public Works:

G. Zarker	Engineering Department
J. Ritch	Department of Administrative Services
H. Miller	Department of Parks and Recreation
R. Groncznack	Water Department
R. Hardy	City Light Department
B. Taber	Executive Director

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Community Affairs Division
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(206) 684-5349

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PREFACE

The 1989 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction (henceforth referred to as the "1989 Seattle Standard Specifications") have been prepared by the Seattle Engineering Department for the Board of Public Works. This document was compiled by combining the 1988 WSDOT/APWA Standard Specifications with Seattle's 1986 Supplemental Specifications, and then revising or supplementing the resulting whole to reflect current City policies and procedures.

For all public works projects administered by the Seattle Engineering Department, or by other departments and agencies working within the jurisdiction of the Seattle Engineering Department, the following are part of the Contract Documents on all individual projects and are to be considered as a whole:

- 1989 Seattle Standard Specifications
- 1986 Seattle Standard Plans
- Traffic Control Manual for In-Street Work (used in conjunction with the MUTCD)
- Laws of the State of Washington
- Charter and Ordinances of the City of Seattle
- Project Manual for the individual project

The 1989 Seattle Standard Specifications and the 1986 Seattle Standard Plans apply whenever any public or private work is performed within the street rights of way of the City of Seattle, including work performed by private parties at their own expense under authority granted by ordinance of the City Council or permit of the Board of Public Works. All requirements of the 1989 Seattle Standard Specifications apply to such work in the same manner as though the work were being performed under Board of Public Works contract, with the exception of those requirements or conditions pertaining to payment for the work performed or to withholding or receiving money due the Contractor. All matters relating to financing of such work shall be between the permitee and the Contractor, and the City shall not enter into such matters.

SHADING: For the convenience of some of our users, we have shaded the text like this to indicate text that was drawn from the '88 WSDOT/APWA Standard Specifications.

Despite considerable efforts to produce a completely error-free document, some mistakes seem to defy detection until after publication. Should you discover errors in this document please bring them to our attention at the following address:

Seattle Engineering Department
Construction Contracts Section
Municipal Building, Room 910
Seattle, Washington 98104

My sincere thanks and appreciation to all those individuals in the Engineering Department, and other City Departments and outside agencies who participated in the effort of drafting, typing, and reviewing this document. It was a chore that took more time and was more involved than was originally anticipated. In particular, thanks to Alan F. Chinn who shouldered most of the work in drafting, coordination, and conflict resolution. Without his dedication, resolve and cheerful disposition under stress, this project would have been much harder to complete. Thanks also to D. L. Freist, S. R. Gant, B. L. Rainwater, M. Stallings, L. Henderson, P. Nable, and T. Time for their wordprocessing skills in getting this document ready for the typesetter. Finally thanks to the editor, D. Scott McLean, P.E. for his efforts in coordinating the final circulation, typesetting, proofing, and printing, and for taking care of all the finishing details that are a necessity for getting the job done right.

Additional copies of this document may be obtained from the 9th Floor Information Counter in the Seattle Municipal Building, 600 Fourth Avenue, Seattle, Washington 98104 at a cost of $35 per copy.

D. J. Howell, P.E.
Manager, Construction Contracts
Seattle Engineering Department

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GENERAL REQUIREMENTS

SECTION 1-01 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

1-01.1 GENERAL

Standard acronyms, abbreviations, definitions and symbols common to the fields of engineering and construction are used throughout the Contract Documents without further definition. A listing of acronyms, abbreviations, and definitions often used in the Contract Documents are included hereinafter. Additional acronyms, abbreviations, definitions, and symbols may also be found in the Project Manual or Drawings. Welding symbols are defined in the current edition of the American Welding Society Structural Welding Code.

When used in the Bid Form to denote items of work and units of measurement, abbreviations are defined to mean the full expression.

When used in the Contract Documents, the following acronyms and words (or pronouns used in place of them) have the indicated meanings unless the context implies otherwise:

(1) Words in the plural indicate singular and vice versa.
(2) Words of a particular gender include any gender and genderless words may refer to any gender when the sense so indicates.

1-01.2 ACRONYMS

AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACSF	Arterial City Street Fund
ADF	Arterial Development Fund
AGA	American Gas Association
AGC	Associated General Contractors of America
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
APA	American Plywood Association
APWA	American Public Works Association
ARA	American Railway Association
AREA	American Railway Engineering Association
ARMA	Asphalt Roofing Manufacturers Association
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestruction Testing
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BR	Bridge Replacement and Rehabilitation Program
CBD	Central Business District
CDBG	Community Development Block Grant
CL	City Light
CLI	Chain Link Institute
CRAB	County Road Administration Board
CRF	Cumulative Reserve Fund
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electrical Institute
EF	Emergency Fund
EPA	Environmental Protection Agency
ER	Emergency Relief Program
FAI	Federal Aid Interstate
FAS	Federal-aid Secondary Program
FASP	Federal-aid Safety Program
FAUS	Federal-aid to Urban Systems
FHWA	Federal Highway Administration
FS	Federal Specifications
FSS	Federal Specifications and Standards, General Services Administration
HES	Hazard Elimination Program
HPMA	Hardwood Plywood Manufacturers Association
HRD	Seattle Human Rights Department
HUD	United States Department of Housing and Urban Development
ICEA	Inusulated Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
ITE	Institute of Transportation Engineers
IES	Illuminating Engineering Society
LID	Local Improvement District
LPI	Lighting Protection Institute
MBE	Minority Business Enterprise
METRO	Municipality of Metropolitan Seattle
MSHA	Mine Safety and Health Act
MUTCD	Manual on Uniform Traffic Control Devices for Streets and Highways
NAPA	National Asphalt Pavement Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NEPA	National Environmental Protection Association
NIF	Neighborhood Improvement Fund
NIP	Neighborhood Improvement Program
NFPA	National Fire Protection Association
NRCA	National Roofing Contractors Association
OMWBE	Office of Minority and Women's Business Enterprises
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PORT	Port of Seattle
PPI	Plastic Pipe Institute
PCI	Prestressed Concrete Institute
RCW	Revised Code of Washington
RRP	Railway-Highway Grade Crossing Program
SAE	Society of Automotive Engineers
SBRP	Special Bridge Replacement Program
SED	Seattle Engineering Department
SEPA	State Environmental Policy Act
SF	Sewer Fund
SIF	Sewer Improvement Fund
SOS	Safer-Off-System Grant
SSPC	Steel Structures Painting Council
SWD	Seattle Water Department
SWF	Solid Waste Fund
TAN	Targeted Area Neighborhood
TIB	Transportation Improvement Board
TRNF	Transit Fund
UATF	Urban Arterial Trust Fund
UL	Underwriters Laboratory
ULID	Utility Local Improvement District
UMTA	Urban Mass Transit Administration
USACE	United States Army Corps of Engineers
USDOE	United States Department of Energy

WBE	Women's Business Enterprise
WCLGB	West Coast Lumber Grading Bureau
WISHA	Washington Industrial Safety and Health Administration
WMBE	Women's and Minority Business Enterprise
WRI	Wire Reinforcement Institute
WSDOE	Washington State Department of Ecology
WSDOT	Washington State Department of Transportation

1-01.3 ABBREVIATIONS

Abbreviations used throughout the Contract Documents are listed with the Standard Plans.

1-01.4 DEFINITIONS

The following terms and their definitions are listed in alphabetical order:

ACTUAL COMPLETION DATE

See "Dates".

ADDENDUM

A written or graphic instrument, issued prior to the Bid opening, which modifies or interprets the Bid Documents by additions, deletions, clarifications or corrections.

ADDITIVE

A supplemental unit of work or group of Bid Items, identified separately in the Bid, which may, at the discretion of the Owner, be awarded in addition to the Base Bid should sufficient funding be available.

ADVERTISEMENT FOR BIDS

A public notice published in the City Official Newspaper, soliciting bids for the Work.

AGREEMENT, FORM OF

The written agreement between the Owner and the Contractor setting forth the obligations of the parties thereunder including, but not limited to, the performance of the Work, the basis of payment and the Contract Time.

ALTERNATE

A unit of Work or group of Bid Items, identified separately in the Bid, which permits a choice of different methods or material of construction for performing the same work.

ARCHITECT

A licensed registered Architect of the State of Washington, acting directly or through duly authorized representatives in the administrative management of the contract.

ASSISTANT

See "Inspector."

AUXILIARY LANE

The part of the roadway next to traveled ways for parking, speed changes, turning, weaving, truck climbing or for anything that adds to through traffic movement.

AWARD

The formal decision of the Owner to accept the lowest and best Bid for the Work.

BASE BID

The summation of Bid Item amounts (extensions) or the lump sum Bid in the Bid Form, excluding Additives, Alternates, Deductives and taxes collected separately pursuant to Washington State Excise Tax Rule 170 or 171.

BASE COURSE

The layer of aggregate, oil-treated aggregate, treated soil, or soil- aggregate which rests upon the subbase or, if no subbase, upon the subgrade.

BID

The written offer of a Bidder, executed pursuant to the Bid Documents, to perform the Work for a specific price. The terms "Bid", "Proposal", "Bid Proposal", and like terms are synonymous.

BIDDER

An individual, partnership, firm, corporation, or joint venture, submitting a Bid. When required by law or otherwise such individual, partnership, firm, corporation or joint venture shall be prequalified.

BID DOCUMENTS

The Advertisement for Bids, Instructions to Bidders, Bid Form, and the proposed Contract Documents including any Addenda issued prior to Bid opening.

BID FORM

The form included in the Bid Documents: The Bid, the Women's and Minority Business Enterprise Utilization Commitment and the Affidavit.

BID GUARANTY

Bid bond, cash, cashier's check or certified check accompanying the Bid as a guarantee that the Bidder will enter into an agreement with the Owner for performance of the Work if the Bidder is awarded the Contract.

BRIDGE APPROACH EMBANKMENT

An embankment beneath a structure and extending 100 feet beyond a structure's end (at subgrade elevation for the full embankment width) plus an access ramp on a 10:1 slope to the original ground elevation. Also, any embankment that replaces unsuitable foundation soil beneath the bridge approach embankment.

CHANGE ORDER

A written order to the Contractor, issued by the Engineer after execution of the Contract, authorizing an addition, deletion, or other revision in the Work, within the scope of the Contract Documents, and establishing the basis of payment and time adjustments, if any, for the Work affected by the change.

COMBINATION WOMEN'S AND MINORITY BUSINESS ENTERPRISE

An independent and continuing business for profit which performs a commercially useful function, and which is owned and controlled by a combination of women and minorities.

CONSULTANT

A licensed registered engineer or architect or an authorized member of a licensed consulting firm or organization retained by the Owner.

CONTRACT

The entire and integrated agreement between the Owner and the Contractor, (see definition of Contract Documents).

CONTRACT BOND

The approved form of security furnished by the Contractor and the Contractor's Surety guaranteeing completion of the Work and payment to persons supplying labor and materials in the prosecution of the Work, in accordance with the terms and conditions of Contract Documents.

CONTRACT DOCUMENTS

The component parts of the Contract which may include, but are not limited to, the executed Bid Form, Bonds, Insurance Certificates, Project Manual, Drawings, Standard Specifications, Standard Plans, Addenda, Supplemental Agreements and Change Orders.

CONTRACTOR

The individual, partnership, corporation, firm or joint venture, contracting with the Owner to do the Work.

CONTRACT PRICE

Awarded Contract Price:

The summation of Bid Item amounts (extensions) or a lump sum for all items Tof Work, including applicable taxes, upon which the Award is made.

Revised Contract Price:

The Awarded Contract Price at any time after Award but prior to the Acceptance Date adjusted as a result of approved Change Order.

Final Contract Price:

The total monies payable to the Contractor under the terms and conditions of the Contract Documents.

CONTRACT TIME

The period of time established by the terms and conditions of the contract within which the Work must be completed.

CULVERT

A drainage structure which may or may not directly support traffic, extending across and beneath a highway, street, driveway, or alley, or other public way.

DATES

Bid Opening Date:

The date on which Bids for the Work are opened and read publicly.

Award Date:

The date on which the Owner formally accepts the Bid of the lowest and best Bidder and awards the Contract.

Contract Completion Date:

The date by which the Work is required to be satisfactorily completed. The Contract Completion Date will be stated in the Notice to Proceed. Revisions of this date will be authorized in writing by the Engineer whenever there is an extension to the Contract Time.

Notice to Proceed Date:

The date stated in the Notice to Proceed on which the contract time begins.

Substantial Completion Date:

The date, established in writing by the Engineer when the Contract Work is completed to the extent that the Owner has full and unrestricted use and benefit of the facilities and only minor incidental work, replacement of temporary facilities or correction or repair remains to complete the total Contract.

Actual Completion Date:

The date, certified in writing by the Engineer, when the Work including every item or element, is satisfactorily complete in accordance with the Contract Documents.

Acceptance Date:

The date on which the Owner accepts the Work as complete.

DAY

Unless otherwise specified, day(s) shall mean calendar day(s).

Calendar Day: .

The time period of twenty-four hours measured from midnight to the next midnight.

Non-Working Day:

(1) Saturday
(2) Sunday
(3) Holiday
(4) a day(s) upon which a suspension order is issued by the Engineer.
(5) a day(s) upon which the Contractor is specifically required by the Contract Documents to suspend the Work.

Business Day:

Any day other than Saturday, Sunday, or Holiday.

Working Day:

A day not otherwise defined as a Non-Working Day.

DEDUCTIVE

A supplemental unit of work or group of Bid Items, identified separately in the Bid which may, at the discretion of the Owner, be deducted from the Base Bid.

DRAWINGS

The portion of the Contract Documents showing in graphic or pictorial form the design, location, and dimensions of the elements of a project; a graphic representation.

ENGINEER

The chief executive officer, or authorized assistant, of a City Department or Division, who is a licensed registered Engineer of the State of Washington, acting directly or through duly authorized representatives in the administrative management of the Contract.

EQUIPMENT

The machinery, tools, implements, apparatus, and appliances, together with the necessary supplies for their upkeep and maintenance, which are necessary to enable the Contractor to perform the Work.

FEDERAL HIGHWAY ADMINISTRATION

The Federal Agency authorized to approve plans and contracts for Federal Aid Highway projects. This agency also inspects such projects to ensure contract compliance.

FRONTAGE ROAD

A local street or road usually next to an arterial highway that serves abutting property and adjacent areas and controls access.

HIGHWAY (ARTERIAL)

Any U.S. or numbered route, controlled access highway, or other major radial or circumferential street or highway designated by local authorities within their respective jurisdiction as part of a major arterial system of streets or highways.

HIGHWAY (STREET, ROAD, ALLEY)

The entire width between the boundary lines of every way, publicly maintained, when any part thereof is open to the use of the public for purpose of vehicular travel.

HOLIDAY

A day designated by law commemorating a religious festival or some important event in history; a day of exemption from labor.

Recognized Holidays for the City of Seattle are:

the first day of January (New Year's Day)

the third Monday in January (Martin Luther King, Jr.'s Birthday)

the twelfth day of February (Lincoln's Birthday)

the third Monday of February (Washington's Birthday)

the last Monday of May (Memorial Day)

the fourth day of July (Independence Day)

the first Monday of September (Labor Day)

the eleventh day of November (Veterans' Day)

the last Thursday of November and the Friday following (Thanksgiving Day)

the twenty-fifth day of December (Christmas Day)

When any recognized Holiday falls on a Sunday, the following Monday shall be considered a Holiday. When any recognized Holiday falls on a Saturday, the preceding Friday shall be considered a Holiday.

INSPECTOR

The Engineer's authorized representative assigned to make detailed inspections of the Work.

JOB SITE

See "Project Site."

JOINT VENTURE

An association of two or more persons or businesses to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills or knowledge and in which they exercise control and share in profits and losses in proportion to their contributions to the enterprise.

LABORATORY

The Materials Laboratory of the Engineer or such other laboratories authorized by the Engineer.

LIQUIDATED DAMAGES

The amount fixed in the Contract Documents to be paid to the Owner by the Contractor, for each working day of delay in completing all or any specified portion of the Work beyond the time specified in the Contract; such obligation shall not be construed as a penalty, and may be deducted by the Owner from any payments due or to become due the Contractor.

MAJOR BID ITEM

A Bid Item, unless specifically excluded in the Project Manual, for which the extension is 10 percent or more of the Awarded Contract Price. A Bid Item other than a Major Bid Item, is a Minor Bid Item.

MATERIAL

Any substance specified for use in the construction of the project and its appurtenances which enters into and forms a part of the finished structure or improvement and is capable of being so used and is furnished for that purpose.

MATERIALMAN

A person or organization who furnishes a raw material, supply, commodity, equipment, or manufactured or fabricated product and does not perform labor at the Project Site; a supplier.

MINORITY BUSINESS ENTERPRISE

An independent and continuing business for profit, which performs a commercially useful function, and which is owned and controlled by one or more minority persons residing in the United States or its territories.

NOTICE OF AWARD

The Written Notice from the Owner to the successful Bidder signifying the Owner's acceptance of the Bid.

NOTICE TO PROCEED

The Written Notice from the Engineer to the Contractor authorizing and directing the Contractor to proceed with the Work and establishing the date on which the Contract Time begins.

OFFICIAL NEWSPAPER

The publication designated annually by the Board of Public Works to publish all official proceedings of The City of Seattle.

OWNER

The City of Seattle, acting through its Board of Public Works.

PAVEMENT STRUCTURE (PAVEMENT)

The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the road bed.

PLANS

See "Drawings."

PROFILES

See "Drawings."

PROJECT

See "Work."

PROJECT ENGINEER

See "Engineer."

PROJECT MANUAL

The compilation of written provisions and requirements for the Work related to a specific Project. The Project Manual includes, but is not limited to, the bidding requirements, sample forms, Agreement Form, wage rates, conditions of the contract, specifications and addenda.

PROJECT SITE

The geographical location, usually defined by legal boundary lines, where the Work is to be performed.

RIGHT OF WAY

Land, property, or property interest, secured and reserved to the public for transportation, utility services, drainage, sidewalks, or other public purposes.

ROADBED

The graded part of the roadway within top and side slopes prepared as a foundation for the pavement structure and shoulders.

SEWER

A pipe or conduit for carrying sewage and other waste liquids: includes sanitary sewer, side sewer, combined sewer, and storm water sewer or drain.

SHOP DRAWINGS

Drawings, diagrams, illustrations, schedules, performance charts, brochures, and other similar data prepared by the Contractor or a subcontractor, manufacturer, supplier or distributor to illustrate how specific portions of the Work shall be fabricated or installed.

SHOULDER

The part of the roadway next to the traveled way or auxiliary lanes. It provides lateral support of base and surface courses and is an emergency stopping area for vehicles.

SPECIAL PROVISIONS

See "Project Manual."

SPECIFICATIONS

Written technical descriptions of materials, equipment, construction systems, standards, and workmanship which, in conjunction with the Drawings, detail the requirements for acceptable completion of the Work. Specifications include notes, schedules, and comments on the Drawings.

STANDARD PLANS

The current edition of The City of Seattle Standard Plans for Municipal Construction adopted by the Owner which show frequently recurring components of work that have been standardized for use by various Departments within The City of Seattle.

STANDARD SPECIFICATIONS

The current edition of The City of Seattle Standard Specifications, as supplemented by the current edition of the Traffic Control Manual for In-Street Work.

STATE

The State of Washington acting through its representatives.

STRUCTURES

Bridges, culverts, walls, buildings, foundations, water tanks, transmission towers, cribbing, caissons, or cofferdams, and other similar features which may be encountered in the Work and are classified as structures in the Contract Documents.

SUBBASE

The layer(s) of specified or selected material of designated thickness in a pavement structure immediately above the subgrade and below the base course.

SUBCONTRACTOR

An individual, partnership, firm, corporation, or joint venture to whom the Contractor, with the prior written approval of the Engineer sublets or subcontracts part of the Work.

SUBGRADE

The top surface of the roadbed on which subbase, base, surfacing, pavement, or layers of similar materials are placed.

SUBSTANTIAL COMPLETION

Completion of the Contract Work to the extent that, as evidenced by Written Notice from the Engineer, the Owner has full and unrestricted use and benefit of the facilities, and only minor incidental work, replacement of temporary substitute facilities, or correction or repair remains to complete the total Contract.

SUBSTRUCTURE

The part of the structure below:

(1) Simple and continuous span bearings, or

(2) Arch skewbacks and construction joints at the top of vertical abutment members or rigid frame piers.

Substructures include backwalls, wingwalls and wing protection railings.

SUPERSTRUCTURE

The part of the structure above:

(1) Simple and continuous span bearings, or

(2) Arch skewbacks and construction joints at the top of vertical abutment members or rigid frame piers.

Superstructures do not include backwalls, wingwalls, and wing protection railings unless supported by the Superstructure.

SUPPLEMENTAL AGREEMENT

A document signed by the Owner, the Contractor and the Surety to the Contract Bond, authorizing a variation of more than twenty-five (25) percent in any one of the following:

(1) The awarded Contract Price.

(2) Any Major Bid Item.

SUPPLEMENTAL CONTRACT

A document executed in accordance with the provisions of RCW 60.28.010 stipulating conditions for completion of that portion of the Work which was deleted from the Contract Documents to allow for acceptance of a substantially completed contract.

SUPPLIER

See "Materialman."

SUPPLIES

Any substance or matter used or consumed in the construction of the project and its appurtenances which does not become part of the structure or improvement.

SURETY

A firm or corporation that is responsible for the Bidder's execution of the Contract and Contract Bond, and is bound with the Contractor to ensure performance of the Contract, payment of all obligations pertaining to the Work, and fulfillment of such other conditions as are specified in the Contract Documents, Contract Bond, or otherwise required by law.

SURFACE COURSE

The top layer of the pavement structure designed to accommodate the traffic load and resist skidding, traffic abrasion, and the disintegrating effects of climate; sometimes called the "Wearing Course".

TRAFFIC CONTROL MANUAL FOR IN-STREET WORK

The document adopted by the Board of Public Works, which refines the basic principles embodied in the Manual on Uniform Traffic Control Devices (MUTCD) as published by the Department of Transportation Washington, D.C. to allow for better application to urban traffic conditions in the Seattle area.

TRAVELED WAY

The part of the road made for vehicle travel excluding shoulders and auxiliary lanes.

VENDOR

See "Materialman."

WATER MAIN

A water supply pipe for public or community use.

WOMEN'S BUSINESS ENTERPRISE

An independent and continuing business for profit which performs a commercially useful function and which is owned and controlled by one or more women residing in the United States or its territories.

WORK

The provision of all labor, materials, equipment, and everything needed to successfully complete a project or improvement pursuant to the Contract Documents. The term Work when capitalized may mean "project" or "improvement."

WORKING DAY

See "Day."

WORKING DRAWINGS

See "Drawings."

WRITTEN NOTICE

A notice in writing to the Owner, Engineer, Contractor or Surety relative to the Work.

SECTION 1-02 BID PROCEDURES AND CONDITIONS

1-02.1 QUALIFICATIONS OF BIDDERS

Bidders shall be qualified by experience, financing, equipment, and organization to do the Work required by the Contract Documents.

1-02.2 BID DOCUMENTS

Information as to where Bid Documents can be obtained or reviewed will be found in the Advertisement for Bids.

1-02.3 ESTIMATED QUANTITIES

The quantities shown on the Bid Form are estimates only, and are stated for Bid comparison purposes. The Owner does not warrant, expressly or by implication, that actual quantities of the Work will correspond with those estimated. The Engineer reserves the right to increase or decrease the amount of any item of Work, or to make other changes in the Work as necessary. Payment will be made on the basis of the actual quantities of each item of Work completed in accordance with the Contract Documents.

1-02.4 EXAMINATION OF BID DOCUMENTS AND PROJECT SITE

Before submitting a Bid, each Bidder shall:

(1) examine the Bid Documents thoroughly,

(2) examine the Project Site to be familiar with local conditions that may in any manner affect cost, progress, or performance of the Work,

(3) be familiar with Federal, State and local laws, ordinances, rules, and regulations that may, in any manner, affect cost, progress, or performance of the Work, and

(4) study and carefully correlate the Bidder's observations with the Bid Documents.

If public access to the Project Site is restricted, the Engineer will schedule access for all Bidders at a specific time prior to Bid submittal so that Bidders may examine the site of the Work.

The lands upon which the Work is to be performed, rights of way for access, and other lands designated by the Owner for use in performing the Work, are identified in the Contract Documents. The submission of a Bid shall constitute an incontrovertible representation that the Bidder has complied with every requirement of this section, and that the Bid Documents are sufficient, in scope and detail, to indicate and convey understanding of all the terms and conditions for performance of the Work.

The Bidder shall determine the methods, labor, and equipment required to perform the Work, and shall reflect their costs in the Bid prices. Costs exceeding those anticipated by the Bidder will not entitle the Bidder to additional compensation, except as may be authorized by Change Order.

If the Engineer has made subsurface investigation of the site of the proposed Work, the boring log data and soil sample test data accumulated by the Engineer will be made available for inspection by the Bidders. It is mutually recognized and agreed by all parties that:

(1) when any of this data is included in the Engineer's Drawings, it is for information, and does not constitute a part of the Contract Documents.

(2) the subsurface investigations made by the Engineer were for the sole purpose of furnishing data necessary for planning and design of the Work.

(3) the Engineer assumes no responsibility whatsoever for the sufficiency or completeness of the data furnished, with respect to meeting the needs of the Bidder in planning the Bidder's work.

(4) the Engineer warrants that the data represents, with reasonable accuracy, the conditions and materials found in the specific borings at the time the borings were made. The Engineer does not warrant the condition, materials, or proportions of the materials between the specific borings.

(5) The Engineer makes no representation or warranty, expressed or implied, that:

(a) the interpretations from the data are correct,

(b) moisture conditions and indicated water tables will not vary substantially from those found at the time that the borings were made,

(c) the ground at the location of the boring has not been physically disturbed or altered after the boring was made.

(6) The availability of subsurface information from the Engineer is solely for the convenience of the Bidder, and shall not relieve the Bidder or the Contractor from any risks, or from any duty to make a separate examination and investigation required by this section, or any other responsibility under the terms and conditions of the Contract.

1-02.5 FORM AND STYLE OF BID

A Bid shall be submitted only on the Bid Form issued by the Owner. An identical sample form may be found in the Project Manual. The Bid Form will identify the project and may describe the Work by listing estimated quantities, units of measure, items of work, and materials to be furnished.

Bids shall be completed by typing or shall be printed in ink by hand, preferably in black ink. Where indicated by the Bid Form, prices shall be expressed in both words and figures. A price shall be submitted for each Bid Item listed.

Spaces, to be filled in by the Bidder, include spaces for unit price bid items or lump sum prices; bid item amounts (extensions); summations and, where applicable, retail sales taxes; acknowledgement of Addenda; the Bidder's name, address, telephone number, and signature; the Bidder's WBE and MBE commitment; a State of Washington Contractor's Registration Number; and a City of Seattle Business License Number. Required certifications, as appropriate, shall be included on the Affidavit of the Bid Form.

Any correction to a Bid made by interlineation, alteration or erasure, shall be initialed by the signer of the Bid. The Bidder shall make no stipulation on the Bid Form, nor qualify the Bid in any manner. A Bid shall be submitted for every Additive, Alternate, or Deductive identified in the Bid Form, unless otherwise specified.

A Bid by a corporation shall be executed in the corporate name, by the president or a vice president (or other corporate officer accompanied by evidence of authority to sign).

A Bid by a partnership shall be executed in the partnership name, and signed by a partner. A copy of the partnership agreement shall be submitted with the Bid Form if the WBE or MBE requirements are to be satisfied through such an agreement.

A Bid by a joint venture shall be executed in the joint venture name and signed by a member of the joint venture. A copy of the joint venture agreement shall be submitted with the Bid Form if the WBE or MBE requirements are to be satisfied through such an agreement.

1-02.6 ADDENDA

Questions regarding the meaning or intent of the Bid Documents shall be submitted to the Engineer in writing. If warranted by the Engineer, interpretations will be provided by addenda. Only questions answered by formal written addenda will be binding. Oral or other interpretations or clarifications will be without legal effect.

Addenda may be issued to modify or interpret the Bid Documents. Addenda will be mailed to persons or organizations to whom the Bid Documents were issued. The Bidder shall acknowledge receipt of each Addendum by filling in the appropriate spaces on the Bid Form Affidavit.

The Bidder should always check with the Engineer the day before Bids are opened to ensure all addenda have been received. The address and telephone number of the Engineer's office where copies of Bid Documents and addenda may be obtained is stated in the Advertisement for Bids.

1-02.7 BID GUARANTY

A Bid shall be accompanied by a certified or cashier's check payable to the order of the Seattle City Treasurer, by cash, or by a bid bond, for a sum of not less than five percent of the maximum bid amount that could be awarded, including sales tax and additives if applicable. A Bid will not be accepted or considered unless accompanied by such check, cash, or bid bond.

If a Bid is accompanied by a bid bond, the bid bond shall be furnished by a company authorized to do business in the State of Washington. In order to be authorized to do business in the State of Washington, the surety shall be registered with the Washington State Insurance Commissioner, and the surety's name shall appear on the current list of authorized insurance companies published by the Office of the Insurance Commissioner.

Bid bonds shall contain the following:

(1) Ordinance, L.I.D., or specification number of the improvement;

(2) Name and nature of the improvement;

(3) The City of Seattle named as obligee;

(4) The amount of the bid bond stated either as a dollar figure or as a percentage which represents five percent of the maximum Bid amount that could be awarded;

(5) Signature of the Bidder's officer empowered to sign official statements. The signature of the person authorized to submit the Bid should agree with the

signature on the bond, and the title of the person must accompany the said signature;
(6) The signature of the surety's officer empowered to sign the bond and the power of attorney.

1-02.8 NONCOLLUSION REQUIREMENT

The Bidder, by signing and having the Bid Form notarized, swears, deposes and says that the Bidder has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding in the preparation and submission of a Bid to the Owner for consideration in the award of a contract on the improvement described in the Bid Documents.

1-02.9 BID SUBMITTAL

1-02.9(1) GENERAL

The authorized Bid Form shall be submitted at the time and place specified in the Advertisement for Bids. The Bid Form, together with the Bid Guaranty and such other documentation as is required, shall be enclosed in a sealed envelope marked with the project title and the Bidder's name, and be addressed to:

Board of Public Works
City of Seattle
Arctic Building, Suite 700
700 Third Avenue
Seattle, WA 98104

If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope, with a notation "BID ENCLOSED" on the face of the envelope. The Bidder shall assume full responsibility for the timely delivery at the location designated in the Advertisement for Bids for receipt of Bids. A Bid submitted or delivered after the time fixed for receipt of Bids will not be accepted.

1-02.9(2) CHANGE OF BID SUBMITTAL DATE

The Owner reserves the right to change the date and time for Bid submittal. Notification of the change will be by Addendum.

1-02.10 MODIFICATION OR WITHDRAWAL OF BID

A Bidder may withdraw or revise a Bid after it has been deposited with the Owner if a written request for a withdrawal or modification, signed by an authorized individual, or a telegram is received by the Owner prior to the time designated for receipt of Bid. If the request for modification or withdrawal is by telegram, written confirmation over the signature of the Bidder shall be mailed and postmarked on or before the time designated for receipt of Bids.

The original Bid, as revised in writing, and received prior to the time designated for receipt of Bids, will be acceptable as the official Bid.

A Bid may not be modified, withdrawn, or cancelled by the Bidder after the time for Bid submittal, except that withdrawal will be permitted if the Award is delayed for a period exceeding the limit set forth for Award, or a Bidder's claim of error is upheld by the Owner.

1-02.11 ADDITIVES, ALTERNATES, DEDUCTIVES

The Engineer reserves the right to arrange the Bid Form with Alternates, Additives, or Deductives, if such be to the advantage of the Owner. The Bidder shall bid on all Additives, Deductives, or Alternates set forth in the Bid Form unless otherwise specified in The Project Manual.

1-02.12 OPENING OF BIDS

Bids will be opened and read orally in Suite 740, Arctic Building, 700 Third Avenue, Seattle, Washington, immediately after 2:00 p.m. on the date indicated in the Advertisement for Bids or in an Addendum.

1-02.13 IRREGULAR BIDS

A Bid will be considered irregular and nonresponsive, and will be rejected if:

(1) the authorized Bid Form is not used or is altered;
(2) the completed Bid Form contains any unauthorized addition, deletion, alternate bid, or condition;
(3) the Bidder adds provisions reserving the right to accept or reject the Award or to enter into the Contract;
(4) the Bidder has not been prequalified prior to Bid submittal when so required by the Bid Documents;
(5) a price per unit cannot be determined;
(6) the Bidder failed to commit to use certified WBE(s) and MBE(s) to the extent required by the Bid Documents.

A Bid may be considered irregular and may be rejected if:

(1) the Bid does not include a unit price for every Bid item;
(2) the Bid Guaranty is insufficient or improper;
(3) any of the unit prices are excessively unbalanced (either above or below the amount of a reasonable Bid) to the potential detriment of the Owner;
(4) receipt of Addenda is not acknowledged;
(5) a member of a joint venture or partnership and the joint venture or partnership submit a Bid for the same project (in such an instance, both Bids may be rejected);
(6) the entries in the Bid Form are not typewritten or entered in ink;
(7) the joint venture or partnership is used to meet the WBE or MBE commitment requirements and the joint venture or partnership agreement is not submitted with the Bid Form;
(8) the Bid is not properly executed;
(9) the Bidder did not bid on all Additives, Deductives, or Alternates, when required.

1-02.14 DISQUALIFICATIONS OF BIDDERS

A Bidder may be deemed not responsible and its Bid rejected if:

(1) more than one Bid is submitted for the same project from a Bidder under the same or different names;
(2) evidence of collusion exists with any other Bidder or potential Bidder. Participants in collusion will be restricted from submitting further bids;
(3) a Bidder, in the opinion of the Owner, is not qualified for the work specified, or to the extent that the Bid exceeds the authorized prequalification amount as may have been determined by a prequalification or pre-award evaluation of the Bidder;
(4) an unsatisfactory performance record exists as shown by past or current Work for the Owner, or for others, as judged from the standpoint of conduct of the Work; workmanship; progress; affirmative action; equal employment opportunity practices; or Disadvantaged Business Enterprise; Minority Business Enterprise; or Women's Business Enterprise utilization;
(5) there is uncompleted work (Owner or otherwise) which might hinder or prevent the prompt completion of the Work bid upon;
(6) the Bidder failed to settle bills for labor or materials on past or current contracts;
(7) the Bidder has failed to complete a public contract, or has been convicted of a crime arising from a previous public contract;

(8) the Bidder is unable, financially or otherwise, to perform the Work;
(9) a Bidder is not authorized to do business in the State of Washington (not registered in accordance with RCW 18.27);
(10) for any other reason deemed proper by the Owner.

SECTION 1-03 AWARD AND EXECUTION OF CONTRACT

1-03.1 CONSIDERATON OF BIDS

1-03.1(1) EVALUATION OF WBE AND MBE UTILIZATION COMMITMENT

1-03.1(1)A REVIEW OF COMMITMENT

(1) The Utilization Commitment as set forth in the Bid Form will be reviewed by the Human Rights Department to determine whether the following requirements have been met:
  (a) the Bidder has fully and accurately completed the Utilization Commitment of the Bid Form;
  (b) the projected WBE, MBE or Combination WMBE utilization as stated in the Utilization Commitment of the Bid Form will satisfy the WBE and MBE set-aside requirements;
  (c) each of the WBEs, MBEs or Combination WMBEs designated in the Utilization Commitment of the Bid Form was certified by the State OMWBE on the date of Bid opening;
  (d) the Bidder contacted each of the designated WBEs, MBEs or Combination WMBEs before the Bid was submitted;
  (e) each of the designated WBEs, MBEs or Combination WMBEs has an agreement with the Bidder which conforms with the information submitted in the Utilization Commitment of the Bid Form; and
  (f) that the WBEs, MBEs or Combination WMBEs will perform the Work designated in the Utilization Commitment of the Bid Form.
(2) If any of these requirements are not met, the Human Rights Department will recommend to the Owner that the Bid be deemed non-responsive.

1-03.1(1)B BIDS WITH ADDITIVES, DEDUCTIVES, OR ALTERNATES

(1) The Bidder shall satisfy the WBE and MBE set-aside requirements in the Base Bid and in all Additives and/or Alternates to be awarded. The Bidder may meet the WBE and MBE set-aside requirements in either the Base Bid alone in an amount sufficient to cover the Additives and/or Alternates that the Owner decides to award, or in both the Base Bid and in the Additives and/or Alternates.
(2) The Bidder shall satisfy the WBE and MBE set-aside requirements in those portions of the Bid the Owner decides to award notwithstanding the deletion of any Deductives that the Owner decides not to include in the Award.

1-03.1(1)C WBE AND MBE UTILIZATION STANDARDS

(1) Only expenditures to WBEs, MBEs or Combination WMBEs that perform a commercially useful function in the Work of a Contract, as defined in Seattle Human Rights Department Rule 103-030(2)(f), will be counted toward meeting WBE and MBE set-aside requirements.
(2) Criteria for establishing compliance with WBE and MBE set-aside requirements will be as follows:
  (a) the entire expenditures to WBE, MBE or Combination WMBE manufacturers that provide goods or materials for a contract will be counted;
  (b) 20% of expenditures to WBE, MBE or Combination WMBE suppliers that are not manufacturers will be counted;
  (c) the entire expenditure to WBE, MBE or Combination WMBE truckers will be counted when the trucking business assumes the actual and contractual responsibility for purchasing and delivering the goods or materials;
  (d) that portion of expenditures to WBE, MBE or Combination WMBE truckers which relates to the actual transportation and delivery costs will be counted when the trucker merely transports goods or materials for which the Bidder or another subcontractor has assumed the actual and contractual responsibility for providing or when the trucker is transporting debris, excess construction materials or other materials from a job site;
  (e) the costs of leasing equipment owned by a WBE, MBE or Combination WMBE and the cost of using equipment operators employed by the WMBE will be counted;
  (f) work subcontracted by a WBE to a non-WBE, will not be counted toward the WBE set-aside; work subcontracted by a MBE to a non-MBE will not be counted toward the MBE set-aside; work subcontracted by a Combination WMBE to a non-MBE, non-WBE, or non-Combination WMBE will not be counted toward the WBE or MBE set-aside. A Combination WMBE that is fulfilling both the WBE and MBE set- asides may subcontract to WBE(s) or MBE(s) in proportion to the terms of the Combination WMBE's utilization commitment;
  (g) expenditures to a joint venture partner that is a WBE, MBE or Combination WMBE will be counted toward WBE, MBE or both WBE and MBE requirements, respectively, provided the WBE, MBE or Combination WMBE joint venture partner performs a commercially useful function.
  (h) expenditures to a business certified as both a WBE and MBE may be counted either toward the WBE or the MBE set-aside or both provided the business performs distinct portions of work on the contract under each category. The same work will not be counted toward both.

1-03.1(2) BID TABULATION

After Bid opening, Bids will be checked for correctness of unit price extensions and the total Bid price. If there is a discrepancy between prices which are written in both word and figure, the amount written in words shall govern. Where prices are not written in both words and figures, a discrepancy between a unit price and the extended amount of any Bid Item shall be resolved by accepting the unit price as correct.

The summation of extensions, corrected where necessary and including sales taxes if applicable, will be used for Award purposes and to fix the Awarded Contract Price and the amount of the Contract Bond.

1-03.1(3) CLAIM OF ERROR

A Bidder who wishes to claim error after the Bids have been opened and tabulated shall submit a notarized affidavit signed by the Bidder, accompanied by original work sheets used in the preparation of the Bid, requesting relief from the responsibilities of Award. The affidavit shall describe the specific error(s) and certify that the work sheets are the originals used in the preparation of the Bid.

The affidavit and the work sheets shall be submitted to the Office of the Executive Director of the Board of Public Works, Arctic Building, Suite 700, 700 Third Avenue, Seattle, Washington 98104 before 5:00 p.m. on the next business day after Bid opening or the claim will not be considered. The Engineer will review the certified work sheets, to determine the validity of the claimed error, and make recommendation to the Owner. If the Owner concurs in the claim of error, the Bidder will be relieved of responsibility, and the Bid Guaranty of the Bidder will be returned. Thereafter, at the discretion of the Owner, all Bids may be rejected or award made to the next lowest and best Bidder.

1-03.1(4) PRE-AWARD INFORMATION

The Owner will evaluate all Bids to determine the lowest and best Bidder. This evaluation may include investigations to establish the responsibility, qualifications and financial ability of the Bidder to do the Work pursuant to the Contract Documents.

A Bidder whose Bid is under consideration for Award shall, upon request, promptly submit satisfactory evidence of qualifications, financial resources, construction experience and organization available for the performance of the proposed Work. Documented information shall be submitted within 7 days after receipt of a written request from the Engineer.

In addition, a Bidder under consideration for Award may be required to furnish:

(1) a complete statement as to the origin, composition, and manufacture of any and all materials to be used in the project, together with samples which may in turn be subjected to tests to determine their quality and fitness for the Work, as provided for in the Contract;
(2) a progress schedule in the form required by the Engineer, showing the order of, and time required, on the various phases of the Work;
(3) a breakdown of costs assigned to any Bid item; and
(4) such additional information as may be specified to assist the Owner in ascertaining the Bidder's general ability to perform the Work.

Additionally, a Bidder under consideration for Award may be required to attend a pre-award conference with the City of Seattle Human Rights Department, at which time the Bidder's programs for compliance with the WBE and MBE set- aside and the EEO/Affirmative Action Requirements will be examined in detail and the Bidder's capability for carrying out the programs evaluated.

1-03.1(5) RIGHTS OF OWNER

In addition to such other rights as may be reserved elsewhere in the Contract Documents, the Owner reserves the right to reject any or all Bids, to waive informalities in the Bidding, to accept a Bid of the lowest and best Bidder, to correct arithmetical errors in a Bid, to readvertise for Bids, to revise or cancel the Work, or to require the Work be done in another way if in the opinion of the Owner the best interest of the public will be served.

1-03.2 AWARD OF CONTRACT

The Owner reserves the right to Award such Additives , Deductives, or Alternates, as may be set forth in the Bid Form. If a Contract is to be awarded, it will be awarded to the lowest and best Bidder within 60 days, beginning the day after the Bid opening. Upon mutual consent of the lowest and best Bidder and the Owner, the 60 day limit may be extended.

A Notice of Award will be mailed to the successful Bidder following Award by the Owner.

1-03.3 EXECUTION OF CONTRACT

1-03.3(1) GENERAL

The Owner is prohibited by RCW 39.06.010 from executing a Contract with a Contractor who is not registered or licensed as required by the laws of the State. In addition, Seattle Municipal Code 5.44 requires that every person engaging in business with The City of Seattle possess a City of Seattle Business License. Bidders having a City of Seattle Business License, a State of Washington Contractor's Registration, or both, shall insert the license number and registration number in the spaces provided on the Bid Form Affidavit. The Owner may, at its option, require that legible copies of the State of Washington Contractor's Registration and the City of Seattle Business License be submitted to the Engineer, prior to Award of Contract.

1-03.3(2) TIME TO EXECUTE AGREEMENT FORM

The original and one copy of the Project Manual, including the unsigned Agreement Form, will be available for signature by the successful Bidder at the Board of Public Works, Arctic Building, Suite 700, 700 Third Avenue, Seattle, Washington 98104, on the first Business Day following Award, or shortly thereafter.

The successful Bidder shall sign and return to the Board of Public Works, the original copy of the Agreement Form bound in the Project Manual, accompanied by the Contract Bond and acceptable evidence of insurance within 14 days of Award unless otherwise mutually agreed by the Owner and the successful Bidder. The Owner will forward a copy of the fully executed Agreement Form to the successful Bidder for incorporation into the successful Bidder's copy of the Project Manual.

1-03.4 CONTRACT BOND

The successful Bidder shall provide an executed Contract Bond for the Awarded Contract price. This Contract Bond shall:

(1) Be on an Owner-approved form,
(2) Be signed by an approved Surety (or sureties) that:
  (a) Is registered with the Washington State Insurance Commissioner, and
  (b) Appears on the current Authorized Insurance List in the State of Washington published by the Office of the Insurance commissioner,
(3) Be conditioned upon the faithful performance of the Contract by the Contractor within the prescribed time,

(4) Guarantee that the Surety shall indemnify, defend, and protect the Owner against any claim of direct or indirect loss resulting from the failure:
  (a) Of the Contractor (or any of the employees, subcontractors, or agents of the Contractor) to faithfully perform the contract and
  (b) Of the Contractor (or the subcontractors or agents of the Contractor) to pay all laborers, mechanics, subcontractors, agents, materialmen, or any other person who provides supplies or provisions for carrying out the work.
(5) Contain the following language: IT IS FURTHER DECLARED AND DECREED that nothing of any kind or nature whatsoever that will not discharge the Principal shall operate as a discharge or a release of liability of the Surety, any law, rule of equity or usage relating to the liability of sureties to the contrary notwithstanding, and the Surety waives notice of any alteration, or extension of time, made by the Municipality, except that any single or cumulative change orders amounting to more than 25% of the Contract Price shall require the consent of the Surety.

The Owner may require the Surety (or sureties) on the Contract Bond to appear and qualify themselves. Whenever the Owner deems the Surety (or sureties) to be inadequate, it may, upon written demand, require the Contractor to furnish additional surety to cover any remaining work. Until the added surety is furnished, payment on the Contract will stop.

1-03.5 FAILURE TO EXECUTE THE CONTRACT

If the Bidder to whom the Award was made fails to execute the Agreement Form, furnish satisfactory bond(s) and insurance(s) within the required time period, or refuses in writing to enter into a Contract with the Owner, the Bidder's Bid Guaranty will be forfeited. The Owner may then Award the Contract to the second lowest responsible Bidder.

If the second lowest responsible Bidder fails to execute the Agreement Form, and furnish satisfactory bond(s) and insurances(s) within 14 days after Award has been made to the second Bidder, the second Bidder's Bid Guaranty will also be forfeited. The Contract may be awarded successively in a like manner to the remaining lowest responsible Bidders until the Agreement Form is executed and bond(s) and insurance(s) furnished, by a responsible Bidder, or the remaining Bids are rejected.

The time for the successful Bidder to execute the Agreement Form and return the Project Manual and furnish satisfactory bond(s) and insurance(s) may be extended for a maximum of 20 additional days if requested by the Bidder, and the Owner deems circumstances warrant the extension.

1-03.6 RETURN OF BID GUARANTY

After the Agreement Form has been executed and the required bond(s) and insurance(s) approved by the Owner, the Bid Guaranty in the form of cash or check will be returned to the successful Bidder. A Bid Guaranty in the form of a Bid Bond from the successful Bidder shall be filed with the executed Contract. A Bid Guaranty in the form of cash or check will be returned to each unsuccessful Bidder after Contract Award or after all Bids have been rejected. Bid Bonds of unsuccessful Bidders will be retained for 30 days after the executed Contract has been filed with the City Clerk, and then disposed of, unless return is requested by an unsuccessful Bidder.

SECTION 1-04 SCOPE OF WORK

1-04.1 INTENT OF CONTRACT DOCUMENTS

The intent of the Contract Documents is to prescribe a complete operating unit, system, or improvement, ready for use by the Owner. The Contractor shall furnish all labor, materials, tools, equipment, transportation, supplies, and everything needed or required to make each and every part of the Work complete. The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

1-04.2 COORDINATION OF CONTRACT DOCUMENTS

All parts of the Contract Documents are essential and complementary. A requirement occurring in one is binding as though occurring in all.

Work or material that has been omitted from the description of a part of the Work, but is clearly implied, shall be furnished by the Contractor as though it had been specifically stated.

If the Contractor finds any discrepancy between various parts of the Contract Documents, or any errors or omissions in the Drawings, or in the layouts and instructions given by the Engineer, the Contractor shall immediately inform the Engineer, in writing, and shall not proceed with any work affected by such discrepancy until directed to do so by the Engineer.

In the event of any conflicting provisions or requirements between the component parts of the Contract Documents, the component parts shall take precedence in the following order:

(1) Change Orders and Supplemental Agreements
(2) Addenda;
(3) Project Manual;
(4) Drawings;
(5) Standard Specifications;
(6) Standard Plans;

In case of any ambiguity or dispute over interpretation of the provisions of the Contract Documents, the decision of the Engineer shall be final unless protest is made.

When appearing on the Drawings, dimensions denoted by figures shall govern over scaled dimensions.

1-04.3 VACANT

1-04.4 CHANGES

As the Work proceeds, the Owner may at any time change the Work within the general scope of the Contract. Among others, these changes may include:

(1) deleting any part of the Work;
(2) increasing or decreasing quantities;
(3) altering specifications, designs, or both;
(4) revising the way the Work is to be done;
(5) adding new work;
(6) altering Owner-provided facilities, equipment, materials, services, or sites; or
(7) ordering the Contractor to speed up or delay the Work.

The Engineer will issue a written Change Order for any change unless the remainder of this section provides otherwise.

Item 1, an equitable adjustment for deleted work will be made as provided in Section 1-09.5.

Item 2, if the quantities of a major item or the total cost of the original Contract increase or decrease by more than 25 percent, an equitable adjustment will be made as provided in Section 1-04.6. If the change is 25 percent or less, it will not require a written order, but will be paid at the unit prices that apply.

Items 3, 4, 5, 6, and 7, the Engineer will determine if the change should be paid for at unit contract price(s). If the Engineer determines that the change increased or decreased the Contractor's costs or time to do any of the Work including unchanged work, the Engineer will make an equitable adjustment by agreement with the Contractor. If the parties are unable to agree, the Engineer will determine the equitable adjustment by using other means to establish the costs or by force account and adjust the time as the Engineer deems appropriate. Extensions of time will be evaluated in accordance with Section 1-08.8.

The Contractor shall proceed with the Work upon receiving:

(1) a written Change Order approved by the Engineer, or
(2) a written order or field directive from the Engineer before actually receiving the written Change Order.

Changes normally noted on field stakes will not require a written Change Order. These changes shall be made at the unit prices that apply. The Contractor shall respond immediately to changes shown on field stakes without waiting for further notice. Written consent of the Surety (or sureties) will be required for a Change Order when the Engineer specifically requests it.

1-04.5 PROTEST, DISPUTE, AND CLAIM PROCEDURES

1-04.5(1) PROCEDURE AND PROTEST BY THE CONTRACTOR

If in disagreement with anything required in a Change Order or other written order, from the Engineer, the Contractor shall:

(1) File a written protest with the Engineer within 15 calendar days after receiving the order,
(2) Supplement the written protest, within 30 calendar days of its filing, with a written statement that:
  (a) Cites Contract provisions that support the protest,
  (b) Estimates the dollar cost, if any, of the protested work, and
  (c) Estimates the amount of added time incurred, if any, and
(3) Provide the Engineer, before final payment, with a written statement of actual adjustment requested.

Throughout any protested work, the Contractor shall keep complete records of extra costs and time incurred. The Contractor shall permit the Engineer access to these and any other records needed for evaluating the protest.

The Engineer will evaluate all protests provided the procedures in this section are followed. If a protest is valid, the Engineer will adjust payment for work or time by an equitable amount. No adjustment will be made for an invalid protest.

In spite of any protest, the Contractor shall proceed promptly with the Work as the Engineer orders.

The Contractor accepts all requirements of a Change Order by: (1) endorsing it, (2) writing a separate acceptance, or (3) not protesting in the way this section provides. Once accepted by the Contractor, any Change Order shall be full, equitable adjustment for all work the Change Order alters or requires.

By not protesting as this section provides, the Contractor also waives any additional entitlement and accepts from the Engineer any written order (including directions, instructions, interpretations, and determinations).

By failing to follow the procedures of this section, the Contractor completely waives any claims for protested work.

1-04.5(2) DISPUTES

When a dispute occurs the Contractor shall pursue resolution through the Engineer. If the negotiation fails to provide satisfactory resolution to the dispute, the Contractor shall follow the procedures outlined in Section 1-04.5(1). If the negotiation resulting from the procedures outlined in Section 1-04.5(1) fails to provide satisfactory resolution, the Contractor shall pursue the more formalized method outlined below for submitting a claim.

1-04.5(3) CLAIMS

If the Contractor claims that additional payment is due and the Contractor has pursued and exhausted all the means provided above to resolve a dispute, the Contractor may file a claim as provided in this section. If the written notifications provided in Section 1-04.5(1) are not given, and if the Engineer is not afforded reasonable access by the Contractor to complete records of actual cost and additional time incurred and if a claim is not filed as provided in this section, then the Contractor agrees to waive any claim for additional payment. The fact that the Contractor has provided a proper notification, provided a properly filed claim, or provided the Engineer access to records of actual cost, shall not in any way be construed as proving or substantiating the validity of the claim. If the claim, after consideration by the Engineer is found to have merit, the Engineer will make an equitable adjustment either in the amount of costs to be paid or in the time required for the work or both. If the Engineer finds the claim to be without merit, no adjustment will be made.

All claims filed by the Contractor shall be in writing and in sufficient detail to enable the Engineer to ascertain the basis and amount of the claim. As a minimum, the following information must accompany each claim submitted:

(1) A detailed factual statement of the claim for additional compensation and time, if any, providing all necessary dates, locations, and items of work affected by the claim.
(2) The date on which facts arose which gave rise to the claim.
(3) The name of each individual, official, or employee involved in or knowledgeable about the claim.
(4) The specific provisions of the Contract which support the claim and a statement of the reasons why such provisions support the claim.
(5) If the claim relates to a decision of the Engineer which the Contract leaves to the Engineer's discretion or as to which the Contract provides that the Engineer's decision is final, the Contractor shall set out in detail all facts supporting its position relating to the decision of the Engineer.
(6) The identification of any documents and the substance of any written communications that support the claim.
(7) Copies of any identified documents, other than documents previously furnished by the Contractor, that support the claim (manuals which are standard to the industry, used by the Contractor, may be included by reference).
(8) If an extension of time is sought:
  (a) The specific days and dates for which it is sought,
  (b) The specific reasons the Contractor believes a time extension should be granted, and
  (c) The specific provisions under which it is sought.
(9) If additional compensation is sought, the exact amount sought and a breakdown of that amount into the following categories:
  (a) Direct labor.
  (b) Direct materials.

  (c) Direct equipment. The rates claimed for each piece of equipment shall not exceed actual cost. In the absence of actual equipment cost, the rates for the equipment, when in use, shall not exceed the rates established by the current AGC/WSDOT Equipment Rental Agreement. The equipment cost shall be broken down to identify the following for each piece of equipment for which the claim is made.
    (1) Detailed description (e.g., Motor Grader Diesel Powered Caterpillar 12 "G", Tractor Crawler ROPS and Dozer Included Diesel, etc.)
    (2) The hours of use or standby.
    (3) The specific day and dates of use or standby.
  (d) Job overhead.
  (e) Overhead (general and administrative)
  (f) Subcontractor's claims (in the same level of detail as specified herein is required for any subcontractor's claims).
  (g) Other categories as specified by the Contractor.

(10) A statement shall be submitted to the Engineer containing the following language:

STATE OF WASHINGTON)
) SS.
THE COUNTY OF KING)

The undersigned, _____ (name),

T, _____ (title) of _____ (company) T,

being first duly sworn on oath, deposes and says:

The claim for extra compensation and time, if any, made herein for work on this Contract is a true statement of the actual costs incurred and time sought, and is fully documented and supported under the Contract between the parties.

Dated _____/s/_____

Subscribed and sworn before me this ___day of_____.

_____

Notary Public in and for the State of Washington

residing at _____

My appointment expires _____

1-04.5(4) APPEALS

If the Engineer denies the claim, appeal may be made to the Owner. Appeal shall be made by the Contractor in writing within 30 days of receiving the Engineer's Written Notice denying the claim or before the Acceptance Date, whichever comes first. The Owner will hold a hearing within 30 days of the appeal filing to determine the merits of the claim. If the Owner concurs with the Contractor, an equitable adjustment will be made. If the Owner concurs with the Engineer, no adjustment will be made. Thereafter, the Contractor may pursue judicial resolution in the Superior Court of King County.

For the convenience of the Contractor and the Owner, it is mutually agreed that:

(1) any claims or causes of action arising from the Contract which the Contractor wants to litigate against the Owner shall be brought within 180 days from the Acceptance Date; and
(2) failure of the Contractor to bring suit within the 180 day time period shall be a complete bar to any such claims or causes of action.

1-04.5(5) APPLICABLE LAW AND VENUE

The Contract shall be construed and interpreted pursuant to the laws of the State of Washington.

The venue of any claims or causes of action arising from this Contract shall be in the Superior Court of King County.

1-04.6 INCREASED OR DECREASED QUANTITIES

If there is a change that increases or decreases by more than 25 percent,

(1) the total cost of the Work when calculated from the Awarded Contract Price, or
(2) the total quantity of a Major Bid Item when calculated from the original Bid quantities,

an adjustment in the price for that portion of the Work, or Major Bid Item, in excess of the 25 percent increase or decrease will be made by Change Order. Written consent of the Owner and Surety (or sureties) will be required for Change Order work whenever the cumulative costs for Change Order work exceeds 25 percent of the Awarded Contract Price. Written consent of the Surety (or sureties) will also be required whenever the Engineer determines such to be in the best interest of the Owner.

Conditions (1) and (2) above shall not apply to Bid Items that are entered in the Bid Form as a fixed price item by the Engineer for the purpose of providing a common Bid Item for all bidders, or are specifically designated in the Project Manual as not being a Major Bid Item due to the unknown quantities to be used. Any impact due to an increase or decrease in the quantities of fixed Bid Items or items designated in the Project Manual as not being a Major Bid Item shall be at the sole risk of the Contractor.

1-04.7 CHANGED CONDITIONS (DIFFERING SITE CONDITIONS)

The Contractor shall promptly, and before such conditions are disturbed, notify the Engineer in writing whenever the following conditions are encountered:

(1) preexisting subsurface or latent physical conditions at the Project Site differing materially from those indicated in the Contract Documents, or
(2) preexisting unknown physical conditions at the Project Site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents.

Upon notification, the Engineer will promptly investigate the alleged changed condition. If the Engineer finds that changed conditions do exist and cause a material change in the Contractor's costs or the time required to complete all of any part of the Work the Engineer will make an equitable adjustment in the amount of compensation to be paid for the Work, the Contract Time, or both.

If the Engineer determines that the changed conditions do not justify an adjustment in compensation or contract time, the Contractor will be so notified in writing. Should the Contractor disagree with such determination, the Contractor may file a Notice of Protest with the Engineer. The Contractor shall proceed with the Work unless ordered to suspend that portion of the Work involved, pending a decision as to the validity of any such claim for changed conditions, or pending the execution of a Change Order, if a claim for changed condition is recognized by the Engineer.

No claim of changed conditions by the Contractor will be allowed unless the Contractor has given the notice required above; provided, however, the time will be extended by the Engineer for good cause shown. The time for claiming

changed conditions will not be extended beyond the time the Contractor knew, or should have known, of the existence of the changed condition. If there is a decrease in the cost or time required to perform the Work, failure of the Contractor to notify the Engineer of the changed condition shall not affect the Engineer's right to make an adjustment in costs or time.

No claim by the Contractor for an equitable adjustment hereunder will be allowed if asserted after the Acceptance Date.

1-04.8 VACANT

1-04.9 VACANT

1-04.10 USE OF MATERIALS FOUND ON THE PROJECT SITE

With written approval of the Engineer, the Contractor may use in performing the Work stone, gravel, sand, or other material obtained from required excavations, or timbers removed in performing the Work, provided that such materials satisfy the requirements of the Contract Documents and are not required for other use by the Contract Documents or as selected materials. In no case will such use be permitted to the detriment of the Owner.

Disposition of suitable materials obtained in the course of the Work shall be as follows, per the Engineer's direction:

(1) Use as selected material in accordance with Section 2-03.3(10) ; or
(2) Delivered to the Engineer as salvage in accordance with Section 2-02.3(7) ; or
(3) Waste and dispose of in accordance with Section 2-01.2.

SECTION 1-05 CONTROL OF WORK

1-05.1 AUTHORITY OF ENGINEER

All work on the Contract shall completely satisfy the Engineer. The Contract and specifications give the Engineer authority over the Work. Whenever it is so provided in this Contract, the decision of the Engineer shall be final: provided, however, that if an action is brought within the time allowed in this Contract challenging the Engineer's decision, that decision shall be subject to the scope of judicial review provided in such cases under Washington case law.

The Engineer's decisions will be final on all questions including, but not limited to the following:

(1) quality and acceptability of materials and Work;
(2) measurement of unit price work;
(3) acceptability of rates of progress on the Work;
(4) interpretation of plans and specifications;
(5) determination as to the existence of changed or differing site conditions;
(6) fulfillment of the Contract by the Contractor; and
(7) payments under the Contract.

If the Contractor fails to respond promptly to the requirements of the Contract or orders from the Engineer:

(1) The Engineer may use City forces, other contractors, or other means to accomplish the Work; and
(2) The Owner will not be obligated to pay the Contractor, and will deduct from the Contractor's payments any costs that result when any other means must be used to carry out the Contract requirements or Engineer's orders.

At the Contractor's risk, the Engineer may suspend all or part of the Work, if:

(1) the Contractor fails to fulfill Contract terms, to carry out the Engineer's orders, or to correct unsafe conditions of any nature,
(2) the weather or other conditions are unsuitable, or
(3) it is in the public interest.

Nothing in these Specifications or in the Contract requires the Engineer to provide the Contractor with direction or advice on how to do the Work. If the Engineer approves or recommends any method or manner for doing the Work or producing materials, the approval or recommendation shall not:

(1) guarantee that following the method or manner will result in compliance with the Contract,
(2) relieve the Contractor of any risks or obligations under the Contract, or
(3) create any liability for the Owner.

1-05.2 AUTHORITY OF INSPECTORS

The Engineer may appoint Inspectors to assist in determining that work performed and materials furnished comply with the Contract Documents. Inspectors have the authority to reject defective material and suspend work that is being done improperly, subject to the final decision of the Engineer. Inspectors may exercise such additional authority as may be delegated to them by the Engineer. An Inspector is not authorized to approve or accept any Work or materials, or to issue instructions or advice, contrary to the provisions of the Contract Documents.

Work performed or materials furnished which at any time is found not to conform to the Contract Documents shall be at the Contractor's risk and shall not be a basis for a claim, even though an Inspector purports to change the Contract Documents to provide for such work or material, to approve or accept such work or material, or issue any instructions contrary to the Contract Documents.

Although Inspectors may advise the Contractor of any faulty work or materials, or infringements of the terms of the Contract Documents, failure of the Engineer or Inspector to do so shall not constitute acceptance or approval.

1-05.3 DRAWINGS

The Contract Documents include Drawings that show such details as are necessary to give a comprehensive understanding of the Work. Any alterations affecting the requirements and information in the Drawings, shall be in writing and approved by the Engineer.

The Engineer may supplement the Drawings with additional drawings and explanations, consistent with the purpose and intent of the original Drawings, to detail and illustrate the Work. The Contractor shall perform the Work according to these supplemental drawings and explanations.

In addition to supplemental Drawings furnished by the Engineer, the Contract Documents may also be supplemented by Shop Drawings prepared by the Contractor, or a material supplier or manufacturer, when necessary or as required by the Contract Documents to detail and illustrate portions of the Work. Shop Drawings shall be reviewed by the Engineer before any work pursuant to those Shop Drawings is performed. Shop Drawings may include, but not be limited to: shop details; erection plans; masonry lay-out diagrams; reinforcing steel and bending diagrams; post tensioning plans; shoring, cribbing, cofferdam, or falsework plans; or formwork plans.

The Contractor shall be fully responsible for the accuracy of dimensions and details on Shop Drawings, and for complete conformity with the Contract Documents, even if the Shop

Drawings have been approved by the Engineer, or if the Contractor and the Engineer agree on dimensions and details. The Owner does not accept Shop Drawings as accurate or adequate, and does not take responsibility for, or warrant that Shop Drawings will meet contract requirements.

The Contractor shall submit Shop Drawings sufficiently in advance of the actual need to permit the Engineer and other reviewing agencies to review them in detail allowing time for any rejections, revisions, and resubmittals. The Contractor shall not claim compensation for any delays in the Work resulting from Shop Drawings not being approved. Such delays shall be entirely the Contractor's risk.

The Bid prices shall include all costs for furnishing Shop Drawings and submittals.

Additional requirements regarding Shop Drawings, submittals, and Operating and Maintenance Manuals may be included in the Project Manual.

1-05.4 CONFORMITY WITH DRAWINGS, STAKES, AND DEVIATIONS THEREFROM

Work performed shall be in conformity with the lines, grades, cross sections, data and dimensions, indicated on the Drawings, or staked by the Engineer. Where specific tolerances are stated in the Contract Documents, the Work shall be performed within those stated limits. The Engineer will determine if the Work is in reasonable conformity with the lines, grades, cross sections, and dimensions given.

The Contractor shall not deviate from the Drawings except when authorized in writing by the Engineer.

1-05.5 CONSTRUCTION STAKES

The Engineer will provide construction stakes and marks establishing lines, slopes, and grades as stipulated in Sections 1-05.5(1) and 1-05.5(2). The Contractor shall assume full responsibility for detailed dimensions, elevations, and excavation slopes measured from these Engineer furnished stakes and marks.

The Contractor shall provide a work site which has been prepared to permit construction staking to proceed in a safe and orderly manner. The Contractor shall keep the Engineer informed of staking requirements and provide at least 48 hours notice to allow the Engineer adequate time for setting stakes.

Stakes, marks, and other reference points, including existing monumentation, set by Owner forces shall be carefully preserved by the Contractor. The Contractor will be charged for the costs of replacing stakes, markers and monumentation that were not to be disturbed but were destroyed or damaged by the Contractor's operations. This charge will be deducted from monies due or to become due to the Contractor.

Any claim by the Contractor for extra compensation by reason of alterations or reconstruction work allegedly due to error in the Engineer's line and grade, will not be allowed unless the original control points set by the Engineer still exist, or unless other satisfactory substantiating evidence to prove the error is furnished the Engineer. Three consecutive points set on line or grade shall be the minimum points used to determine any variation from a straight line or grade. Any such variation shall, upon discovery, be reported to the Engineer. In the absence of such report the Contractor shall be liable for any error in alignment or grade.

The Contractor shall provide all surveys required other than those to be performed by the Engineer.

The Contractor's surveyor shall be a licensed surveyor or licensed engineer in the State of Washington. The Contractor shall keep updated survey field notes in a standard field book and in a format set by the Engineer. These field notes shall include all survey work performed by the Contractor's surveyor in establishing line, grade and slopes for the construction work. Copies of these field notes shall be provided the Engineer upon request and upon completion of the contract work the field book or books shall be submitted to the Engineer and become the property of the Owner.

If the survey work provided by the Contractor does not meet the standards of the Engineer, then the Contractor shall, upon the Engineer's written request, remove the individual or individuals doing the survey work and the survey work will be completed by the Engineer at the Contractor's expense. Costs for completing the survey work required by the Engineer will be deducted from monies due or to become due the Contractor.

All costs for survey work required to be performed by the Contractor shall be included in the prices bid for the various items which comprise the improvement.

1-05.5(1) ROADWAY AND UTILITY SURVEYS

The Engineer shall furnish to the Contractor one time only all principal lines, grades, and measurements the Engineer deems necessary for completion of the Work. These shall generally consist of one initial set of:

(1) Slope stakes for establishing grading,
(2) Curb grade stakes,
(3) Centerline finish grade stakes for pavement sections wider than 25 feet, and
(4) Offset points to establish line and grade for underground utilities such as water, sewers, and storm drains.

On alley construction projects with minor grade changes, the Engineer shall provide offset hubs on one side of the alley to establish the alignment and grade. Alleys with major grade changes shall be slope staked to establish grade before offset hubs are set.

1-05.5(2) BRIDGE AND STRUCTURE SURVEYS

For all structural work such as bridges and retaining walls, the Contractor shall retain as a part of Contractor organization an experienced team of surveyors under direct supervision of a licensed surveyor. The Contractor shall ensure that required field measurements and locations, match and fulfill the intended plan dimensions. The Contractor shall provide all surveys required to complete the structure, except the following primary survey control which will be provided by the Engineer.

(1) Centerline or offsets to centerline of the structure
(2) Stations of abutments and pier centerlines
(3) A sufficient number of bench marks for levels to enable the Contractor to set grades at reasonably short distances
(4) Monuments and control points as shown on the Drawings.

The Contractor shall establish all secondary survey controls, both horizontal and vertical, as necessary to assure proper placement of all project elements based on the primary control points provided by the Engineer. Survey work shall be within the following tolerances:

(1) Stationing	+ .01 foot
(2) Alignment	+ .01 foot (between successive points)
(3) Superstructure Elevations	+ .01 foot (from plan elevations)
(4) Substructure Elevations	+ .05 foot (from plan elevations)

During the progress of the Work, the Contractor shall make available to the Engineer all field books including survey information, footing elevations, cross sections and quantities.

The Contractor shall be fully responsible for the close coordination of field locations and measurements with

appropriate dimensions of structural members being fabricated.

1-05.6 INSPECTION OF WORK AND MATERIALS

Work performed and materials furnished will be subject to inspection by the Engineer. The Contractor shall give the Engineer notice when work and materials are ready for inspection, tests, or approvals. The Contractor shall provide such facilities as are deemed necessary by the Engineer for sufficient and safe access to the Work. Such facilities shall include, but not be limited to, walkways, railings, ladders, platforms, shoring, safety harnesses, safety lines, and safety nets.

Upon request, the Contractor shall furnish, without charge, samples of materials used, or to be used in the Work, for inspection and testing, to ensure conformance with the Contract Documents. If materials are tested and approved for the Work, then used for purposes not connected with the Work, the cost of testing in inspection will be deducted from monthly progress payments to the Contractor. Materials used without inspection may be ordered removed and replaced, and the cost of the material, and the work associated with the removal and replacement of the material, shall be at the Contractor's expense.

Inspection test measurements, or other acts or functions performed by the Engineer, are recognized as being for the sole purpose of assisting the Engineer to determine with reasonable assurance, that work, materials, rate of progress, and quantities, comply with the Contract Documents. These acts or functions shall not relieve the Contractor from determining independently that full compliance with the Contract Documents is met at all times, or relieve the Contractor from full responsibility for the Work.

Upon request, the Contractor shall remove or uncover any portions of completed Work for inspection by the Engineer. After inspection, the Contractor shall restore those portions of the Work to the standards required by the Contract Documents. The costs associated with uncovering, removing, testing, and restoration, including compensating the Engineer for any additional professional services required, shall be borne by the Contractor, if:

(1) the exposed Work proves to be unacceptable; or
(2) the exposed Work was placed without authority or without due notice to the Engineer.

If the exposed Work proves to be acceptable and the Contractor had performed the original work with the authority of and due notice to the Engineer, payment will be made as for Extra Work for all costs associated with the uncovering, removing, and restoration and the Contract Time will be adjusted.

Where work is required to be performed on any facility of a public agency, railroad, or utility, or to the satisfaction of any federal, state, county, or municipal agency, their representatives shall be permitted to inspect the work when the Contractor is advised by the Engineer to permit them to do so. The Contractor agrees that such inspection shall in no sense make such representatives a party to the Contract, or constitute an interference with the rights of the Owner or the Contractor.

1-05.7 DEFECTIVE AND UNAUTHORIZED WORK

Work and materials which do not conform to the requirements of the Contract Documents, work done beyond lines and grades shown in the Drawings or established by the Engineer, and extra work and materials furnished without written approval of the Engineer, will be considered defective and unauthorized work. Such work shall be at the Contractor's risk and expense and will be rejected, even if the work has been inspected, or progress payments made. Upon order of the Engineer, such Work shall immediately be remedied, removed, replaced, or disposed of, at the Contractor's expense.

Failure on the part of the Engineer or Inspector to reject or condemn defective and unauthorized work shall not release the Contractor from the Contractor's contractual obligations, be construed to mean acceptance of such work or materials by the Owner or, after Acceptance, bar the Owner from recovering damages or obtaining such other remedies as may be permitted by law.

No extension of time or compensation will be allowed because of delay in the correction of defective work.

1-05.8 OWNER'S RIGHT TO CORRECT DEFECTIVE OR UNAUTHORIZED WORK

If the Contractor fails to remedy defective or unauthorized work within the time specified in a written notice from the Engineer, or fails to perform any part of the Work required by the Contract Documents, the Engineer may correct and remedy such work as may be identified in the written notice with Owner forces or by such other means as the Owner may deem necessary.

If the Contractor fails to comply with a written order to remedy what the Engineer determines to be an emergency situation, the Engineer may have the defective and unauthorized Work corrected immediately, have the rejected Work removed and replaced, or have Work the Contractor refuses to perform completed by using Owner or other forces. An emergency situation is any situation which, in the opinion of the Engineer, a delay in its remedy could be potentially unsafe, or might cause serious risk of loss or damage to the public.

Direct or indirect costs incurred by the Owner attributable to correcting and remedying defective or unauthorized Work, or Work the Contractor failed or refused to perform, shall be paid by the Contractor. Payment will be deducted by the Engineer from monies due, or to become due, the Contractor. Such direct and indirect costs shall include in particular, but without limitation, compensation for additional professional services required, and costs for repair and replacement of work of others destroyed or damaged by correction, removal, or replacement of the Contractor's unauthorized Work. No extension of time or compensation will be allowed because of the delay in the performance of the Work attributable to exercise of the Owner's rights provided herein.

The rights exercised under the provisions of this section shall not diminish the Owner's ability to pursue any other avenue for additional remedy or damages with respect to the Contractor's failure to perform the Work as required.

1-05.9 VACANT

1-05.10 GUARANTIES

1-05.10(1) GENERAL GUARANTY AND WARRANTY

The Contractor shall furnish to the Engineer all guaranties or warranties furnished as a normal trade practice in connection with the purchase by the Contractor or a subcontractor, of any equipment, materials, or items incorporated in the Work.

If within one year after the Acceptance Date of the Work by the Owner, defective and unauthorized Work is discovered, the Contractor shall promptly, upon written order by the Owner, return and in accordance with the Engineer's instructions, either correct such Work, or if such Work has been rejected by the Engineer, remove it from the Project Site and replace it with nondefective and authorized Work, all without cost to the Owner. If the Contractor does not promptly comply with the written order to correct defective and unauthorized Work, or if an emergency exists, the Owner reserves the right to have

defective and unauthorized Work corrected or removed and replaced pursuant to Section 1-05.8 "Owner's Right to Correct Defective and Unauthorized Work."

The Contractor agrees the above one year limitation shall not exclude or diminish the Owner's rights under any law to obtain damages and recover costs resulting from defective and unauthorized work discovered after one year but prior to the expiration of the legal time period set forth in RCW 4.16.040 limiting actions upon a contract in writing, or liability expressed or implied arising out of a written agreement.

1-05.10(2) WARRANTY OF TITLE

The Contractor shall warrant good title to all materials, supplies, and equipment purchased for, or incorporated in the Work. Nothing contained in this paragraph, however, shall defeat or impair the right of persons furnishing materials or labor, to recover under any bond given by the Contractor for their protection, or any rights under any law permitting such persons to look to funds due the Contractor in the hands of the Owner.

The provisions of this paragraph shall be inserted in all subcontracts and material contracts, and notice of its provisions shall be given to all persons furnishing materials for the Work when no formal contract is entered into for such materials.

1-05.11 FINAL INSPECTION

1-05.11(1) SUBSTANTIAL COMPLETION DATE

When the Contractor considers the entire Work ready for its intended use, the Contractor shall notify the Engineer in writing that the entire Work is substantially complete (except for such items as are specifically listed by the Contractor as incomplete) and request the Engineer to establish a Substantial Completion Date. The Engineer will schedule an inspection of the Work with the Contractor to determine the status of completion.

If, after this inspection, the Engineer concurs with the Contractor that the Work is substantially complete and ready for its intended use, the Engineer, by written notice to the Contractor, will set the Substantial Completion Date. If, after this inspection the Engineer does not consider the Work substantially complete and ready for its intended use, the Engineer will, by written notice, so notify the Contractor giving the reasons therefor.

Upon receipt of written notice concurring in or denying substantial completion, whichever is applicable, the Contractor shall pursue vigorously, diligently and without unauthorized interruption, the Work necessary to reach Substantial or Actual Completion. The Engineer will not schedule final inspection until the entire Work, including final cleanup and such extra Work as may have been ordered by the Engineer, has been completed by the Contractor. The Contractor shall provide the Engineer with a revised schedule indicating when the work necessary to reach Substantial Completion or Actual Completion, whichever is applicable, will be finished.

1-05.11(2) FINAL INSPECTION DATE

When the Contractor considers the Work complete and ready for Final Inspection, the Contractor by Written Notice, shall request the Engineer to schedule a final inspection. The Engineer will, within 5 days, set a date for Final Inspection. The Engineer and the Contractor will then make a Final Inspection and the Engineer will notify the Contractor in writing of all particulars in which the Final Inspection reveals the Work incomplete or unacceptable. The Contractor shall immediately take such corrective measures as are necessary to remedy the listed deficiencies. Corrective work shall be pursued vigorously, diligently, and without interruption until completion.

If action to correct deficiencies is not initiated within 7 days after receipt of the Written Notice listing the deficiencies, the Owner may, upon Written Notice to the Contractor, take whatever steps are necessary to correct those deficiencies. Such steps may include the correction of defects by Owner-provided forces or by others. In such case, the direct and indirect costs incurred by the Owner shall be deducted from monies due or becoming due the Contractor. Such indirect or direct costs shall include in particular, but without limitation to, compensation for additional professional services required in cost of repair and replacement of the work of others which is destroyed or damaged by correction, removal, or replacement of the Contractor's deficient work.

The Contractor will not be allowed an extension of Contract Time because of a delay in the performance of the Work attributable to the exercise of the Owner's rights hereunder.

Upon correction of all deficiencies, the Engineer will notify the Contractor and the Owner, in writing, of the date upon which the Work was considered complete.

1-05.11(3) OPERATIONAL TESTING

It is the intent of the Owner to have at final acceptance a complete and operable system. Therefore when the Work involves the installation of machinery or other mechanical equipment; street lighting, electrical distribution or signal systems; buildings; or other similar work it may be desirable for the Owner to have the Contractor operate and test the Work for a period of time after final inspection but prior to acceptance. Whenever items of work are listed in the Project Manual for operational testing they shall be fully tested under operating conditions for the time period specified to ensure their acceptability prior to final acceptance. During and following the test period, the Contractor shall correct any items of workmanship, materials, or equipment which proves faulty, or that are not in first class operating condition. Equipment, electrical controls, meters, or other devices and equipment to be tested during this period, shall be tested under the observation of the Engineer, so that the Engineer may determine their suitability for the purpose for which they were installed.

The costs for power, gas, labor, material, supplies, and everything else needed to successfully complete operational testing, shall be included in the various contract prices related to the system being tested, unless specifically set forth otherwise in the Bid Form.

Operational and test periods, when required by the Owner, shall not affect a manufacturer's guaranties or warranties furnished under the terms of the Contract.

1-05.12 ACCEPTANCE

A Certificate of Completion for the Work, approved by the Owner will constitute acceptance of the Work. The issuance of this certificate of completion will not constitute acceptance of unauthorized or defective work or material.

1-05.13 SUPERINTENDENTS, LABOR, AND EQUIPMENT

The Contractor shall keep a set of Contract Documents at the Project Site, shall give the Work the attention required to maintain scheduled progress, and shall cooperate with the Engineer and the Engineer's inspectors in administration of the Work.

The Contractor shall be present, in person, or be continuously represented by a duly authorized representative at the Project Site during progress of the Work. The Contractor shall designate in writing before starting the Work a Project Manager or Superintendent, who shall be experienced, capable of understanding the Contract, and able to supervise the performance of the Work. The Contractor's

Superintendent or Project Manager shall have full authority to represent and act for the Contractor. Written notice given to the Project Manager or Superintendent shall be as binding as if given to the Contractor.

The Work shall be under the continuous supervision of competent personnel experienced in the class of work being performed. Incompetent, careless, or negligent employees or supervisors shall be discharged by the Contractor upon written order of the Engineer. A superintendent that repeatedly fails to follow a written order, direction, instruction or determination from the Engineer shall, upon written order from the Engineer, immediately be removed from the project site by the Contractor. The Contractor shall then designate in writing to the Engineer, a new superintendent. Failure to comply with such order shall be sufficient grounds for termination of the Contract.

Machinery and equipment shall be adequate for the purposes used, kept in good workable condition, and operated by competent operators.

The Contractor's performance and compliance with the terms of the Contract Documents will be rated by the Engineer. The rating will be in the following categories:

(1) progress of work;
(2) quality of work;
(3) equipment;
(4) administration/management/supervision; and
(5) coordination and control of subcontractors.

An unacceptable report will be taken into consideration when determining a Contractor's qualifications for future work.

1-05.14 COOPERATION WITH OTHER CONTRACTORS

The Owner reserves the right to perform at any time other and additional work by contract, Owner forces, or otherwise at or near the Project Site (including material sites). Should work be underway or subsequently undertaken within or adjacent to this project, the Contractor shall cooperate with all other Contractors or other forces, and conduct the Work so that the operations of both suffer the least interference and delay. Should there be disagreement between the Contractors, or the Contractor and the Engineer, as to the manner and order of performing work, such disagreement will be resolved by the Engineer, and the Engineer's determination shall be final unless protest is made.

If the Contract gives notice of other work that may affect the Work, the coordination of the Work shall be taken into account by the Contractor, and any resulting cost shall be included in the various Bid Items which make up the Work.

1-05.15 METHODS OF SERVING NOTICES

Written Notice shall be considered delivered and the service completed when posted by certified or registered mail to the other party at the last given address, or delivered in person or to an authorized representative of the other party on the Project Site.

1-05.16 WATER AND POWER

The Contractor shall make necessary arrangements, and shall bear the costs for power and water necessary for the performance of the Work.

1-05.17 ORAL AGREEMENTS

No oral agreement or conversation with any officer, agent, or employee of the Owner, either before or after execution of the contract, shall affect or modify any of the terms or obligations contained in any of the documents comprising the contract. Such oral agreement or conversation shall be considered as unofficial information and in no way binding upon the Owner, unless subsequently put in writing.

SECTION 1-06 CONTROL OF MATERIALS

1-06.1 SOURCE OF SUPPLY AND QUALITY OF MATERIALS

Promptly after Award, the Contractor shall notify the Engineer of the proposed sources for materials, including fabricators. Approval of the Engineer is required for materialmen and fabricators before delivery is started. The Contractor shall furnish material from other approved sources if it is found that sources of supply which have been approved do not furnish a uniform product, or if the product is determined to be unacceptable.

Material incorporated in the permanent Work shall be new unless otherwise specified in the Project Manual, or specifically approved by the Engineer. Only materials conforming to the requirements of the Contract Documents and approved by the Engineer shall be used in the Work. Material proposed for use in the Work may be inspected or tested at any time during their preparation and use. Materials approved which later become unfit shall be considered unacceptable, and shall not be used in the Work.

1-06.2 SAMPLES AND TESTS

Materials, not tested prior to Award pursuant to Section 1-03.1(4), shall be delivered to the Project Site in sufficient time and quantities to permit the Engineer to test them prior to use. Representative samples shall be submitted without charge by the Contractor, producer, or fabricator for examination and test by the Engineer prior to incorporating the material in the Work. Samples shall be secured whenever necessary to determine the quality of the material. Unless otherwise authorized in writing by the Engineer, samples will be accepted for tests only if those samples were taken by the Engineer, or taken in the Engineer's presence.

Testing of materials will be according to such special methods of tests as are set forth in the Contract Documents, the Washington State Department of Transportation Laboratory manual, or applicable designated recognized standards of national organizations. This will apply to field tests, as well as to laboratory tests.

1-06.3 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

The Engineer may accept certain materials on the basis of a Manufacturer's Certificate of Compliance as an alternative to material inspection and testing when so specified in the Project Manual. The certification shall be furnished prior to use of the material. The Contractor may request, in writing, authority from the Engineer to install such material prior to submitting the required certification, however, no payment will be made for the work in the absence of an acceptable Manufacturer's Certificate of Compliance. The Engineer reserves the right to deny the request for good cause. The Manufacturer's Certificate of Compliance must identify the manufacturer, the type and quantity of material being certified, the applicable

specifications being affirmed and the signature of a responsible corporate official of the manufacturer and include supporting mill tests or documents. A Certificate of Compliance shall be furnished with each lot of material delivered to the Work and the lot so certified shall be clearly identified in the certificate.

All materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. Any material not conforming to the requirements will be subject to rejection whether in place or not. The Engineer reserves the right to refuse to accept materials on the basis of a Certificate of Compliance.

1-06.4 HANDLING AND STORAGE OF MATERIALS

Materials used in the Work shall be handled and stored by the Contractor by such methods as will prevent damage from careless handling, from exposure to elements, from mixture of foreign materials, or from any other cause. The Engineer will refuse to accept or to sample for testing, materials that are improperly handled or stored.

1-06.5 VACANT

1-06.6 SIEVES FOR TESTING

Sieves for testing purposes will be woven wire cloth sieves conforming to the requirements of AASHTO Designation M92, or ASTM Designation E11, or square hole perforated plates, conforming to ASTM Designation E323.

SECTION 1-07 LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

1-07.1 LAWS AND REGULATIONS

The Contractor shall observe and comply with all federal and state laws, and with county, city, and municipal resolutions, ordinances, and regulations that will in any way affect the Work. Such information, interpretation, or representation of laws, regulations, or ordinances referenced in the Contract Documents shall not take precedence over the law, regulation, or ordinance itself, nor relieve the Contractor from the Contractor's responsibility for determining the true current construction and content of such laws, regulations, and ordinances.

1-07.1(1) SAFETY RULES AND STANDARDS

The Contractor shall establish and supervise:

(1) a safe and healthy working environment;
(2) an accident prevention program; and
(3) training programs to improve the skill and competency of all employees in the field of occupational safety and health.

The Washington State Department of Labor and Industries shall be the sole and paramount administrative agency responsible for the administration of the provisions of the Washington Industrial Safety and Health Act of 1973 (WISHA).

The Contractor shall comply with the Federal Occupational Safety and Health Act of 1970 (OSHA), including all revisions and amendments thereto; the provisions of the Washington Industrial Safety Act of 1973 (WISHA); and the requirements of the following chapters of the Washington Administrative Code:

(1) Chapter 296-24 WAC General Safety and Health Standards.
(2) Chapter 296-62 WAC Occupational Health Standards.
(3) Chapter 296-155 WAC Safety Standards for Construction Work.

In addition, the Contractor shall comply with the following requirements when they are applicable:

(1) Chapter 296-44 WAC Safety Standards - Electrical Construction Code
(2) Chapter 296-45 WAC Safety Standards - Electrical Workers
(3) Local Building and Construction Codes.

In cases of conflict between different safety regulations, the more stringent regulation shall apply.

The Contractor shall maintain at the Project Site office, or other well known place at the Project Site, all articles necessary for providing first aid to the injured. The Contractor shall establish, publish, and make known to all employees, procedures for ensuring immediate removal to a hospital, or doctor's care, persons, including employees, who may have been injured on the Project Site. Employees should not be permitted to work on the Project Site before the Contractor has established and made known procedures for removal of injured persons to a hospital or a doctor's care.

The Contractor shall have sole responsibility for the safety, efficiency, and adequacy of the Contractor's plant, appliances, and methods, and for any damage or injury resulting from their failure, or improper maintenace, use, or operation. The Contractor shall be solely and completely responsible for the conditions of the Project Site, including safety of all persons and property in performance of the Work. This requirement shall apply continuously, and not be limited to normal working hours. The required or implied duty of the Engineer to conduct construction review of the Contractor's performance does not, and shall not, be intended to include review and adequacy of the Contractor's safety measures in, on, or near the Project Site.

1-07.2 STATE TAXES

The Washington State Department of Revenue has issued special rules designed to assist the Contractor in accurately reporting to the Department of Revenue the Contractor's tax liability. Although information may be included in the Project Manual regarding the application of state taxes to a particular contract or Bid Item, it shall be the Contractor's responsibility as to the correct interpretation of the laws and regulations relating to such taxes. Adjustments will not be made in the amount to be paid by the Owner under the contract because of any misunderstanding by the Contractor as to the Contractor's liability for, or the amount of, any taxes. If the Contractor is in doubt as to the tax procedures in any particular case, the Contractor shall consult with the Washington State Department of Revenue.

1-07.2(1) STATE SALES TAX - RULE 171

WAC 458-20-171, and its related rules, apply to building, repairing, or improving streets, roads, etc., which are owned by a municipal corporation, or political subdivision of the state, or by the United States, and which are used, primarily, for foot or vehicular traffic. For work performed in such cases, the Contractor shall include Washington State Retail Sales Taxes in the various unit Bid Item prices, or other contract amounts, including those that the Contractor pays on the purchase of materials, equipment, or supplies used or consumed in doing the Work.

1-07.2(2) STATE SALES TAX - RULE 170

WAC 458-20-170, and its related rules, apply to the constructing and repairing of new or existing buildings, or other structures, upon real property. For work performed in such cases, the Contractor shall collect from the Owner, retail

sales tax on the full contract price. The Owner will automatically add this sales tax to each payment to the Contractor. For this reason, the Contractor shall not include the retail sales tax in the unit Bid Item prices, or in any other contract amount subject to Rule 170, with the following exception.

Exception: The Owner will not add in sales tax for a payment the Contractor or a subcontractor makes on the purchase or rental of tools, machinery, equipment, or consumable supplies not integrated into the project. Such sales taxes shall be included in the unit Bid Item prices or in any other contract amount.

1-07.2(3) SERVICES

The Contractor shall not collect retail sales tax from the Owner on any contract wholly for professional, or other services (as defined in State Department of Revenue Rules 138 and 224).

1-07.3 VACANT

1-07.4 SANITATION

The Contractor shall provide and maintain in a clean, neat and sanitary condition any accommodations for Contractor and Owner employees that are necessary to comply with the requirements an ' regulations of the State Department of Social and Health Services and other agencies. The Contractor shall commit no public nuisance, keep all sites clean, dispose of all refuse in a proper manner and leave the premises in a neat and sanitary condition.

1-07.5 PREVENTION OF ENVIRONMENTAL POLLUTION AND PRESERVATION OF PUBLIC NATURAL RESOURCES

During the life of the Contract the Contractor shall comply with all provisions of Federal, State and local statutes, ordinances and regulations pertaining to the prevention of environmental pollution and the preservation of public natural resources. Pursuant to RCW 39.04.120 (Ch. 62, Sec 1, Laws of 1973, 1st Ex. Session) such provisions as are reasonably obtainable are set forth below. Further, if the Contractor must undertake additional work not contemplated by the Contract, due to the enactment of new or the amendment of existing statutes, ordinances, rules, or regulations occurring after the submission of the successful Bid, the Owner will issue a Change Order setting forth the additional work that must be undertaken, which shall not invalidate the Contract. Such additional work shall be considered extra work and will be compensated as such.

1-07.5(1) WATER QUALITY

The Contractor shall comply with city ordinances, State, and Federal laws and other regulations or rules as are applicable to water pollution occurring in waters of the State and in interstate waters.

The Contractor shall:

(1) exercise precautions throughout the life of the Contract to prevent pollution, erosion, siltation, and damage to property;
(2) provide for the flow of all water courses, including but not limited to streams, ditches, sewers, and drains, intercepted during the progress of the Work;
(3) completely restore disturbed water courses in as good condition as the Contractor found them, or make such final provisions for them as the Engineer may direct;
(4) not obstruct the gutter of any street;
(5) use all proper measures to provide for the free passage of surface water; and
(6) make provisions to take care of all surplus water, mud, silt, slickings, or other run-offs pumped from excavations or resulting from sluicing or other operations.

The Contractor shall comply with the water quality criteria set forth by the Department of Ecology and regulations set forth by:

(1) the Washington State Departments of Wildlife and Fisheries;
(2) those Federal statutes on oil spills enacted under the Federal Water Pollution Control Act Amendments of 1972 (a copy of which may be obtained from the U.S. Environmental Protection Agency);
(3) the water quality standards of the State of Washington as set forth in Chapter 173-201 of the Washington Administrative Code; and
(4) any local statutes, regulations, ordinances, or rules, which stipulate the various types of discharge prohibited in public sewer systems or any drainage ditch in the local jurisdiction.

State statutes on water pollution covering liability of the Contractor, penalty for violation, liability and damages for injury or death of fish, animals or vegetation are set forth in RCW 90.48. As an aid to the Contractor, some, though not all, of the rules set forth by the various State departments are summarized below. The Contractor is cautioned, however, that each Department of the State may add other restrictions as they deem necessary to protect fish and to prevent air or water pollution:

(1) State Departments of Wildlife and Fisheries: In doing the work the Contractor shall:
  (a) Not degrade water quality in a way that would harm fish. (The Washington State Water Quality Regulations will serve as water quality criteria for the Work.)
  (b) Release into a flowing stream or open water any fish stranded by the Work.
  (c) Replant any stream bank or shoreline areas if the Work has disturbed the vegetative cover. (Any trees, brush, and grasses used in replanting shall resemble the type and concentration of surrounding vegetation, unless the Project Manual provides otherwise.)
  (d) Provide an open water channel at the lowest level of any isolated pothole remaining when the Work is complete.
  (e) Protect fish by preventing harmful siltation on the bed or bottom of any body of water.
  (f) Not block stream flow or fish passage.
  (g) Keep all equipment out of any flowing stream or other body of water (except as the Project Manual may permit).
  (h) Not remove gravel or other bottom material from within the high- water flow channel bed of any stream nor from the bottom of any other body of water (except as the Project Manual may permit).
  (i) Dispose of any project debris beyond high-water flows.

(2) State Department of Ecology: In doing the work, the Contractor shall:
  (a) Obtain a waste discharge permit from the Ecology Department before:
    (1) Washing aggregate, and
    (2) Discharging into a ground or surface waterway, water from pit sites or excavations, when the water contains turbidity, silt, or foreign materials.

  (b) Provide the Engineer with a copy of each waste discharge permit before starting the Work.
  (c) Control drainage and erosion to minimize the pollution of any waterway.
  (d) Dispose of all toxicants (including creosote, oil, cement, concrete, and water used to wash equipment) in ways that will prevent them from entering State waters.
  (e) Dispose of all debris, overburden, and other waste materials in ways that will prevent them from entering State waters.
  (f) Immediately notify the Engineer and the Department of Ecology if any accidental spill of oil, chemical or sewage occur into the waters of this State.

The Contractor shall perform such temporary work as may be necessary to effectively control water pollution, erosion, and related damage within the Project Site or which might be necessary at work areas located outside the Project Site. These outside areas may include, but are not limited to, equipment, material and other storage sites. When temporary control facilities or measures are no longer needed, they shall be removed and the areas restored or finished as designated by the Engineer.

If work is suspended for an extended period of time, the Contractor shall be responsible for controlling erosion, pollution, and runoff during the shutdown period.

In addition to other requirements in the Contract Documents this temporary work shall include, but is not limited to, the following water quality considerations:

(1) **Diversion of Uncontaminated Water:** Storm water shall be diverted around the project to prevent pickup of silt. This may be accomplished by pumping; improvising ditches; lining channels or by placing metal, plastic or concrete gravity pipe; constructing ditches, berms, culverts, etc., to control surface water; or constructing dams, settling basins, or energy dissipators to control down stream flows.
(2) **Intercepting Ground Water:** Surfacing ground water shall be intercepted and routed around the construction site to prevent silt erosion by the use of gravel trenches, French drain tiles, well points, or interceptor ditch. The Contractor shall provide means of controlling underground water which may be encountered during the Work.
(3) **Turbid Water Treatment Before Discharge:** Determination of turbidity in surface waters shall be at the discretion of the Engineer; for Lake Class Receiving Waters, turbidity shall not exceed 5 NTU (Nephelometric Turbidity Units) over background conditions; for Class AA and Class A Waters, turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU; for other classes of waters, refer to WAC 173-201-045.

The term turbidity means the optical property of sample demonstrating the scattering and absorption of light caused by suspended material as expressed in Nephelometric Turbidity Units and measured with a calibrated turbidimeter.

Discharges to a State waterway caused by aggregate washing, drainage from aggregate pit sites, and stockpiles or dewatering of pits and excavations shall not increase the existing turbidity of the receiving waters.

Turbid water from the Project Site shall be treated before being discharged into stream or other State waters. Turbidity may be removed by the use of lagoons or holding ponds, settling basins, overflow weir, polymer water treatment, discharging to ground surface, by percolation, evaporation or by passing through gravel, sand or fiber filters.
(4) **Erosion Control:** Temporary erosion control shall be exercised by minimizing exposed areas and slopes until permanent measures are effective. Plastic sheet covering shall be placed over exposed ground areas to protect from rain erosion. Other alternative methods for erosion control under certain situations may include netting, mulching with binder, and seeding.

Should rutting and erosion occur the Contractor shall be responsible for restoring damaged areas and for clean-up of eroded material including that in ditches, catch basins, manholes, and culverts and other pipes.
(5) **Chlorine Residual:** Water containing chlorine residual shall not be discharged directly into storm drains, streams, or State waters. Chlorine water may be discharged into sanitary sewers or disposed on land for percolation. Chlorine residual may be reduced chemically with a reducing agent such as sodium thiosulphate. Water shall be periodically tested for chlorine residual.
(6) **Vehicle and Equipment Washing:** Water used for washing vehicles and equipment shall not be allowed to enter storm drains, streams or other State waters unless separation of petroleum products, fresh concrete products or other deleterious material is accomplished prior to discharge. Detergent solution may be discharged into sanitary sewers or allowed to be held on the ground for percolation. A recirculation]system for detergent washing is recommended. Steam cleaning units shall provide a device for oil separation.
(7) **Oil and Chemical Storage and Handling:** Handling and storage of oil and chemicals shall not take place adjacent to waterways. The storage shall be made in dike tanks and barrels with drip pans provided under the dispensing area. Shut-off and lock valves shall be provided on tanks. Shut-off nozzles shall be provided on hoses. Oil and chemicals shall be dispensed only during daylight hours unless the dispensing area is properly lighted. Disposal of waste shall not be allowed on oil and chemical spills. Fencing shall be provided around oil storage. Locks shall be provided on valves, pumps, and tanks.
(8) **Sewage:** If a sanitary sewer line is encountered and repair or relocation work is required, the Contractor shall provide blocking and sealing of the sanitary sewer line. Sanitary sewer flow shall be pumped out, collected, and hauled by tank truck or pumped directly to a sanitary system manhole for discharge. The existing sewers shall be maintained by the Contractor without interruption of service by the use]of temporary sewer bypasses. In addition, the excavated materials adjacent to and around a rupture of a sanitary sewer line shall be removed from the Project Site and deposited into refuse trucks for haul to a sanitary fill site. Equipment and tools in contact with the above]materials shall be washed by pressure water lines and the attendant]wash water discharged into a sanitary sewer line for transmission to a sewage treatment plant.

In the event of a sanitary sewage spill, notification shall be made to: Seattle-King County Health Department, 587-4632 and METRO, 447-6666.

The Contractor shall immediately notify the Engineer and the local United States Coast Guard office of all incidents of chemical, oil, or other contaminated spills or discharges into State waters which become known to the Contractor. If the local Coast Guard office cannot be reached the Contractor shall call the Department of Ecology at 867-7000 or the toll free

number 1-(800)-424-8802. The toll free number is for the National Response Center, Washington, D.C. operated 24 hours a day by the Coast Guard.

1-07.5(2) AIR QUALITY

The Contractor shall not cause or allow the discharge of particulate matter, the emission of any air contaminants or odor bearing gases in excess of the limits specified under Regulation I of the Puget Sound Air Pollution Control Agency, Article 9 - Emission Standards.

The Contractor shall maintain air quality within the National Emission Standards for Hazardous Air Pollutants. Air pollutants being defined as that to which no ambient air quality standard is applicable and which in the judgement of the Administrator of the Environmental Protection Agency Clean Air Act may cause, or contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness.

1-07.5(3) NOISE POLLUTION

The Contractor shall take all reasonable measures for the suppression of noise resulting from work operations. Mobile engine driven cranes, loaders and similar material handling equipment; engines used in stationary service for standby power; and air compressors for high and low pressure service shall be equipped with exhaust and air intake silencers designed for the maximum degree of silencing. The type of silencer required is that for use in critical noise problem locations such as high density residential, hotel, and hospital areas.

The Contractor shall conduct performance of the Work consistent with the applicable noise control levels set forth in Seattle Municipal Code Chapter 25.08 or if outside the City limits and in King County King County Ordinance No. 3139.

1-07.5(4) LIABILITY

The Contractor shall be liable for the payment of all fines and penalties resulting from failure to comply with the Federal, State and local pollution control regulations even though the Engineer is on the job at the time of the violation.

Except as may be otherwise provided for in the Project Manual costs pertaining to the prevention of environmental pollution and the preservation of public natural resources as outlined in the Contract Documents shall be considered as incidental to the Work and such costs shall be included in the unit Bid Item prices for the various items of Work which comprise this Contract.

1-07.5(5) ARCHAEOLOGICAL AND HISTORIC PRESERVATION

"On the private and public lands of this State, it shall be unlawful for any person, firm, corporation or any individual to knowingly alter, dig into or excavate by use of any mechanical, hydraulic, or other means, or to damage, deface or destroy any historic or prehistoric archaeological resource or site... without having obtained written permission from the preservation officer for such activities on public property ...." (RCW 27.53.060)

It shall be the responsibility of the Contractor to notify the Engineer if any artifacts, skeletal remains or other archaeological resources (as defined under RCW 27.53.040) are unearthed during excavation or otherwise discovered on the construction site. If ordered by the Engineer, the Contractor shall immediately suspend any construction activity which, in the opinion of the Engineer, would be in violation of RCW 27.53. Suspension of the Work shall remain in effect until the Engineer has obtained permission to proceed from the State Historic Preservation Officer.

1-07.6 PERMITS AND LICENSES

The Contractor shall obtain all permits and licenses required to complete the Work except for those permits and licenses obtained by the Owner and referenced or included in the Contract Documents. A copy of each permit or license shall be furnished to the Engineer. The Contractor shall also give notice as the permits and licenses may require. The costs of permits and licenses obtained by the Contractor shall be included in the prices bid for the Work.

1-07.7 LOAD LIMITS

While moving equipment and materials on any public highway, the Contractor shall comply with any law that controls traffic or limits loads. The Contract does not exempt the Contractor from such laws nor does it license overloads. At the Engineer's request, the Contractor shall provide any information needed to determine the weight of equipment on the roadway.

When the Contractor moves equipment or materials within the project boundaries, legal load limits shall apply on:

(1) Any road open to and in use by public traffic,
(2) Any existing road not scheduled for major reconstruction under the current Contract, and
(3) Any newly paved road (with its final lift in place) built under this Contract. The Contractor may haul overloads (not exceeding 25 percent) on such roads not open to public traffic if this does not damage completed work. Should damage occur, the Contractor shall pay all repair costs.

On all other parts of the project, the Contractor may operate equipment without load-limit restrictions except as described in items 1, 2, and 3 below. In doing so, however, the Contractor remains responsible for any damage that may result. All vehicles subject to license on a tonnage basis will be required to license to the maximum legal capacity before being eligible to operate under the weight limitation described in item 1, 2, or 3 below.

The Engineer may approve higher load limits in items 1, 2, or 3 below if it is necessary and safe to do so. To obtain such approval, the Contractor shall request it from the Engineer in writing. The request shall describe in detail the loading, configuration, and movement or position of the equipment on the structure or over the culverts and pipes. The request shall state that the Contractor assumes all risk for damages. The Contractor shall include in the unit prices all costs for operating over bridges or culverts. Nothing in this section affects the Contractors's other responsibilities under these Specifications or under public highway laws.

(1) **Structures Designed for Direct Bearing of Live Loads.** On these structures, the gross or maximum load on each individual vehicle axle shall not exceed the legal load limit by more than 35 percent. No more than one vehicle shall operate over any structure at one time.

(2) **Underpasses and Reinforced Concrete Box Culverts Under Embankments.** Over these structures, maximum loads shall be 24,000 pounds on a single axle and 16,000 pounds each on tandem axles spaced less than 10 feet apart, provided that:

(a) The embankment has been built to specifications, and
(b) The embankment has reached at least 3 feet above the top of the underpass or culvert.

When the embankment has reached 5 feet above the top of the culvert or underpass, the Contractor may increase axle loads up to 100,000 pounds each if outside wheel spacing is at least 7 feet on centers on the axle.

(3) **Pipe Culverts and Sewer Pipes.** Over pipe culverts and sewer pipes, maximum loads shall be 24,000 pounds on a single axle and 16,000 pounds each on tandem axles spaced less than 10 feet apart, provided that:

(a) The culvert or pipe has been installed and backfilled to specifications, and
(b) The embankment has reached at least 2 feet above the top limit of pipe compaction as defined in Design A or Design C.

When the embankment has reached 5 feet above the top limit of pipe construction, the Contractor may increase axle loads up to 100,000 pounds each if outside wheel spacing is at least 7 feet on centers on the axle-except that:

(a) For Class III reinforced concrete pipes, the embankment shall rise above the top limit of compaction at least: (a) 6 feet for Design A work, and (b) 7 feet for Design C work.
(b) For Class II reinforced concrete pipes, the maximum load for each axle shall be 80,000 pounds if outside wheel spacing is at least 7 feet on centers on the axle. In this case, the embankment shall rise above the top limit of compaction at least: (a) 6 feet for Design A work and (b) 10 feet for Design C work.

1-07.8 VACANT

1-07.9 WAGES

1-07.9(1) GENERAL

The Work is subject to the wage requirements of RCW 39.12 (Prevailing Wages on Public Works), RCW 49.28 (Hours of Labor), and to RCW 49.46 (Minimum Wage Act) as amended or supplemented. On projects funded in whole or part from Federal monies, Federal wage laws and rules shall also apply. When the Work is subject to both State and Federal prevailing wage requirements, the Contractor and every subcontractor must comply with whichever standard is higher.

The Contractor, any subcontractor or other person doing any portion of the Work, shall not pay any laborer, worker, or mechanic less than the applicable prevailing hourly wage rates and fringe benefits for said worker's classification. Higher wages and benefits may be paid at the Contractor's option. It shall be the sole responsibility of the Contractor to assign the appropriate classification to all laborers, workers or mechanics who perform any work pursuant to this Contract, in conformance with the scope of work descriptions of the Industrial Statistician of the Washington State Department of Labor and Industries. It shall also be the Contractor's sole responsibility to ascertain the applicable prevailing rate of wage for each such classification. Laborers, workers, and mechanics must be paid in full at least once each week and in lawful money of the United States.

The Owner holds the Contractor responsible for compliance of all subcontractors with payroll reporting requirements and payment of prevailing wages.

1-07.9(2) PREVAILING WAGE RATES

The Project Manual includes hourly minimum rates for wages and fringe benefits to be paid laborers, workers and mechanics employed in the Work as established by the State Department of Labor and Industries. When the project is funded in whole or part from Federal monies, the Project Manual also includes the Federal hourly minimum wage and fringe benefit rates, as identified by the U.S. Department of Labor's "General Wage Decision."

Any listing of wages and fringe benefits in the Project Manual for any classification is intended only as a guideline for the Contractor and does not necessarily reflect the most recent classification or prevailing wage rate. Prevailing wage rates will be determined by the Department of Labor and Industries and published only on the first business day of February and the first business day of August of each year. All prevailing wage rates become effective thirty days after they are published. Current prevailing wage information may be obtained upon request from the Industrial Statistician of the Department of Labor and Industries, ESAC Division, - HC-710, 925 Plum Street, Olympia, WA 98504, telephone (206) 753-4019. For projects funded in whole or part with Federal monies, current Federal prevailing wage information may be obtained upon request from the U.S. Department of Labor, Employment Standards Administration, Wage and Hour Division, Federal Office Building, Seattle, WA 98104, telephone (206) 442-1914.

By including wage and fringe benefit rates in the Project Manual, the Owner does not imply that the Contractor will find labor available at those rates. The Contractor shall calculate any amount above the minimums which have to be paid.

If the Contractor employs labor in a classification not listed in the Project Manual, the Contractor shall, on projects where only State prevailing wage rates apply, request the Industrial Statistician of the Washington State Department of Labor and Industries to determine the correct prevailing wage rate for that classification and locality. If the project is funded in whole or part with Federal monies, the Contractor shall request the Industrial Statistician of the Washington State Department of Labor and Industries to determine a State prevailing wage rate for that classification and locality and shall ask the U.S. Department of Labor to determine a Federal prevailing wage rate for that classification and locality. Should those wage rates differ, the Contractor shall use the highest wage rate determined.

1-07.9(3) OVERTIME

Pursuant to the provisions of Chapter 49.28 RCW and WAC 296-127-022, work performed on public works contracts will not require the payment of overtime rates for the first two hours worked in excess of eight hours per day when the employer has obtained the employees' agreement to work a four-day ten-hour week.

For the purpose of this rule an agreement must:

(1) Have been authorized by employees who bargained collectively with their employers through representatives of their own choosing; or
(2) Be obtained in writing; and
(3) Be obtained individually from each employee; and
(4) Obtained separately for each public works project.
(5) Obtained voluntatily.

Notwithstanding the above provisions, overtime must be paid for all hours worked in excess of 40 hours per week.

1-07.9(4) EFFECTIVE DATE FOR DETERMINING PREVAILING WAGES

In accordance with WAC 296-127-011, the effective date for determining State prevailing wages will be the date of bid opening, provided the Contract is awarded within six months after bids are due. If the Contract is not awarded within six months after bids are due, the effective date for determining prevailing wages shall be the date the Contract is awarded. If the Contract is not awarded pursuant to bids (e.g. emergency contracts), the effective date for determining prevailing wages shall be the Award Date of the Contract.

For projects funded in whole or part with Federal monies, the effective date for determining prevailing wages shall be 10 days prior to the date bids are due provided the Contract is

awarded within 90 days after bids are due, unless the Owner determines there is sufficient time to notify bidders of changes in the prevailing wage rates up to the date of bid opening, in which case those rates shall apply. . If the Contract is not awarded within 90 days after the bids are due, the effective date for determining prevailing wages shall be the Award Date of the Contract.

1-07.9(5) PAYROLLS

Payroll reports for the Contractor and every subcontractor shall be submitted weekly to the Executive Director of the Board of Public Works, Arctic Building, Suite 700, 700 Third Avenue, Seattle, Washington 98104, within 72 hours after the expiration of each pay period. The payroll reports shall contain the following information:

(a) Name and residence address of each worker.
(b) Social Security number of each worker.
(c) Classification of work performed by each worker. The classification must be specific and match the classification categories listed in the Project Manual.
(d) Total number of hours employed each day.
(e) Total number of hours employed during the payroll period.
(f) Hourly rate of wages paid to each worker.
(g) Total or gross amount earned by each worker.
(h) Deductions for Medical Aid, FICA, Federal withholding tax, and any other deductions taken.
(i) Net amount paid each worker.
(j) Contractor's (or subcontractor's) name and address.
(k) Days and dates worked.
(l) Date of final day of pay period.
(m) Whether fringe benefits were paid to each worker as part of the hourly wage rate or whether fringe benefits were paid into an approved plan, fund, or program.

Payrolls may be submitted on Federal payroll form WH-347 (or equivalent), which may be obtained from the Federal Bookstore, Federal Building, 915 Second Avenue, Room 194, Seattle, WA 98174, telephone (206) 442-4270. The reverse side of the form contains an affidavit which must be filled out and signed. If the Contractor's payroll reports are computerized, the computerized reports may be submitted along with a Statement of Compliance affidavit form which may be photocopied from the sample in the Project Manual.

The first payroll submitted for the Work for both the Contractor and each subcontractor shall be labeled "Initial". The last payroll submitted for the Work for both the Contractor and each subcontractor shall be labeled "Final". Payrolls shall be sequentially numbered for all periods in which work is performed.

1-07.9(6) REQUIRED DOCUMENTS

Before payment is made by the Owner of any sums due under this Contract, the City Comptroller shall receive from the Contractor and each subcontractor a copy of a "Statement of Intent to Pay Prevailing Wages" (form F700-029-000), approved by the Industrial Statistician of the Washington State Department of Labor and Industries.

Upon completion of the Work, the City Comptroller shall receive from the Contractor and each subcontractor a copy of a "Affidavit of Wages Paid" (form L700-007-000), approved by the Industrial Statistician of the Washington State Department of Labor and Industries. These forms, along with other requirements outlined in section 1.09.9(2) of these specifications, shall be received by the City Comptroller prior to release of retainage.

A fee of $25.00 per each "Statement of Intent to Pay Prevailing Wages" and "Affidavit of Wages Paid" is required to accompany each form submitted to the Department of Labor and Industries. The Contractor is responsible for payment of these fees and shall submit all forms directly to the Department of Labor and Industries for approval. The cost of these fees shall be included in the prices of the various units of work which comprise this contract.

The required forms specified herein may be obtained from the Department of Labor and Industries.

Each progress estimate submitted for payment shall include or have attached a statement signed by the Contractor that the prevailing wages have been paid in accordance with the prefiled Statement of Intent to Pay Prevailing Wages on file with the City of Seattle Comptroller, or the estimate will not be paid. The following is a sample of the wording required:

"To: City Comptroller

Project:_____BPW#: _____

I certify that the prevailing wages have been paid in accordance with the prefiled Statement or Statements of Intent to Pay Prevailing Wages on file with the City Comptroller for the period covering _____, 19 _____ to_____, 19_____.

_____ _____
Contractor Signature

This letter shall be signed by an authorized representative of the Contractor prior to payment of any voucher pursuant to RCW 39.12.040."

1-07.9(7) APPRENTICES

A laborer, worker, or mechanic employed on the Work for whom an apprentice agreement is registered and approved by the State Apprenticeship Council pursuant to Chapter 49.04 RCW within 60 days of hiring may be paid the applicable prevailing hourly rate for an apprentice of that trade. If formal registration with the State Apprenticeship Council is not accomplished within 60 days of hiring, the laborer, worker or mechanic must be paid the prevailing hourly journeyman rate for all hours worked on the Contract until an apprenticeship agreement is registered.

If the Contractor makes use of an apprentice on Work also governed by Federal wage rates and regulations, the Contractor shall present to the Owner written evidence of registration of such employees in a program approved by the Washington State Apprenticeship Council and recognized by the U.S. Bureau of Apprenticeship and Training. Such evidence shall be submitted with the first payroll upon which the name of the employee appears. In the absence of such a state apprenticeship council program, the Contractor shall submit evidence of approval and registration by the U.S. Bureau of Apprenticeship and Training.

1-07.9(8) POSTING NOTICES

In a location acceptable to the Department of Labor and Industries, and in compliance with the requirements of RCW 39.12.020, the Contractor shall post:

(1) One copy of the approved "Statement of Intent to Pay Prevailing Wages," for the Contractor, each subcontractor, and each agent of a subcontractor.
(2) The address and telephone number of the Industrial Statistician for the Department of Labor and Industries (along with notice that complaints or questions about wage rates may be directed there).

1-07.9(9) DISPUTES

In the event any dispute arises as to what the prevailing wages are for this Contract, and the dispute cannot be resolved by the parties involved, the matter shall be referred to the Director of the Department of Labor and Industries of the State

of Washington when such dispute involves State prevailing wage rates. In such case, the Director's decision shall be final, conclusive, and binding on all parties.

If the dispute involves a Federal prevailing wage rate, the matter shall be referred to the U.S. Secretary of Labor for a decision. In such case, the Secretary's decision shall be final, conclusive, and binding on all parties.

When the Work is subject to both State and Federal prevailing wage requirements, the Contractor and every subcontractor shall comply with whichever standard is higher.

1-07.9(10) AUDITS

The Contractor's records pertaining to wages paid and payrolls shall be open to inspection or audit by representatives of the Owner and, if applicable, representatives of grant agencies funding or controlling funding for the project at any time during the life of the Contract and for a period of not less than three years after the Acceptance Date. The Contractor shall retain such records for that period. Where such records pertaining to wages paid on any payrolls are maintained by subcontractors or agents of the Contractor, the Contractor guarantees that the records of such subcontractors or agent shall be open to inspection and audit on the same terms and conditions as the records of the Contractor.

If an audit is to be commenced more than 60 days after the Acceptance Date of the Contract, the Contractor will be given a reasonable notice of time when such audit is to begin.

1-07.10 WORKER'S BENEFITS

The Contractor shall make all payments required for unemployment compensation under Title 50 RCW and for industrial insurance and medical aid required under Title 51 RCW. If any payment required by Title 50 or Title 51 is not made when due, the Owner may retain such payments from any money due the Contractor and pay the same into the appropriate fund.

For work on or adjacent to water, the Contractor shall make the determination as to whether workers are to be covered under the Longshoremen's and Harbor Worker's Compensation Act administered by the U.S. Department of Labor, or the State Industrial Insurance coverage administered by the Washington State Department of Labor and Industries, or both coverages.

The Contractor shall include in the various items in the bid proposal all costs for payment of unemployment compensation and for providing either or both of the insurance coverages. The Contractor will not be entitled to any additional payment for: (1) failure to include such costs, or (2) determinations made by the U.S. Department of Labor or the Washington State Department of Labor and Industries regarding the insurance coverage.

The Public Works Contract Division of the Department of Labor and Industries will provide the Contractor with applicable industrial insurance and medical aid classification and premium rates. The "Request for Release" form of the Department of Labor and Industries is also for the purpose of obtaining a release with respect to the payments of industrial insurance and medical aid premiums.

1-07.11 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS

1-07.11(1) GENERAL

The Contractor shall not discriminate and shall take affirmative action to ensure equal employment opportunity pursuant to Chapter SMC 20.44. These, and other requirements which may be set forth in the Project Manual, shall constitute the specific Affirmative Action requirements for the Work.

The Contractor and all subcontractors (not including materialmen) holding subcontracts of $1,000 or more shall comply with the following minimum specific requirement activities of equal employment opportunity. The Contractor shall include these requirements in every subcontract of $1,000 or more with such modification of language as is necessary to make them binding on the subcontractor.

1-07.11(2) EQUAL EMPLOYMENT OPPORTUNITY POLICY

The Contractor shall accept as operating policy the following statement which is designed to further the provision of equal employment opportunity to all persons without regard to their race; color; sex; religion; national origin; marital status; sexual orientation; political ideology; age, creed; ancestry; or the presence of any sensory, mental or physical handicap; and to promote the full realization of equal employment opportunity through a positive continuing program:

"The Contractor will not discriminate against any employee or applicant for employment because of race, religion, creed, color, sex, marital status, sexual orientation, political ideology, ancestry, national origin, or the presence of any sensory, mental or physical handicap, unless based upon a bona fide occupational qualification. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their creed, religion, race, color, sex, national origin, or the presence of any sensory, mental or physical handicap. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer, recruitment, or recruitment advertising, layoff or termination rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

"The Contractor will, prior to commencement and during the term of the contract, furnish to the Director of the Human Rights Department or the Director's designee upon request and on such form as may be provided, a report of the affirmative action taken by the Contractor in implementing the terms of these provisions. The Contractor will permit access to the records of employment, employment advertisements, application forms, and other pertinent data requested by the Director to determine compliance with these requirements.

"If the Director finds probable cause to believe that the Contractor has failed to comply with the terms of these requirements, the Contractor and the Owner shall be so notified in writing. The Owner will give the Contractor an opportunity to be heard, after 10 days notice. If the Owner concurs in the findings of the Director, the Owner may suspend the contract, withhold any funds due or to become due to the Contractor, or both pending compliance by the Contractor.

"Failure to comply with these requirements shall be a material breach of the contract."

The foregoing requirements and policy shall be inserted in all subcontracts for work covered by the Contract.

1-07.11(3) EQUAL EMPLOYMENT OPPORTUNITY OFFICER

The Contractor shall designate and make known to the Engineer and the Human Rights Department at the Preconstruction Conference the firm's Equal Employment Opportunity Officer (hereinafter referred to as the EEO Officer). The EEO Officer will have the responsibility for making him/herself known to each of the Contractor's employees. The EEO Officer shall possess the responsibility, authority, and capability for effectively administering and promoting an active Contractor program of equal employment opportunity.

1-07.11(4) DISSEMINATION OF POLICY

1-07.11(4)A SUPERVISORY PERSONNEL

All members of the Contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, shall be made fully cognizant of, and shall implement the Contractor's equal employment opportunity policy and contractual responsibilities to provide equal employment opportunity in each grade and classification of employment. To ensure that the above agreement will be met, the following actions shall be taken:

(1) EEO Meetings: Periodic meetings of supervisory and personnel office employees shall be conducted before the start of work and then not less often than once every 6 months, at which time the Contractor's equal employment opportunity policy and its implementation shall be reviewed and explained. The meetings shall be conducted by the EEO Officer or other knowledgeable company official.

(2) EEO Education: All new supervisory or personnel office employees shall be given thorough instruction by the EEO Officer or other knowledgeable company official regarding all major aspects of the Contractor's equal employment opportunity obligations within 30 days following their reporting for duty with the Contractor.

(3) Internal EEO Procedures: All personnel who are engaged in direct recruitment for the project shall be instructed by the EEO Officer or appropriate company official in the Contractor's procedures for locating and hiring minority and women employees.

The Contractor shall ensure that all employees, particularly supervisors, are aware of, and adhere to their obligations to maintain a working environment free from discriminatory conduct, including, but not limited to, harassment and intimidation of minorities and women.

1-07.11(4)B EMPLOYEES, APPLICANTS, AND POTENTIAL EMPLOYEES

In order to make the Contractor's equal employment opportunity policy known to all employees, prospective employees, and potential sources of employees, i.e., schools, employment agencies, labor unions (where appropriate), college placement officers, etc., the Contractor shall take the following actions:

(1) Notices and Posters: Notices and posters setting forth the Contractor's equal employment opportunity policy shall be placed in areas readily accessible to employees, applicants for employment, and potential employees.

(2) EEO Education: The Contractor's equal employment opportunity policy and the procedures to implement such policy shall be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

(3) Non-Segregation: The contractor will ensure that all of contractor's facilities and activities are non-segregated with the following exceptions: separate male and female or single user toilet and changing facilities will be provided.

1-07.11(5) RECRUITMENT

The Contractor shall be responsible for directing recruitment efforts, both oral and written to minority, female, and community organizations and shall take the following actions:

(1) Equal Opportunity Employer: When advertising for employees, the Contractor shall include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements shall be published in newspapers or other publications having a large circulation among minority and women's groups in the area from which the project work force would normally be derived.

(2) Systematic and Direct Recruitment: The Contractor shall, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minority and women applicants, including, but not limited to, State employment agencies, schools, colleges, and minority and women's organizations. To meet this requirement, the Contractor shall, through the designated EEO Officer, identify sources of potential minority and women employees and establish with such identified sources procedures whereby minority applicants may be referred to the Contractor for employment consideration.

(3) Exclusive Hiring: In the event the Contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the Contractor is expected to observe the provisions of that agreement to the extent that the system permits the Contractor's compliance with equal employment opportunity contract provisions. (The U.S. Department of Labor has held that where implementation of such collective bargaining agreements have the effect of discriminating against minorities or women, or obligates the Contractor to do the same, such implementation violates Executive Order 11246, as amended.)

(4) Referrals and Notices (Existing Employees): The Contractor shall encourage present employees to refer minority and women applicants for employment by posting appropriate notices or bulletins in areas accessible to all employees. In addition, information and procedures with regard to referring minority and women applicants shall be discussed with employees.

(5) Female and Minority Youth: When possible, the Contractor shall provide after school, summer, and vacation employment opportunities for female and minority youth.

1-07.11(6) PERSONNEL ACTIONS

Wages, working conditions, and employee benefits shall be established and administered; and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race; color; religion; sex; maritial status; sexual orientation; political ideology; age; creed; ancestry; national origin; or the presence of any sensory, mental or physical handicap. The following procedures shall be followed:

(1) Conditions of Employment: The Contractor shall conduct periodic inspections of project sites to ensure that working conditions and employee facilities do not

indicate discriminatory treatment of Project Site personnel.

(2) Wages: The Contractor shall periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

(3) Work Force Profile: The Contractor shall evaluate the work force profile on a quarterly basis to identify job categories in which minorities and women are underutilized. The Contractor shall undertake affirmative action to remedy underutilization of minorities and women at all levels of its work force including management. There is an employment goal of not less than 21% minorities and 20% women; and an employment subgoal of 4.5% for minority women.

(4) Review of Personnel Actions: The Contractor shall periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the Contractor shall promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

(5) Complaints: The Contractor shall promptly investigate all complaints of alleged discrimination made to the Contractor in connection with the obligations under this Contract, shall attempt to resolve such complaints, and shall take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation the Contractor shall inform every complainant of all of the avenues of appeal.

(6) Application Forms: The Contractor shall review all existing application forms, test minimum qualifications, etc., for job relatedness and necessity, and revise any forms, practices, and activities which would adversely impact minority and women applicants.

(7) Name and Address File: The Contractor shall maintain a current file of the names and addresses and telephone numbers of all job applicants.

1-07.11(7) TRAINING AND PROMOTION

1-07.11(7)A GENERAL

The Contractor shall assist in locating, qualifying and increasing the skills of minority and women employees and applicants for employment through training and promotion. The Contractor may call the WSDOT Supportive Service Consultant (the Tacoma Urban League) 1-(800)-562-8197, toll free, for assistance in filling a trainee position with a minority or woman.

Consistent with the Contractor's work force requirements and as permissible under Federal, State and City regulations, the Contractor shall make full use of training programs, i.e., apprenticeship and "on-the-job" training programs, for the specific project and the geographical area of the Work to meet training requirements and promotion needs. The use of established State or Federal approved apprenticeship programs and standards is preferred over a Contractor's own "on-the-job" training program.

1-07.11(7)B TRAINING PROVISIONS

When the Bid Form includes a Bid Item for "Training", part of the Contractor's specific affirmative action program shall be provided as follows:

(1) The Contractor shall provide on-the-job training aimed at developing full journeyman status in the type of trade involved. The minimum number of apprentices or trainees on a project will be specified in the Project Manual. The number of training hours to be performed will be specified under the Bid Item, "Training".

At least 25% of apprentices or trainees, but in no case less than 1 apprentice or trainee, in each occupation shall be in their first year of apprenticeship or training. If the Contractor asserts that 25% requirement in a single occupation is not feasible, the Contractor shall provide documentation substantiating such assertion.

The Contractor may determine how many, if any, trainees are to be trained by a subcontractor. However, the Contractor shall retain the primary responsibility for meeting the training requirements imposed by these requirements. The Contractor shall also ensure that these Training Provisions are made applicable to subcontracts.

(2) Training program requirements: The Contractor shall be responsible for the preparation and submittal of its own, and any of its subcontractors, training program on the forms provided by the Engineer.

The training program shall be submitted to the Engineer and the Seattle Human Rights Department (HRD) for approval at the Pre-Construction Conference, and shall be resubmitted to the Engineer for approval before changes modify the training program. The Training Program shall indicate how the Contractor will meet the required number of training hours and the minimum number of trainees, including the number of first year apprentices or trainees required. The hours shown on the Contractor's Training Program submitted at the Pre-Construction Conference shall establish a minimum requirement the Contractor must attain to be in compliance with these training provisions. If the training program shows less than the number of hours set forth in the Bid Form the Contractor shall provide proof that the number of hours set forth in the Bid Form is an unreasonable amount before the reduced training hours will be approved.

The Training Program shall include the trade or trades proposed to accomplish the training item in the Contract, the number of trainees and hours assigned to the trade, the training standard or program to be used for each selected occupational classification, and the scheduled date for the trainee in each of the occupational classifications to commence work. A detailed breakdown of the hours assigned to the various skills of the trade must be submitted for other than apprenticeship trades. Approval or acceptance of the Contractor's Training Program shall be obtained from the Engineer and HRD prior to commencing a trainee's work covered by the submitted Training Program. After approval of the Training Program, documentation concerning each individual trainee shall be submitted on a monthly basis.

The number of trainees shall be distributed among the work classifications used for the Work taking into consideration the Contractor's needs and the availability of journeymen in the various classifications within reasonable area of recruitment. The Contractor will be credited for each trainee employed by the Contractor on the Work who is currently enrolled or becomes enrolled in an approved program. The Contractor will be reimbursed for such trainees as provided hereinafter.

(3) Affirmative Action Recruitment Required: This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a protected group individual or not. However, training and upgrading of minorities and women toward journeyman

status is a primary objective of this Training Provision. Accordingly, the Contractor/Subcontractor assigned training shall make every effort to enroll minority and women trainees to the extent such persons are available within a reasonable area of recruitment. More specifically, if a nonminority male trainee/apprentice is proposed for utilization toward meeting the training goal, approval may be granted if the Contractor/Subcontractor proposing to utilize the trainee is otherwise in compliance with the contract's Equal Employment Opportunity and On-the-Job Training requirements and further provides documentation as to the efforts taken to fill the specific training position with either minorities or females; or, if not otherwise in compliance, furnishes evidence of his/her systematic and direct recruitment efforts in regard to the position in question and in promoting the enrollment and/or employment of minorities and females in the craft which the proposed trainee is to be trained.

As a minimum, a Contractor/Subcontractor who is not otherwise in compliance can substantiate their systematic and direct recruitment efforts by providing documentation as to the following:

(a) Written notification to minority and female recruitment sources and community organizations of available employment opportunities with the Contractor/Subcontractor and/or enrollment opportunities with its unions;
(b) Records documenting the Contractor efforts, and the outcome of those efforts, to employ minority and female applicants and/or refer them to unions;
(c) Records reflecting the Contractor/Subcontractor's efforts/participation in developing minority and female on-the-job training opportunities, including upgrading programs and apprenticeship;
(d) Written notices to unions and training programs disseminating the Contractor/Subcontractor's EEO policy and requesting their cooperation in achieving his/her EEO and OJT obligations.

Systematic and direct recruitment efforts must be through public and private sources likely to yield minority and female trainees. Such documentation must be submitted in a timely manner. The determination of the Contractor/Subcontractor's compliance with this section shall be made on a case-by-case basis. The Engineer's determination of compliance with this section shall be administered as provided in Section 1-05.1, based upon a recommendation by HRD.

(4) Journeymen Trainees Not Eligible: No employee shall be engaged in a trainee classification after such employee has successfully completed a training course leading to journeyman status or in which the trainee has been employed as a journeyman. The Contractor may satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used, the Contractor's records shall document the findings in each case.

1-07.11(7)B1 TRAINING PROGRAM

The minimum length of training for each occupational classification shall be established in the training program classification selected by the Contractor. Training Programs shall be approved by the Engineer, HRD, and when applicable, approved by the Washington State Department of Transportation and the Federal Highway Administration.

1-07.11(7)C ACCEPTABLE TRAINING PROGRAMS

Acceptable training programs are those employing trainees/apprentices from the following:

(1) Apprentices registered with the Washington State Department of Labor - Joint Apprenticeship Training Council (JATC) approved apprenticeship agreement. Pursuant to RCW 49.04.060, an apprenticeship agreement is:
  (a) an individual written agreement between an employer and apprentice, or
  (b) a written agreement between an employer, or an association of employers, and an organization of employees describing conditions of employment for apprentices, or
  (c) a written statement describing conditions of employment for apprentices in a plant where there is no bonafide employee organization.

  All such agreements shall conform to the basic standards and other provisions of Chapter 49 RCW.
(2) Apprentices registered with the U.S. Department of Labor - Bureau of Apprenticeship and Training (BAT) approved program.
(3) Apprentices registered with an approved apprenticeship program recognized by Washington, Oregon, and Idaho, March, 1985 Apprenticeship Registration Reciprocity Agreement.
(4) Trainees participating in a non-BAT/JATC program approved by the FHWA/WSDOT for the specific project.

Such training programs will be considered acceptable provided they are administered in a manner consistent with the equal employment obligations of Federal Aid highway construction contracts.

1-07.11(7)D TRAINING PROGRAM APPROVAL

Training Programs will be approved if the proposed number of trainees for the Contractor and all subcontractors cumulatively, equal or exceed the number established in the Project Manual and the proposed number of training hours equal the minimum number of training hours indicated in the Bid Form. A program will be approved only if it is reasonably calculated to meet the EEO obligations of the Contractor and to qualify the average trainee for journeyman status by the end of the training period, or beneficially contributes toward a trainee achieving journey status in the classification concerned.

In addition, the Contractor shall comply with the following:

(1) Other Than Apprenticeship Trades: Contractors who are not affiliated with a program approved by BAT or JATC and want to write their own training program may have the training program approved provided the program is submitted for approval on the training program forms provided by the Engineer, are submitted in a format similar to the required format established by, or in accordance with, RCW 49.040 and include or address satisfactorily the following standards:
  (a) Minimum Qualifications: The Contractor shall establish minimum qualifications for persons entering the training program.
  (b) Work Skills: An outline of the work processes in which the trainee will receive supervised work experience and training on the job and the allocation of the approximate time to be spent in each major process shall be set forth in these standards. In addition to the on-the-job training, the Contractor shall outline the methods, if any, by which the trainee may obtain related formal class instruction or, if such formal class instruction is not available, a course outline for home study developed from trade journals, manuals, or other correspondence, a record of the number of hours spent in class or in home study, and the trainee's progress shall be maintained by the Contractor.
  (c) Terms of Training: The training program shall be an individually written agreement between the employer and the trainee, signed by both, with a copy submitted to the Engineer. The terms of training shall be stated in hours. The number of hours required for completion to journeyman status shall not exceed 1,000 hours for any one individual without prior approval of the Engineer. For non-apprenticable trainees, training shall not be less than 200 hours of training. The training program shall contain a provision which will set forth the method by which the Contractor will fulfill the training requirements of the Contract, should an individual training agreement be terminated prior to its completion. The Contractor shall provide, as part of the training program, a certification of completion to the apprentice or trainee signed by the Contractor which will be a record of the apprentice or trainee's successfully completed training. Training in the Laborer classification may be permitted provided that significant and meaningful training is provided and the training program developed by the Contractor provides a final objective and a structured method of reaching that training objective. Trainees in the Laborer's craft shall be trained in accordance with the current Laborer's training program authorized by the Washington State Apprenticeship and Training Council. For non-apprentice trainees, a minimum of 200 hours per trainee shall establish meaningful training. A minimum assignment of 20 hours per apprentice is required for an apprentice trainee.
  (d) Program Monitoring: The method for recording and reporting the training completed shall be stated in the training program. The Contractor shall provide the Engineer with a monthly progress report which shall contain the trainee's name, classification, wage rate, and progress as of that month for the purpose of documenting the Contractor's obligation in meeting these Contract training requirements.
  (e) Ratio of Trainees: A numeric ratio of trainees to journeymen shall be established. It shall be consistent with proper supervision, training, safety and continuity of employment. The ratio language shall be specific and clear as to application in terms of job site and work force during normal operations (normally considered to fall between 1:10 and 1:4).
(2) Program Approval Required: Approval or acceptance of the Contractor's training program shall be obtained from the Engineer and HRD prior to commencing the trainee's work covered by the program.
(3) Trainee Approval Required: After approval of the training program, information concerning each individual trainee and good faith effort documentation shall be submitted on forms provided by the Engineer. It is the intention of these provisions that training be provided in the construction crafts rather than clerk typists or secretarial type positions. Training is permissible in lower level management positions, such as office engineers, estimators, timekeepers, etc. when the training is oriented towards construction applications. When a trainee first starts work on the project, the Contractor shall notify the Engineer prior to the trainee's first working day. Notification shall include name of trainee or apprentice, social security number, ethnic background, classification being trained in, the proposed trainee's past experience as a journeyman in any craft, prior training and hours the trainee has received in previous training programs, and that the individual has been made aware of any apprenticeship programs established for similar type work. Written documentation shall be submitted within 10 working days after verbally notifying the Engineer, of the proposed trainee's past working history described in the preceding sentence. Tentative approval may be given by the Engineer upon first notification of the trainee starting work on the project. Final written approval or disapproval will be made by the Engineer and HRD. Upon receipt of tentative approval, reimbursement for hours trained in accordance with the Training Provisions will be allowed. If there is a final disapproval of the trainee, the Contractor shall be notified by the Engineer with no additional reimbursement made for the trainee's hours beyond the date of notification.
(4) Off-Site Training: Some off-site training is permissible as long as the training is of an integral part of an approval training program and does not comprise a significant part of the overall training.
(5) Training Reimbursement: Except as otherwise noted hereinafter, the Contractor will be reimbursed under the contract item "Training" per hour for each hour of training for each employee that is trained in accordance with an approved individual Training Program. Training hours will not be counted towards meeting the training goal or be reimbursed until the training program is approved by the Engineer and HRD. The Contractor will only be paid a maximum of 1,000 hours for each trainee trained in an occupational classification not having an apprentice-training program approved by the U.S. Department of Labor or a State apprenticeship agency recognized by the Bureau (e.g., teamsters, office engineers, laborers) unless prior written approval is received from the Engineer and HRD to exceed the 1,000-hour limit.

Reimbursement will be made on the monthly progress estimate upon receipt of a certified invoice that shows the related weekly payroll number, the name of the apprentice or trainee, the hours of training for each skill identified in the approved program, total hours per trainee or apprentice, total hours trained under the program, previously paid hours under the contract, hours due this estimate and the dollar amount due this estimate. The certified invoice shall show a statement indicating the Contractor's effort to enroll minorities and women when a new enrollment occurs. When an apprentice is first enrolled, copies of the certificate showing apprenticeship registration must accompany the invoice. Reimbursement for apprenticeship registration must accompany the invoice. Reimbursement for apprenticeship training occurring prior to approval of the training program will be allowed if the Contractor provides written notification to the Engineer of this occurrence at the time the apprenticeship commences work. This reimbursement will be made even though the Contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the Contractor from receiving other reimbursement. Reimbursement for offsite training indicated above may also be made to the Contractor where the Contractor does one or more of the following and the trainees are concurrently employed on a Federal aid project: (a) contributes to the cost of the training, (b) provides the instruction to the trainee or (c) pays the trainee's wage during the offsite training period.

(6) Compliance: No payment will be made to the Contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyman is caused by the Contractor and evidences a lack of good faith on the part of the Contractor in meeting the minimum requirements of this training provision. It is normally expected that a trainee will begin his training on the project as soon as feasible after start of work utilizing the skill involved and remain on the project as long as training opportunities exist in his work classification or until he has completed his training program. It is not required that all trainees be employed for the entire length of the contract. A Contractor will have fulfilled his responsibilities under this training provision if the Contractor has provided acceptable training to the minimum number of trainees specified and the total training hours exceed the number of hours set forth in the Bid Form. The number trained shall be determined on the basis of the total number enrolled on the contract for a significant period. (A significant period shall mean a period of not less than 200 hours per nonapprenticeship trainee and 20 hours for an apprentice trainee.)

(7) Training Program Revisions: A revised training program shall be submitted to the Engineer and HRD for approval whenever the current approved training program, in the opinion of the Engineer, appears to be falling short of the required minimum level of training to be provided (i.e., minimum number of trainees, training hours per trainee, or less than the number of training hours set forth in the Contractor's current approved Training Program or the number of training hours set forth in the Bid Form, whichever is greater); or the Contractor wishes to change the "on-the-job" training standards. No payments will be made to the Contractor on any estimate until a revised Training Program is approved by the Engineer and HRD, and when applicable, the Washington State Department of Transportation and the Federal Highway Administration. Such revised Training Program shall provide the means for achieving the minimum requirements set forth in this training provision.

(8) Wage Progressions: Trainees shall be paid at least the applicable ratio or wage progressions shown in the apprenticeship standards published by the Washington State Department of Labor and Industries. In the event that no training program has been established by the Department of Labor and Industries, the trainee shall be paid in accordance with the provisions of RCW 39.12.021 which reads as follows:

"Apprentice workmen employed upon public works project for whom an apprenticeship agreement has been registered and approved by the State Apprenticeship Council pursuant to Chapter 49.04 RCW, must be paid at least the prevailing hourly rate for an apprentice of that trade. Any workman for whom an apprenticeship agreement has not been registered and approved by the State Apprenticeship Council shall be considered to be a fully qualified journeyman and, therefore, shall be paid at the prevailing hourly rate for journeyman."

1-07.11(7)E OTHER REQUIREMENTS

In addition to the requirements already stated the Contractor shall ensure the following:

(1) Monitoring: The Contractor shall furnish the trainee a copy of the program the trainee will follow in providing the training. The Contractor shall provide each trainee with a certification showing the type and length of training satisfactorily completed. Copies shall also be provided the Engineer.

(2) Maintenance of Records: The Contractor shall provide for the maintenance of records and furnish to the Engineer periodic reports documenting the Trainee's performance under this Training Provision.

(3) Assistance: The Contractor shall advise all employees and applicants for employment of available training programs and entrance requirements for each.

(4) Promotions: The Contractor shall periodically review the training and promotion potential of minority group and women employees and shall encourage eligible employees to apply for such training and promotion.

1-07.11(7)F LIQUIDATED DAMAGES

The failure of the Contractor to provide the minimum required training shall be considered a material breach of Contract for which remedies may include, but not be limited to, the assessment of liquidated damages and/or termination of the Contract.

Because it is impossible or extremely difficult to ascertain and determine the actual value of damages suffered by the public, the City, the State, and the Federal Government as a result of a Contractor's noncompliance with these training provisions the Contractor agrees to pay liquidated damages, and authorizes and directs the Owner to deduct from any money due or to become due the Contractor, an amount equal to the average minimum prevailing base wage rate (i.e., excluding fringe benefits) for trainees or apprentices in all the occupational classifications set forth in the Contractor's training programs multiplied times each hour of training the Contractor fails to provide according to the Training Provisions outlined in the Contractor's approved training program, or the number of hours below the minimum required by the contract, whichever is greater. If there is a conflict between a Federal and State prevailing wage rate the higher of the two shall be used in the liquidated damage calculations.

The Contractor further agrees that such deductions shall not in any way release the Contractor from other contract obligations and liabilities in respect to the performance of the Work.

The Contractor agrees the method of calculating liquidated damages as set forth herein is reasonable and that the amount indicated is a damage and not a penalty.

The City and State of Washington may lose federal funding for the Work or other Work if the specified minimum training is not provided. Therefore, in addition to the liquidated damages assessment and where the Contractor has acted in bad faith, the Owner may disqualify the Contractor from eligibility for providing goods or services as a Contractor or Subcontractor to the City for a period not to exceed 2 years.

1-07.11(8) UNIONS

If the Contractor relies in whole or in part upon unions as a source of employees, then the Contractor's best efforts shall be used to obtain the union's cooperation to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the Contractor either directly or through a contractor's association acting as agent shall include the following procedures:

(1) Joint Training Programs: The Contractor's best efforts shall be used to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority group members and women for membership in the unions and increasing the skills of minority group employees and women so that they may qualify for higher paying employment.

(2) EEO Clause: The Contractor's best efforts shall be used to incorporate an equal employment opportunity clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to race, color, religion, sex, or national origin.

(3) Referral Practices and Policies: The Contractor shall obtain information as to the referral practices and policies of the labor union, except to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the Contractor. The Contractor shall certify to the Engineer and shall set forth what efforts have been made to obtain such information.

(4) Non-Cooperation: In the event the union is unable to provide the Contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the Contractor shall, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, or national origin, making full efforts to obtain qualified and/or qualifiable minority group persons and women. In the event the union referral practice prevents the Contractor from meeting the obligations pursuant to Executive Order 11246, and 23 CFR Part 230 as amended, and the Contract Documents, the Contractor shall immediately notify the Owner.

1-07.11(9) VACANT

1-07.11(10) RECORDS AND REPORTS

1-07.11(10)A GENERAL

The Contractor shall keep such records as are necessary to determine compliance with the Contractor's equal employment opportunity obligations. The records kept by the Contractor shall indicate:

(1) Work Force Data: The number of minority and non-minority group members and women employed in each work classification on the project.

(2) Good Faith Efforts - Unions: The progress and efforts being made in cooperation with unions to increase employment opportunities for minorities and women (applicable only to contractors who rely in whole or in part on unions as a source of their work force).

(3) Good Faith Efforts - Recruitment: The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and women employees.

(4) Subcontracting: The progress and efforts being made in securing the services of minority group and women subcontractors and subcontractors with meaningful minority and women representation among their employees.

1-07.11(10)B WORK FORCE REPORTS

The Contractor shall submit to the Human Rights Department at the time of the preconstruction conference a completed Work Force Report form.

The Work Force Report form is a projection and commitment of minorities and women to be used on the Contractor's work force during the term of the Contract and a profile of the Contractor's permanent work force. The name and title of the person with the Contractor's firm who has the authority and responsibility for assuring compliance and reporting progress on affirmative action requirements must be indicated on the Work Force Report form.

1-07.11(10)C EEO REPORTS

The Contractor shall submit Equal Employment Opportunity) (EEO) reports required by the Human Rights Department which will be used to document the Contractor's compliance with the EEO provisions of this Contract. These reports shall be submitted on a bi-monthly basis to the Human Rights Department by the Contractor and each subcontractor whenever that subcontractor is working on the project. The Contractor's first submittals are due two weeks after the Contract start date specified in the Notice to Proceed, and two-week intervals thereafter, until completion of the work. Subcontractor submittals are due two weeks after commencement of the Work and every two weeks thereafter.

A Contractor having more than one contract or project with the City shall not combine the reporting information of the separate contract or project. Each contract or project shall be reported separately. The shifting of minorities and women to the work force of various separate projects in an attempt to show compliance within an affirmative action plan will not be acceptable.

To meet the records and reporting requirements, the Contractor shall specifically:

(1) Maintain a current file of the names, addresses, and telephone numbers of all job applicants specifying the race and gender of each job applicant, and the action taken with respect to such job applicant.

(2) Maintain and keep a written record of the time and place of notices regarding affirmative action, persons notified, and the specific subject of the notice.

(3) Maintain records in an easily retrievable and understandable format that will document any and all openings and opportunities for advancement that occur; the Contractor's efforts to train, recruit, and promote minorities and women; and the results of those affirmative action efforts.

The Contractor shall submit such additional forms and documentation as may be included in the Contract Documents on the forms and at the times set forth therein.

1-07.11(10)D REQUIRED RECORDS AND RETENTION

Records shall be retained for a period of three years following completion of the Work and shall be available at reasonable times and places for inspection by authorized representatives of the Owner, and when applicable, the State Department of Transportation and the Federal agency providing funds for the Work.

1-07.11(11) COMPLIANCE MONITORING

The Seattle Human Rights Department will monitor the Contractor's and each subcontractor's affirmative action program, utilizing the EEO documentation submitted by the Contractor for the Contractor and each subcontractor, to determine the affirmative action efforts made by the Contractor and each subcontractor. The Contractor shall cooperate fully with the Human Rights Department and shall be responsible for each subcontractor's compliance. If HRD is not satisfied that the documentation submitted by the Contractor complies with the requirements herein, an attempt will be made by HRD to reach a satisfactory solution of the problem with the Contractor. Should discussions between the HRD and the Contractor result in an unsatisfactory conclusion, as determined by the HRD, then HRD will find that the Contractor has not made a good faith effort and is in noncompliance with the Contractor's sworn statement to ensure equality of opportunity in employment during the term of the contract.

Coincident with or before a report from the HRD asserting unsatisfactory performance is sent to the Owner, HRD will notify the Contractor in writing of such report and of the Contractor's right to be heard by the Owner. The Owner will give the Contractor an opportunity to be heard after 10 days notice. If the unsatisfactory performance is by a subcontractor, the Contractor will be given an opportunity to remedy the subcontractor's noncompliance before the report is sent to the Owner.

If after said hearing, the Owner concurs with the report submitted by HRD that (1) the Contractor has failed to comply with the promises and representations made in the sworn statement and other required documentation or (2) has failed to live up to or ensure compliance with the employment goals established in the Contract pursuant to Section 20.44.100 of the Seattle Municipal Code, the Owner will find the Contractor in noncompliance. Thereafter, the Owner will not enter into a contract with the noncomplying Contractor until the Owner is reasonably assured of future satisfactory compliance. This action will be in addition to such other remedies which may be available to the Owner under the provisions of the Contract.

1-07.12 WOMEN AND MINORITY BUSINESS ENTERPRISE REQUIREMENTS

1-07.12(1) GENERAL

As required by RCW 35.22.650 and in addition to SMC 20.46 and other provisions of these specifications, the Contractor and all subcontractors shall comply with the following clause:

> "Contractor agrees that he shall actively solicit the employment of minority group members. Contractor further agrees that he shall actively solicit bids for the subcontracting of goods or services from qualified minority businesses. Contractor shall furnish evidence of his compliance with these requirements of minority employment and solicitation. Contractor further agrees to consider the grant of subcontracts to said minority Bidders on the basis of substantially equal proposals in the light most favorable to said minority businesses. The Contractor shall be required to submit evidence of compliance with this section as part of the bid."
>
> "As used in this clause, the term 'minority business' means a business at least 51% of which is owned by minority group members. Minority group members include but are not limited to Blacks, Women, Native Americans, Orientals, Eskimos, Aleuts and Spanish Americans."

The Contractor shall comply with the requirements set forth in SMC 20.46, SHRR Chapter 103, and the Contract Documents regarding utilization of WBE and MBEs. Failure to meet the WBE and MBE utilization requirements will be considered a material breach of contract. HRD and the Engineer will monitor compliance with the WBE and MBE requirements throughout the life of the contract. The Contractor shall submit such reports and information as the HRD may deem necessary to determine compliance. Expenditures paid to WBEs, MBEs and Combination WMBEs will be evaluated to determine compliance with the Contractor's original WBE and MBE utilization commitment.

1-07.12(2) CERTIFICATION OF WBE AND MBE

Businesses used to meet the WBE and MBE requirements shall be certified by the Washington State Office of Minority and Women Business Enterprises (OMWBE) at the time of bid opening.

Utilization of a decertified business will not count towards the WBE and MBE utilization requirements if no appeal has been made or 14 days have passed following completion of the appeal process pursuant to WAC 326-20. If the Contractor is utilizing a firm which becomes decertified, the Contractor may count utilization of the decertified firm until the first practical opportunity to begin using another certified firm. The decision by the Director of Human Rights Department as to when the first practical opportunity to begin using another firm may occur will be final.

1-07.12(3) SUBSTITUTION OF WBEs, MBEs, OR COMBINATION WMBEs

(1) The Contractor may substitute a WBE, a MBE, or Combination WMBEs designated to be utilized in the Bid Form if the Contractor shall continue to meet or exceed the total utilization commitment for WBEs and MBEs by utilizing other certified WBEs, MBEs, or Combination WMBEs.

(2) Prior to substituting any WBE, MBE, or Combination WMBE the Contractor shall notify the Engineer, Owner and HRD in writing and state the name of the WBE, MBE, or Combination WMBE to be replaced, the name of the business to be substituted and the work the newly designated business will perform. HRD will review all proposed substitutions prior to performance and will notify the Engineer, Owner and the Contractor whether the WBE and MBE utilization requirements will be met if the substitution occurs.

1-07.12(4) WMBE PARTICIPATION IN CHANGES

Whenever an authorized individual change (as specified in Section 1-04.4) increases the monetary value of the Contract by ten percent or more of the Awarded Contract Price, the mandated set-aside percentages for participation by WBEs, MBEs or Combination WMBEs stipulated in the Bid Form shall apply to the Revised Contract Price unless waived pursuant to SMC 20.46.080B.6.

For authorized individual changes of ten percent or less of the Awarded Contract Price, the mandated set aside percentages shall apply only to the Awarded Contract Price.

1-07.12(5) WMBE REPORTING REQUIREMENTS

Within 30 days after completion of their performance, the Contractor shall require all WBE, MBE, and Combination WMBE subcontractors and any second-tier subcontractors of all WBE, MBE, and Combination WMBE subcontractors, whether or not the second-tier subcontractors are WBEs, MBEs, or Combination WMBEs, to submit Declaration of Payment Received Reports to HRD stating the work actually performed on the Contract and a record of the total dollar amount received by Bid Item. Additional documents may be requested as deemed necessary by HRD to determine compliance with the WMBE utilization requirements. HRD will recommend that the Owner not accept the Work as complete if the verified reports are not received. When WBE, MBE and Combination WMBE subcontractors and any of their second-tier subcontractors are employed on more than one project with the same Contractor, the records kept by the Contractor shall delineate the work performed and total dollar amount received for each separate project.

1-07.12(6) SANCTIONS FOR NONCOMPLIANCE

Failure to comply with SMC 20.46 may result in the imposition of one or more of the following sanctions:

(1) Refusal to award a contract;
(2) Suspension of a contract;
(3) Withholding of funds;
(4) Recision of a contract based upon a material breach of the WMBE contract provisions; and

(5) Disqualification of a bidder, contractor, subcontractors or other business from eligibility for providing goods and services to the City for a period not to exceed two years. No contract shall be awarded to any person or business which is disqualified from doing business with the City pursuant to SMC 20.46 or similarly disqualified from doing business with another governmental agency based upon a failure to comply with WMBE requirements substantially the same as SMC 20.46.

1-07.13 CONTRACTOR'S RESPONSIBILITY FOR WORK AND DAMAGE

Except as provided for otherwise hereinafter, the Work, including Change Order Work, shall be the sole risk of the Contractor until the Acceptance Date. Damage to, or destruction of, either permanent or temporary work, utilities, materials, or equipment and plant shall be corrected or replaced by the Contractor, at the Contractor's expense, regardless of the cause of damage.

Exceptions to the above shall be limited exclusively to the following:

(1) A part of the permanent Work performed by the Contractor which is damaged by earthquake or flood of other act of God, or by slides occurring on finished slopes before final acceptance of the Work; provided, however, that this exception shall not apply should damages be by reason of the Contractor's failure to comply with the Contractor's contractual responsibilities or to perform sound engineering and construction practices in the conduct of the Work, or to take reasonable precautions under the circumstances.

(2) Third party damage or vandalism occuring after the Actual Completion Date.

Damage qualifying under the exceptions listed above shall be corrected promptly when ordered by the Engineer, and compensation therefor shall be made at the unit Bid Item prices, if applicable, and as extra work if not. Where public safety is affected and an emergency exists, the Engineer may elect to accomplish repair by means of Owner provided forces. Nothing contained in this section shall be construed as relieving the Contractor of responsibility for, or damage resulting from the Contractor's own operations or from the Contractor's own negligence, nor shall the Contractor be relieved from full responsibility for making good any defective or unauthorized work.

The Contractor shall bear sole responsibility for damage to property located off the Project Site caused by erosion, siltation, run-off, or other related causes during the construction of the project and for any pollution of rivers, streams, ground water, or other waters which may occur as a result of construction operations.

1-07.14 INDEMNIFICATION

The Contractor shall defend, indemnify and save harmless the Owner and its officers, employees and agents from every claim, risk, loss, damage, demand, suit, judgment and attorney's fee, and any other kind of expense on account of injury to or death of any and all persons, or on account of property damage of any kind, whether tangible or intangible, or loss of use resulting therefrom arising out of or in any manner connected with the Work performed under this Contract, or caused or occasioned by reason of the presence of the property, or an officer, employee or agent of either the Contractor or a subcontractor upon or in proximity to the property of the Owner, at any time before the Acceptance Date.

If the claim, suit, or action for injuries, death, or damage is caused by or results from the concurrent negligence of (a) the Contractor or its officer, agent, or employee and (b) the Owner or its officer, agent or employee, these indemnity provisions shall be valid and enforceable only to the extent of the Contractor's negligence.

The Contractor shall also indemnify, defend, and save harmless any county, city or district and the officers and employees of said county, city or district connected with the Work within the limits of which county, city or district the Work is being performed hereunder all in the same manner and to the same extent as provided above for the protection of the Owner and the Owner's officers, employees and agents provided that no retention of money due the Contractor will be made by the Owner except as provided in RCW 60.28, pending disposition of suits or claims for damages brought against the county, city or district.

1-07.15 TEMPORARY WATER POLLUTION/EROSION CONTROL

Temporary water pollution/erosion control work shall consist of temporary measures which may be indicated in the Contract Documents, proposed by the Contractor and approved by the Engineer, or ordered by the Engineer during performance of the Work. This temporary work is intended to provide prevention, control, and abatement of water pollution/erosion within the limits of the project, and to minimize damage to the Work, adjacent property, streams, and other bodies of water.

The Contractor shall coordinate temporary water pollution/erosion control work with the permanent drainage and erosion control work that may be specified in the Contract Documents to the extent that effective and continuous water pollution/erosion control is maintained during performance of the Work.

The Contractor is hereby notified that compliance with these requirements may necessitate performance of certain items of work at a different time or in a different manner than has been considered normal construction practices in the past and that such revisions in scheduling of Work may interfere with said normal construction practices.

Therefore, if required by the Contract Documents, the Contractor shall, before starting the Work, submit to the Engineer for approval an effective temporary water pollution/erosion control plan. The plan shall show the scheduling for permanent pollution/erosion control work and for temporary erosion control measures the Contractor proposes to take to prevent water pollution/erosion due to the Work on areas within the limits of the project or on other work areas outside the Project Site, haul roads, and upon adjacent property, streams, and other bodies of water. The Contractor shall not perform clearing, grubbing or earthwork on the project, other than that specifically authorized in writing by the Engineer, until the plan has been approved. The Contractor shall revise and bring the plan up to date whenever the Engineer makes written request for revisions.

The Owner will not be liable to the Contractor for failure to approve all or any portion of an originally submitted or revised water pollution/erosion control plan, nor for any delays to the work due to the Contractor's failure to submit an acceptable plan. The Contractor shall allow the Engineer not less than 5 working days for the review of a submitted or revised plan.

When the Engineer determines that water pollution/erosion is likely to be a problem, clearing and grubbing operations shall be so scheduled and performed that grading operations and permanent erosion control features can follow immediately. If the project conditions do not permit this scheduling, temporary water pollution/erosion control measures shall be taken between successive construction stages.

The area of excavation, borrow, and embankment operations in progress will be limited commensurate with the

Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other permanent erosion control measures current according to the accepted schedule. If the Engineer determines that water pollution and/or erosion could occur due to seasonal limitations, the nature of the material, or the Contractor's progress, temporary water pollution/ erosion control measures shall be taken immediately. The Engineer may require the Contractor's operations to be scheduled so that permanent erosion control features will be installed concurrently with or immediately following grading operations.

Under no conditions shall the amount of surface area of erodable earth material exposed at one time by clearing and grubbing, excavation, borrow or fill within the right of way exceed 18,000 square feet without prior approval by the Engineer.

Permanent erosion control work ordered by the Engineer and not covered in the Bid will be considered extra work and paid for as such. Only erosion control included in the Bid Form or designated by the Engineer and ordered as extra work will be considered permanent control measures.

Temporary erosion control and water pollution control shall be the Contractor's responsibility. Costs for temporary erosion and water pollution control work will be considered incidental to the Work and such costs shall be included in the lump sum Bid or the unit prices for the various items of Work listed in the Bid Form which comprise the Contract.

1-07.16 PROTECTION AND RESTORATION OF PROPERTY

1-07.16(1) PRIVATE AND PUBLIC PROPERTY

The Contractor shall protect from damage or destruction private and public property on or in the vicinity of the Work that is not scheduled for repair, replacement or removal and shall ensure that interference with the use of such property is minimized.

Property includes land; improvements lawfully occupying the right-of-way; trees, shrubbery and landscaping; survey markers and monuments; buildings and structures; conduits and pipes; fences; highway facilities including signs, guardrails, pavements, curbs, driveways, sidewalks, traffic buttons, paint striping and other channelization; and other property of all descriptions whether shown on the Drawings or not.

On the Contractor's own volition or upon Written Notice from the Engineer the Contractor shall, at no expense to the Owner, provide and install safeguards acceptable to the Engineer to protect public and private property. If public or private property is damaged or destroyed or its use interferred with by the Contractor, the Contractor's agents or the Contractor's employees, such interference shall be terminated and damaged or destroyed property repaired and restored immediately to its former condition by the Contractor at the Contractor's expense. Should the Contractor refuse or not respond promptly to a written request to restore damaged or destroyed property to its original condition, the Engineer may have such property restored by other means at the Contractor's expense.

1-07.16(2) TREES, SHRUB, AND PLANT MATERIAL RESTORATION

Trees, shrubbery, and flower beds designated on the Drawings shall be left in place and protected from damage or injury. Where trees exist in planting areas and are not to be removed, it shall be the Contractor's responsibility to trim low limbs which will interfere with the normal operation of the Contractor's equipment. The trimming shall be performed in a professional manner by competent personnel prior to equipment operations and in a manner acceptable to the Engineer.

Trees or other plant material, not ordered or scheduled to be removed, that are destroyed or damaged to the extent that continued life is questionable, or if disfigured for any reason related to the Contractor's operation, shall be removed and replaced by the Contractor. Restoration shall be of the same species, of the same size where possible, and shall be from approved nursery stock. In addition to the approved restoration, the Contractor will be assessed damages for the difference in the dollar value of the damaged tree, shrub or other plant material as determined by the City Arborist from the "Guide for Establishing Values of Trees and Other Plants," prepared by the Council of Tree and Landscape Appraisers, current edition, and the dollar value of the tree, shrub, or other plant material replacing the destroyed or damaged tree, shrub, or plant material. Damages assessed will be deducted from monies due or that may become due to the Contractor. The planting shall be done in accordance with the requirements of the Contract Documents during the first fall or spring planting period whichever comes first.

1-07.16(3) FENCES, MAILBOXES, AND MISCELLANEOUS ITEMS

The Contractor shall install and maintain temporary fencing when working through easements or by private property. The Contractor shall be liable for all damages if this requirement is not complied with.

The Contractor shall follow all requirements of the U.S. Post Office Department for maintenance of postal service. When the Work necessitates removing or otherwise disturbing existing mailboxes or newspaper boxes within the limits of the project, the Contractor shall temporarily install the boxes in locations that will not impair their usefulness. As soon as possible, the boxes shall be reinstalled at their original location or at other locations ordered by the Engineer. New supports or boxes will not be required unless the original boxes or posts were damaged by the Contractor. Replacement or repairs shall be at the Contractor's expense. Mailbox height shall be in accordance with U.S. Post Office Department requirements.

When trenching is required within a planting strip the Contractor shall protect the existing curb, gutter and sidewalk from damage utilizing timber pads if necessary. The Contractor shall demonstrate to the Engineer the method or procedure the Contractor intends to follow in order to protect existing improvements adequately before proceeding with trenching in the planting strip.

Where sprinkler systems are encountered in the planting strip the Contractor shall carefully remove the existing sprinkler system for reinstallation by the Contractor after the work is complete.

When due to the Contractor's operations plastic traffic buttons, lane markers or pavement markings are damaged, destroyed or obliterated outside the neat lines of a trench or area of pavement restoration, the Contractor shall restore them in kind at no expense to the Owner.

1-07.16(4) PAYMENT

All costs for the protection and repair or restoration of damage or destroyed property specified in this section will be considered incidental to the Work and such costs shall be included in the lump sum Bid or the unit prices for the various items of work listed in the Bid Form.

1-07.17 UTILITIES AND SIMILAR FACILITIES

1-07.17(1) GENERAL

The Contractor shall protect from damage private and public utilities encountered during the work. Utilities shall include, but are not limited to, sewer and storm drain systems;

water distribution systems; electrical distribution systems; natural gas distribution systems; telephone, telegraph, and CATV systems; fire alarm systems; petroleum pipe lines; steam distribution systems; traffic control systems; powerlines and appurtenances; METRO trolley lines and feeders; railroad tracks and appurtenances; and similar facilities and systems.

Public and private utilities, or their contractors, will furnish all work necessary to adjust, relocate, repair or construct their facilities unless otherwise provided for in the Contract Documents.

The Contractor shall, before an excavation begins, call the Utilities Underground Location Center 1-800-424-5555.

Where it is necessary to remove or relocate private utilities in order to accommodate the Work, the removal or relocation will normally be accomplished in advance of construction. Under some circumstances, however, this removal or relocation may have to be performed concurrent with the Work. In this case, the Contractor shall coordinate the Contract Work with that of the utilities so as to cause the least possible interference with both kinds of work. Where a private utility should have been removed or relocated prior to the Contractor beginning the Work at the point affected, and such work by the utility was not accomplished, the Contractor shall note the presence of the facility and immediately notify the Engineer in writing.

The right is reserved to the Engineer and the owners of utilities, or their authorized agents, to enter upon the right-of-way for the purpose of making changes, connections, or repairs to their facilities. The Contractor shall cooperate with forces engaged in this work and shall avoid any unnecessary delay or hindrance to work being performed by other forces. It shall be the Contractor's responsibility to make whatever notifications and applications as may be necessary in coordinating utility and Contractor work.

Should the Contractor desire to have any adjustments in line or grade made on any utility, or other improvement, for the Contractor's convenience in order to facilitate the Work, and rearrangement is in addition to or different from the rearrangements indicated in the Contract Document, the Contractor shall make whatever notifications and applications as are necessary with the owners of the utility for such rearrangement and bear all expenses in connection to that work.

Locations and dimensions shown in the Drawings for existing facilities are in accordance with available information obtained without uncovering, measuring or other verification.

Attention is directed to the possible existence of underground facilities which are not shown in the Contract Documents. When the relocation of these facilities are necessary to accommodate the Work, the Engineer will provide for the relocations of these facilities by other forces, or the relocations shall be performed by the Contractor as extra work pursuant to a Change Order.

It is anticipated that the Contractor may encounter private water service utilities (water service lines running between meters and private residences) during work operations. Records of these utilities are not maintained by the City and therefore do not appear on the Drawings and will not be field located by the Seattle Water Department. The locations of these private utilities can usually be ascertained by relative meter location, residence location, or through discussion with various private property owners. It shall be the Contractor's responsibility to locate and protect these private water services from damage.

If it is necessary to provide temporary water supply connections due to conflict with existing private water service pipes during the course of construction, it shall be the responsibility of the Contractor to do so.

In all cases, private water service lines damaged by the Contractor shall be repaired by the Contractor at the Contractor's expense. The Contractor shall notify the Engineer immediately of any such damage and shall begin repairs immediately and work continuously until water service is restored. Repair of damaged private water service lines shall be inspected by the Seattle Water Department or applicable water utility prior to backfilling.

The Contractor is alerted to the existence of RCW 19.122, an act relating to underground utilities and prescribing penalties. Any cost or scheduling impact incurred by the Contractor by reason of Contractor's required compliance with these statutory provisions shall be borne by the Contractor.

No excavation shall begin until all known facilities in the vicinity of the excavation area have been located and marked.

Except as otherwise provided herein, all costs incurred by the Contractor in complying with requirements of this Section shall be included in the lump sum Bid or the unit prices for the various items of Work listed in the Bid Form.

1-07.17(2) CLEARANCES FROM WATERMAIN

1-07.17(2)A SEWERS

Where possible, sewers shall be laid at a lower invert elevation than watermains.

Watermains and sewers shall be spaced apart horizontally a minimum of 10 feet, measured center to center, except the spacing may be reduced to the following "nearest point" measurements:

(1) 5 feet horizontal when the watermain is a ductile iron watermain.
(2) Less than 5 feet when the watermain is ductile iron, when
  (a) the sewer is constructed of materials and with joints that are equivalent to watermain standards; and
  (b) the bottom of the watermain is at least 18 inches above the top of the sewer.

Watermains crossing over sewers shall be constructed of ductile iron and shall be spaced to provide a minimum separation of 18 inches between the bottom of the watermain and the top of the sewer. Watermains passing under sewers shall in addition to the requirements above be protected by providing:

(1) A minimum vertical spacing of 18 inches between the bottom of the sewer and the top of the watermain;
(2) Adequate support for the sewer to prevent excessive deflection of joints and settling on and breaking the watermain; and
(3) The point of crossing centered between two successive joints of the watermain pipe.

When the watermain is existing and new side sewers are being installed or reconnected the following requirements pursuant to Seattle Municipal Code Chapter 21.16 shall apply:

(1) Ductile iron pipe shall be used for all side sewers over watermains for a distance of at least 5 feet from the center of the watermain. Side sewers laid below watermains shall be laid at least 6 inches below and 12 inches horizontal, from all watermains and water service lines as measured from the "nearest points," unless cast iron pipe is used for the side sewer.

Exceptions to the above requirements must be approved by the Seattle Water Department, Water Quality Control Division.

1-07.17(2)B GAS MAINS AND OTHER UTILITIES

A minimum of 1 foot vertical and 6 inch horizontal clearance shall be provided between existing gas mains or gas service lines, and new ductile iron water lines. If relocation of either utility is not practical, a protective wrap shall be provided for the entire distance where clearance is less than required. Wrapping material shall consist of either a split PVC pipe or PVC wrapping of at least 0.04 inch thickness, and shall be applied to either one of the pipes.

A clearance of 6 inches or more is desired between watermains and all other utilities except gas mains, gas service lines, and sewers. If the separation is less than 6 inches, a separation of at least 2 inches shall be maintained and a sheet of 2-inch thick polyethylene plastic foam material shall be placed in the separation between the watermain and the other utility (except gas lines and sewer lines).

1-07.18 PUBLIC LIABILITY AND PROPERTY DAMAGE INSURANCE

1-07.18(1) GENERAL

The Contractor shall obtain and maintain in full force and effect during the term of the contract, public liability and property damage insurance.

When the Contractor delivers the executed Contract for the Work to the Owner it shall be accompanied by a Certificate of Insurance (or a Certificate and a Binder) for a primary policy of Comprehensive General Liability insurance meeting the requirements set forth hereinafter. This Certificate of Insurance shall be subject to approval by the Owner as to company, terms, and coverages. Failure of the Contractor to fully comply during the term of the Contract with these requirements regarding insurance will be considered a material breach of contract and shall be cause for immediate termination of the Contract at the option of the Owner.

The policy of insurance shall specifically name "The City of Seattle" and any other entity specifically required by the Project Manual as an additional insured. The Owner shall be given 20 days prior written notice of any cancellation, reduction or modification of the insurance.

The Contractor shall not begin work under the Contract until the required insurance has been obtained and approved by the Owner. Insurance shall provide coverage to the Contractor, all subcontractors, and the Owner. The coverage shall protect against claims for personal injuries, including accidental death, as well as claims for property damages which may arise from any act or omission of the Contractor or the subcontractor, or by anyone directly or indirectly employed by either of them.

Upon request, the Contractor shall forward to the Owner's Risk Manager the original policy, or endorsement obtained, to a Contractor's policy currently in force.

1-07.18(2) COVERAGES

The insurance shall provide the minimum coverages set forth below:

1-07.18(2)A STANDARD

(a) Extended Bodily Injury
(b) Employees as Additional Insured
(c) Premises/Operations Liability (M&C)
(d) Owners and Contractors Protective Liability
(e) Products and Completed Operations Liability (through guarantee period)
(f) Blanket Contractual Liability
(g) Broad Form Property Damage Liability
(h) Personal Injury, including coverages A, B, C, with no employee exclusion
(i) Stop Gap or Employers Contingent Liability
(j) Automobile Liability, including coverage for owned, nonowned, leased or hired vehicles.
(k) Explosion, Collapse, Underground Damage (X.C.U.) as applicable.

1-07.18(2)B SPECIAL

If the contract requires working over water, the following additional coverages are required:

(a) Watercraft, owned and non-owned
(b) U.S. Harborworkers'/Longshoremen and Jones Act

Other additional coverages that may be required will be listed in the Project Manual.

When the use of explosives is necessary for the prosecution of the Work, the Contractor's insurance shall contain a special clause permitting blasting.

1-07.18(3) LIMITS

(a) All coverages combined single limit:

$1,000,000 per occurrence, no deductible;

Providing coverage in these stated amounts shall not be construed to relieve the Contractor from liability in excess of such limits.

1-07.18(4) EVIDENCE OF INSURANCE

The Contractor shall provide evidence of insurance by one of the following methods:

(1) A Certificate of Insurance may be submitted which conforms to the following requirements:
  (a) Names The City of Seattle as an additional insured;
  (b) Contains the appropriate amount and types of coverages which are specified by the Contract;
  (c) Does not contain the following or similar wording: "This Certificate is issued as a matter of information only and confers no rights upon the Certificate holder";
  (d) Provides for cancellation notice to The City of Seattle of at least 20 days;
  (e) Does not contain the following or similar wording regarding cancellation notification to the City: "Failure to mail such notice shall impose no obligation or liability of any kind upon the company".

(2) A completed Acord form #25 (or equivalent) may be submitted which conforms to the following requirements:
  (a) The wording at the top of the form, "This Certificate is issued as a matter of information only and confers no rights upon the Certificate holder," must be deleted in its entirety;
  (b) The wording at the bottom of the Acord form, "Should any of the above described policies be cancelled before the expiration date thereof, the issuing company will endeavor to mail _____ days written notice to the below named Certificate holder, but failure to mail such notice shall impose no obligation or liability of any kind upon the company", shall be changed to read "Should any of the above described policies be cancelled or reduced as to coverage before the expiration date thereof, the issuing company will mail 20 days written notice to the Certificate holder, The City of Seattle, the named additional insured, by certified mail";
  (c) The City of Seattle is named as an additional insured;
  (d) The appropriate amount and types of coverages specified in the Contract are contained therein.

(3) A completed Acord form #25 may be submitted without the changes described in (2) (a) above if the Acord form is accompanied by a completed Endorsement naming The City of Seattle as an additional insured and containing the insured's name and policy number, and signed by a duly authorized agent/broker. The changes described in (2) (b) above must be made on the Certificate of Insurance.

(4) A completed Acord form #25 (or equivalent) may be submitted without the changes described in (2) (a) above if it is accompanied by an Insurance Binder (Acord #75, or equivalent) indicating that the Endorsement naming The City of Seattle as an additional insured is bound with the Certificate of Insurance (Acord #25). The Contractor must submit the Endorsement prior to the expiration of the Insurance Binder. Failure to replace a Binder which has expired may result in a material breach of the Contract and the City, at its option, may stop all work.

The changes described in (2) (b) above must be made on the Certificate of Insurance.

(5) A certified copy of the insurance policy may be submitted which shall name The City of Seattle as an Additional Insured.

1-07.19 GRATUITIES

The Contractor shall not extend any loan, gratuity, or gift of money in any form whatsoever to any employee or officer of the Owner; nor shall the Contractor rent or purchase any equipment or materials from any employee or officer of the Owner.

1-07.20 PATENTED DEVICES, MATERIALS, AND PROCESSES

The Contractor shall assume all costs arising from the use of patented devices, materials, or processes used on or incorporated in the Work, and agrees to indemnify, defend, and save harmless the Owner, and its duly authorized agents and employees from all actions of any nature for, or on account of the use of any patented devices, materials, or processes.

1-07.21 VACANT

1-07.22 USE OF EXPLOSIVES

Explosives shall not be used without written authority of the Engineer; and then only under such restrictions as may be required by the proper authorities. Explosives shall be handled, marked, stored and used in strict compliance with WAC 296-52 and such local laws, rules, and regulations as may apply. The stricter provision shall apply. For work within The City of Seattle, the Seattle Fire Code, Article 77, shall also apply and the individual in charge of blasting shall be certified by the Seattle Fire Department. In all cases, the individual in charge of blasting shall have a current Washington State Blaster Users License.

The Contractor shall obtain, comply with, and pay for such permits and costs as may be necessary in conjunction with blasting operations. Copies of the permits shall be furnished to the Engineer. For work within the city limits of Seattle, a permit shall be obtained from the Seattle Fire Department.

The Contractor shall use the utmost care so as not to endanger the life or property, cause slides, or disturb the materials outside the neat lines of the cross section. Blasting in the vicinity of proposed structures shall be completed before construction on such structures is undertaken. Explosives shall not be left in an unprotected manner along or adjacent to any existing public place.

The Contractor shall notify public utilities and railroads having facilities near the site of the work of intention to use explosives and the location, date, time and approximate duration of such blasting. Such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from injury.

1-07.23 TRAFFIC CONTROL

Traffic control shall be performed in accordance with the requirements of the Project Manual and the "Traffic Control Manual for In-Street Work."

1-07.24 RIGHTS OF WAY

Street right of way lines, limits of easements, and limits of construction permits will be indicated on the Drawings. The Contractor's construction activities shall be confined within these limits, unless arrangements for use of private property are made.

Generally, the Owner will have obtained, prior to Bid opening, all rights of way and easements, both permanent and temporary, necessary for carrying out the completion of the Work. Exceptions to this will be noted in the Contract Documents or brought to the Contractor's attention by a duly issued Addendum.

Whenever any of the Work is accomplished on or through property other than public right of way, the Contractor shall meet and fulfill all covenants and stipulations of any easement agreement obtained by the Owner from the owner of the private property. Copies of the easement agreements will be included in the Project Manual or made available to the Contractor as soon as practical after they have been obtained by the Engineer.

Whenever easements or rights of entry have not been acquired prior to advertising, they will be so noted on the Drawings. The Contractor shall not proceed with any portion of the Work in areas where easements or rights of entry have not been acquired until the Engineer certifies to the Contractor that the easement is available or that the right of entry has been received. If the Contractor is delayed due to acts of omission on the part of the Owner in obtaining easements, the Contractor will be entitled to an extension of time. The Contractor agrees that such delay shall not be a breach of contract.

Each property owner shall be given 48 hours notice prior to entry by the Contractor. This includes entry onto easements and private property where private improvements must be adjusted.

The Contractor shall be responsible for providing, without expense or liability to the Owner, any additional land and access thereto that the Contractor may desire for temporary construction facilities, storage of materials, or other Contractor needs. However, before using any private property, whether adjoining the Work or not, the Contractor shall file with the Engineer a written permission of the property owner, and, upon vacating the premises, a written release from the property owner of each property disturbed or otherwise interfered with by reasons of construction pursued under this contract. The statement shall be signed by the private property owner, or proper authority acting for the owner of the property affected, stating that permission has been granted to use the property and all necessary permits have been obtained or, in the case of a release, that the restoration of the property has been satisfactorily accomplished. The statement shall include the parcel number, address, and date of signature. Written releases shall be filed with the Engineer prior to Acceptance.

1-07.25 OPENING OF SECTIONS TO TRAFFIC

The Owner reserves the right to use and occupy any portion of the Work before completion of the entire Contract without incurring any liability to the Contractor except as otherwise provided in this Contract and without constituting acceptance of any of the Work.

If the Owner opens any portion of the Work prior to completion of the entire Work because (1) early opening is specified in the Contract Documents or (2) the Contractor has failed to prosecute the Work continuously and efficiently then any work remaining after that portion of the project is open to traffic shall be performed at unit contract prices for items of work involved. No additional compensation will be made for costs incurred by the Contractor because of inconvenience, additional length of travel to conform to established traffic patterns and planned access features, compliance with statutes governing traffic regulations and limitations of loads, or for additional flagging costs necessary to protect the Work and the traveling public. The Contractor shall take into acount all costs of construction resulting from the contractual requirement that public traffic be able to use, concurrent with construction activities, portions of the Work and shall include such costs in the lump sum Bid or the unit prices for the various items of Work listed in the Bid Form.

1-07.26 PERSONAL LIABILITY OF PUBLIC OFFICERS

Neither the Owner, nor any officer or employee of the Owner, shall be personally liable for any acts or failures to act in connection with the Work, it being understood that in such matters they are acting solely as agents of the Owner.

1-07.27 NO WAIVER OF OWNER'S LEGAL RIGHTS

The Owner shall not be precluded or estopped by any measurement, estimate or certificate made either before or after the completion and acceptance of the Work and payment therefor from showing the true amount and character of the Work performed and materials furnished by the Contractor or from showing that any such measurement, estimate, or certificate is untrue or incorrectly made or that the Work or materials do not conform in fact to the contract. The Owner shall not be precluded or estopped notwithstanding any such measurement, estimate or certificate and payment in accordance therewith from recovery from the Contractor and the Contractor's Sureties such damages as it may sustain by reason of the Contractor's failure to comply with the terms of the Contract. Neither the acceptance by the Owner nor any payment for the whole or any part of the Work nor any extension of time nor any possession taken by the Owner shall operate as a waiver of any portion of the Work or of any power herein reserved or any right to damages herein provided or bar recovery of any money wrongfully or erroneously paid to the Contractor. A waiver of any breach of the Contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor and the Owner recognize that the impact of overcharges to the Owner by the Contractor resulting from anti-trust law violations by the Contractor's suppliers and/or subcontractors adversely affect the Owner rather than the Contractor. Therefore the Contractor agrees to assign to the Owner any and all claims for such overcharges.

1-07.28 NOTIFICATIONS RELATIVE TO CONTRACTOR'S ACTIVITIES

The Engineer will initially notify other public agencies and private utilities with facilities in the street right of way as to the time Bids will be called, and the approximate time of starting the Work. The Engineer will also define what the project consists of and will point out particular problems. The Contractor shall be responsible for making detailed notifications as follows.

Notification procedures regarding work performed in City street areas are outlined in the Traffic Control Manual for In-Street Work and the Project Manual. Notification shall be in such detail as to give the time of commencement and completion of the work, names of streets or locations of alleys to be closed, schedule of operation, routes of detours, etc.

The Contractor shall call the Utilities Underground Location Center for field location of utilities, not less than 2 or more than 10 Business Days before the scheduled date for commencement of excavation which may affect underground utility facilities, unless otherwise mutually agreed to in writing by the Contractor and utility involved. The Utilities Underground Location Center toll- free telephone number is 1-800-424-5555. If a utility is known to or suspected of having underground facilities within the area of proposed excavation, and that utility is not a subscriber to the Underground Utilities Location Center, notice shall be provided individually to the utility.

In addition the Contractor shall make the following notifications when applicable:

(1) Partial or Complete Street Closure:

(a) Within Seattle City Limits: The Contractor shall notify the Seattle Fire Department (386-1400) and Seattle Police Department (684-8762) at least 24 hours in advance of the date of actual closure.

(b) Outside Seattle City Limits: The Contractor shall notify the King County Roads Division (255-2531); King County Fire Marshall (296-6675), and King County Police (344-4080) at least 24 hours in advance of the date of actual closure.

(c) Boundaries of Seattle City Limits: The Contractor shall notify the agencies set forth in both (a) and (b) above.

(2) Water Shut-Offs:

(a) Within Seattle City Limits: The Contractor shall notify the Seattle Fire Department (386-1400) of impending water shut-offs 24 hours in advance of shut-off.

(b) Outside Seattle City Limits: The Contractor shall notify the King County Fire Marshall (296-6675) and the King County Health Department (587-2722) 24 hours in advance of water shut-offs.

(c) On Boundaries of Seattle City Limits: The Contractor shall notify the agencies set forth in (a) and (b) above 24 hours in advance of water shut-offs.

(3) Other Notifications:

For work on roads and highways outside the Seattle City limits, notifications shall be provided in accordance with permit and other requirements of the agency having jurisdiction over those roads and highways. The Contractor shall familiarize him/herself with those requirements prior to starting work.

Water service connections will be scheduled by the Engineer with the Water Department.

SECTION 1-08 PROSECUTION AND PROGRESS

1-08.1 PRELIMINARY MATTERS

The Engineer will furnish the Contractor with up to 10 copies of the Drawings and Project Manuals. Additional documents may be furnished upon request at the cost of reproduction. Prior to undertaking each part of the Work the Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures shown therein and all applicable field measurements. The Contractor shall promptly report in writing to the Engineer any conflict, error or discrepancy which the Contractor may discover.

After the Contract has been executed, but prior to the Contractor beginning the Work, a preconstruction conference will be held between the Contractor, the Engineer and such other interested parties as may be invited. The purpose of the preconstruction conference will be:

(1) To review the initial progress schedule;
(2) To establish a working understanding among the various parties associated or affected by the Work;
(3) To establish and review procedures for progress payment, notifications, approvals, submittals, etc.;
(4) To establish normal working hours for the Work;
(5) To review safety standards and traffic control; and
(6) To discuss such other related items as may be pertinent to the Work.

The Contractor shall prepare and submit at the preconstruction meeting the following:

(1) A breakdown of all lump sum items;
(2) A list of proposed subcontractors;
(3) A preliminary schedule of working drawing submittals;
(4) If applicable a list of material sources for approval; and
(5) A Work Force Report Form.

1-08.1(1) SUBCONTRACTING

The Contractor shall perform work amounting to not less than 40% of the Awarded Contract Price with the Contractor's own organization under the Contractor's immediate supervision except that items designated in the Contract Documents as specialty items may be performed by subcontract. The cost of any specialty items so performed by subcontract may be deducted from the Awarded Contract Price before computing the amount of work required to be performed by the Contractor's own organization. Work performed to meet the requirements for Minority and Women Business Enterprise Utilization will be considered specialty items.

Work shall not be subcontracted, regardless of tier, without written consent of the Engineer. A request to subcontract shall be made on the "Subcontractor Approval Application Form" provided by the Engineer. If requested by the Engineer the Contractor shall provide substantiation that the proposed subcontractors are experienced and equipped to do the Work. Consent to subcontract will not be given unless the Engineer is satisfied with the proposed subcontractor's prior performance, equipment, experience, and ability to perform the Work. Consent to subcontract any portion of the Work shall not relieve the Contractor of responsibility for performance of the Work.

Subcontracting shall create no contract between the Owner and the subcontractor nor shall the subcontractor have any rights against the Owner by reason of its subcontract with the Contractor. The Contractor shall be responsible for all work and materials furnished and no subcontract shall in any case release the Contractor of the Contractor's obligations or liability under the terms of the Contract Documents or the Contractor's bond. A list of all work to be subcontracted and the names of all proposed first tier subcontractors shall be submitted to the Engineer at the Preconstruction Meeting. A Contractor wishing to substitute subcontractors during the progress of the work shall submit the request to the Engineer for approval.

The Contractor shall submit to the Engineer, with any request for first tier subcontractor approval, subcontractor approval forms for each contracting firm that will act as a second or lower tier subcontractor for any tier subcontractor. Such second or lower tier subcontractors, collectively, shall not perform work involving over 25 percent of the total subcontracted amount being handled by the subcontractor involved. Other than the 25 percent limitation, the second or lower tier subcontractor shall be subject to the same requirements as first tier subcontractors. The 25 percent limitation on the Work which may be performed by second or lower tier subcontractors shall not apply to such activities as may be specifically excluded in the Project Manual. Each subcontract shall contain a provision which requires the subcontractor to comply with RCW 39.12 and furnish all certificates, statements, and submittals required by the Contract Documents.

The purchase of sand, gravel, crushed stone, crushed slag, batched concrete aggregates, ready mixed concrete, fabricated structural steel, or any other materials produced and furnished from established recognized commercial plants together with the delivery of these materials to the site of the Work by means of vehicles owned or operated by such plants or by recognized commercial hauling companies shall not be construed as subcontracting under these provisions. Such purchase shall be considered as being purchased from materialmen.

When a portion of the Work which has been subcontracted by the Contractor is not being prosecuted in a manner satisfactory to the Engineer, the subcontractor shall be removed and replaced immediately upon the Engineer's written order, and shall not again be employed on the work unless the Contractor makes protest, and the Contractor's protest is upheld by the Owner.

If the Engineer determines that any subcontractor is performing services in an unsatisfactory manner or is not completing the Work in accordance with the requirements of the Contract Documents or is otherwise undersirable or unacceptable, the Engineer will by written notice so notify the Contractor. The Contractor shall then take immediate steps to terminate such subcontractor. Subletting by subcontractors will be subject to the same regulations.

1-08.1(2) HOURS OF WORK

Except in case of emergency or unless otherwise approved by the Owner the normal hours of work shall be between 6:00 a.m. and 7:00 p.m. on any working day and shall consist of 8 hours exclusive of a lunch period of not more than one hour. The normal hours of work shall be established at the preconstruction conference or prior to the Contractor commencing the Work and shall not be changed or extended without approval of the Engineer.

Permission to work Saturdays, Sundays, holidays or other than the normal hours of work Monday through Friday may be given subject to certain conditions set forth by the Owner or Engineer. These conditions include, but are not limited to, requiring the Engineer or other Owner employees to be present during the Work. Such other Owner employees include, but are not limited to, survey crews; personnel from the Owner's material testing lab; inspectors; and employees from the administering or other departments.

Seattle Municipal Code, Chapter 25.08 specifies maximum permissible sound levels for sound sources located within the City or King County. Permission to work outside normal hours of work may be withdrawn at any time if the Contractor exceeds the specified maximum permissible sound level or if a

complaint is received from the public or adjacent property owners. The Contractor shall have no claim for damages or delay should such permission be withdrawn.

Requests to perform work on Saturdays between 6:00 a.m. and 7:00 p.m. only shall be submitted to the Engineer no later than noon on the working day prior to the Saturday for which the Contractor is requesting permission to work.

Requests to perform work on holidays, Sundays, or before 6:00 a.m. or after 7:00 p.m. on any day requires approval of the Owner. Such request shall be submitted to the Engineer no later than 10 days prior to the day for which the Contractor is requesting permission to work.

1-08.1(3) REIMBURSEMENT FOR OVERTIME WORK OF OWNER EMPLOYEES

When the Contractor elects to work on a Saturday, Sunday or holiday, or longer than an 8-hour period on any working day, such work shall be considered as overtime work. On all such overtime work, the Contractor shall reimburse the Owner for the full costs of straight time with benefits plus overtime for employees of the Owner required to work overtime hours.

The Contractor hereby authorizes the Owner to deduct such costs from any amounts which might then be or thereafter become due or payable by the Owner to the Contractor under or by virtue of the provisions of the Contract.

1-08.2 ASSIGNMENT

The performance of the Work or any part of it shall not be assigned without written consent of the Owner. Consent will not be given to a proposed assignment which would relieve the Contractor or the Contractor's Surety of their responsibilities under the contract.

The Contractor may assign moneys due or to become due under the Contract. This assignment will be recognized by the Owner, if given written notice, to the extent permitted by law. Assignment of monies shall be subject to all setoffs, withholdings, and deductions provided for by law and under the Contract.

1-08.3 PROGRESS SCHEDULE

The Contractor shall submit a progress schedule to the Engineer for approval within 14 days after receipt of the Notice to Proceed.

1-08.4 NOTICE TO PROCEED AND PROSECUTION OF THE WORK

Notice to Proceed will be given after the contract has been executed and the Contract Bond and evidence of insurance have been approved and filed by the Owner. The Contractor shall not commence the Work until the Notice to Proceed has been given by the Engineer. The Contractor shall begin the Work within 10 days of the Notice to Proceed Date. Thereafter, Work shall be prosecuted vigorously, diligently, and without unauthorized interruption. There shall be no voluntary shutdowns or slowing of operations by the Contractor without prior approval of the Engineer. Such approval shall not relieve the Contractor from the contractual obligation to complete the Work within the prescribed Contract Time.

1-08.5 TIME FOR COMPLETION

The Work shall be completed in its entirety within the time specified in the Contract Documents or as extended by the Engineer. The Contract Time will be stated in working days, shall begin on the Notice to Proceed Date, and shall end on the Contract Completion Date.

The Contract Time has been established to allow for periods of normal inclement weather, which from historical records, is to be expected during the Contract Time, and during which periods, work is anticipated to be performed. Each successive working day, beginning with the Notice to Proceed Date and ending with the Actual Completion Date, shall be charged to the Contract Time as it occurs except a day or part of a day which is designated a non-working day or an unusually severe weather day by the Engineer.

The Engineer will furnish the Contractor a weekly report showing the number of working days charged against the Contract Time for the preceding week, the number of working days specified for completion of the Work, the number of working days remaining to complete the Work, and the revised Contract Completion Date. This weekly report will be correlated with the Contractor's current approved progress schedule. The Contractor will be allowed 14 days from the date of each report in which to file a written protest of an alleged discrepancy in the Contract Time as reported. Otherwise, the report will be deemed to have been accepted by the Contractor as correct.

Upon completion of the Work, the Engineer will advise the Contractor and the Owner in writing of the the Actual Completion Date of the Work.

1-08.6 SUSPENSION OF WORK

The Contractor shall immediately suspend the Work or resume suspended Work only when ordered or authorized in writing to do so by the Engineer. The Engineer may suspend all or part of the Work and for such periods of time as the Engineer may deem proper if:

(1) Unusually severe weather or such other conditions beyond the control of the Contractor, the Engineer, or the Owner will in the opinion of the Engineer prevent satisfactory and timely performance of the Work;
(2) The Contractor fails to perform a material requirement of the Contract Documents or written order given to the Contractor by the Engineer.

Suspension of the Work by the Engineer for condition (1) or (2) shall not be grounds for any claim by the Contractor for damages except as provided hereinafter.

The periods of suspension due to condition (1) will be counted as unusually severe weather days unless the Engineer concludes that the Contractor should have performed the suspended Work had the Contractor prosecuted the Work vigorously, diligently, and without unauthorized interruption prior to the suspension in accordance with the Contractor's current approved progress schedule. The unusually severe weather days allowed will be the number of working days or parts thereof the Engineer determines completion of the Work was delayed by the suspension.

The periods of suspension due to condition (2) or for failure of the Contractor to perform the Work timely, vigorously, and diligently will be considered a nonexcusable delay.

1-08.7 MAINTENANCE DURING SUSPENSION

In preparing for or during suspensions of the Work, the Contractor shall do whatever is necessary to prevent damage to or deterioration of the Work. The Contractor's safety and maintenance responsibilities shall remain unchanged except for those assumed by the Owner under the conditions set forth in this section.

If a suspension of work is ordered by the Engineer for an extended period of time because:

(1) unusually severe weather or other unforeseeable conditions beyond the control of the Contractor, Engineer, or Owner will prevent satisfactory and timely performance of the Work and the Engineer concludes that the Contractor should have performed the suspended Work had the Contractor prosecuted the Work vigorously, diligently, and without unauthorized interruption prior to the suspension in accordance with the Contractor's current approved progress schedule when weather or conditions were suitable; or
(2) the Contractor failed to perform a written order given by the Engineer (or other material provision of the Contract Documents).

The Contractor, at no expense to the Owner, shall perform all work necessary to provide a safe, smooth, and unobstructed roadway through the Project Site for use by public traffic during the period of suspension. Provision and maintenance shall be in accordance with the traffic control provisions of the Contract Documents and the "Traffic Control Manual for In-Street Work." If the Contractor fails to do such work, the Owner may have such work accomplished by Owner or other forces and will deduct any costs incurred by the Owner from monies due or to become due the Contractor.

If a suspension of the Work is ordered for condition (1) above and, in the opinion of the Engineer, the Contractor prosecuted the Work vigorously, diligently, and without unauthorized interruption prior to the suspension and provided a temporary road or detour which may be maintained by routine maintenance forces of the Owner during the period of suspension, then the cost of maintaining a smooth and unobstructed road or detour will be borne by the Owner. However, the Owner's responsibility shall be for routine maintenance only and shall be restricted to the following in the specific locations designated by the Engineer:

(a) Maintenance of the traveled roadway and detour surface;
(b) Maintenance of roadway drainage along and under the traveled roadway and detour; and
(c) Maintenance of all necessary barricades, signs, and lights to direct the traffic through the construction area and detour.

The Contractor shall accept a traveled roadway or detour as it has been maintained by the Owner, and no claim shall be made on account of its condition or the manner in which maintenance has been performed by the Owner. Areas which are not open to traffic shall be maintained and safeguarded by the Contractor at the Contractor's expense.

1-08.8 TIME EXTENSIONS AND DELAYS - ENTITLEMENT AND COMPENSTATION

1-08.8(1) GENERAL

The Contract will be extended for a period equivalent to the actual time which the Work is suspended or delayed for an excusable reason. Entitlement, length of time extension, and compensation if applicable will be determined by the Engineer.

If the performance of the Work is suspended or delayed, and the Contractor believes the reason for the suspension or delay is excusable or compensable, the Contractor shall submit to the Engineer a written request for an extension of time. The request shall be submitted within 5 days after the last day of the happening, event, or occurrence which caused the claimed delay. The request shall state the reasons why the extension of time should be granted.

Within 20 days after the last day of the happening, event or occurrence causing the claimed delay, but before the Acceptance Date, whichever comes first, the Contractor shall submit documentation substantiating the claim for an extension of time, together with a revised progress schedule indicating the specific impacts of the claimed delay, and, if applicable, the amount of monetary damages suffered as a result of the claimed delay. The Contractor's approved progress schedule in effect at the start of the claimed delay shall be used to evaluate the extent of the delay and the claimed delay's impact on the Contract Time.

The Contractor shall keep full, complete, and separate records of the costs and additional time of claimed delays. The Engineer shall have access to those records, and such other Contractor or subcontractor records the Engineer may deem necessary for evaluating the claimed delay and compensation. Failure to comply with each of these requirements, including the time period requirements, shall constitute waiver of the right to later make a claim for an extension of time, compensation, or both.

The Contractor's request for an extension of time shall have the consent of Surety named on the Contract Bond when the cumulative requests for extensions of time equals or exceeds 25% of the number of working days set forth in the Contract Documents.

Failure of the Contractor to efficiently utilize all available time after the Notice to Proceed Date will be considered in evaluating requests for extensions of time.

The granting of a time extension or payment of additional compensation will be made by Change Order except for suspensions of the Work ordered or authorized by the Engineer for unusually severe weather or other conditions the Engineer determines will prevent satisfactory or timely performance of the Work.

1-08.8(2) NONEXCUSABLE DELAYS

Nonexcusable delays shall be those delays caused by factors within the Contractor's control and which could have been foreseen or avoided had the Contractor exercised due care, prudence, foresight, or diligence and pursued the Work vigorously and without unauthorized interruption. Nonexcusable delays will not entitle the Contractor to an extension of time and will not be compensable.

Nonexcusable delays include, but are not limited to, delays caused by or resulting from the Contractor's own subcontractors or materialmen; the Contractor's lack of sufficient working capital; the default of the Contractor; Contractor's act or failure to act; and the Contractor's failure to procure materials or workmen or perform the work according to the Contract Documents.

The Contract may be terminated for a nonexcusable delay.

1-08.8(3) EXCUSABLE DELAYS

Excusable delays shall be those delays caused by factors beyond the control and without fault or negligence of the Contractor. Excusable delays will entitle the Contractor to an extension of time if the activities which are subject to the delay are on the critical path of the construction schedule and the Contractor has submitted a request for an extension of time within the prescribed time limits.

Excusable delays may include, but are not limited to: acts of God; acts of the public enemy; acts of a government in sovereign capacity; acts, neglects or defaults of the Owner, the Engineer, or of another Contractor employed by the Owner; for unforeseeable conditions not the fault of the Contractor; fires; floods due to nature; epidemics; quarantine restrictions; unusual transportation delays (freight embargos); strikes or combined actions of labor; unusually severe weather, or other conditions that permit extensions of time under other provisions of the contract Documents. Foreseeability shall modify all factors in determination of entitlement to an excusable delay.

Normal inclement weather which, from historical records, is to be expected and during which periods the Work is anticipated to be performed shall not be considered unusually severe weather. The Contractor shall consider normal inclement weather in the preparation of the construction schedule and if the Contractor elects not to perform the work during periods of normal inclement weather the Contractor will not be entitled to an extension of time for these periods of

nonwork. Unusually severe weather will include, but is not limited to, prolonged periods of snow, freezing temperatures, or above-average rainfall, and other unusual weather disturbances during which periods the Contractor is unable to perform the Work in strict accordance with the requirements of the Contract Documents.

The Contract cannot be terminated for an excusable delay.

1-08.8(3)A COMPENSABLE DELAYS

Compensation will be provided for an increase in cost of performance of the Work (excluding profit) if the performance of all or any part of the Work is suspended or delayed for an unreasonable period of time by an act of the Engineer or the Owner in the administration of the Work and such act is not expressly or implicitly authorized by the Contract Documents, or by failure of the Engineer or Owner to act within a time period specified in the Contract Documents (or if no time is specified, within a reasonable time). However, no adjustment will be made under this section for a suspension or delay if:

(1) the performance would have been suspended or delayed by any other cause including the fault or negligence of the Contractor, or

(2) compensation is provided for or excluded under any other provision of the Contract Documents. (Compensable time extensions may be granted for reasons arising from the "CHANGES" or "CHANGED CONDITIONS (DIFFERING SITE CONDITIONS)" contract provisions. However, time extension granted under the "CHANGES" or "CHANGED CONDITIONS" contract provisions shall not be considered a delay or suspension of the Work as defined in this section.)

If the Contractor believes the performance of the Work will be delayed as a result of an act or failure to act by the Engineer or Owner, the Contractor shall keep full and complete records of the cost and additional time of such suspensions or delays, and shall permit the Engineer to have access to those records and any other records as may be deemed necessary by the Engineer to assist and evaluate in the claim for damages. No adjustment will be allowed for any cost incurred by the Contractor more than 5 days before the date the Engineer was notified by the Contractor, in writing, of the claimed delay.

1-08.8(3)B NONCOMPENSABLE DELAYS

Noncompensable delays shall be delays to the completion of the Work arising from conditions beyond the control and without the fault or negligence of the Contractor, the Engineer, or the Owner. Noncompensable delays include, but are not restricted to: acts of God; acts of the public enemy; fires; floods due to nature; epidemics and quarantine restrictions; unusual transportation delays (freight embargos); strikes or combined actions of labor; unusually severe weather; and delays of subcontractors or suppliers at any tier.

1-08.8(4) CONCURRENT DELAYS

Concurrent delays may entitle the Contractor to an extension of time, compensation, or both. Concurrent delays shall be those delays where performance is delayed due to causes attributable to both the Contractor and the Engineer or Owner. Assessment of liquidated damages and recovery of delay damages shall be based upon the apportionment of the delay and the expenses attributable to each party.

1-08.9 LIQUIDATED DAMAGES

Time is of the essence of the Contract. Delays inconvenience the public and add time needed for administration, engineering, inspection and supervision.

Because it is impractical to calculate the actual cost of delays, liquidated damages have been adopted to provide compensation for damages resulting from failure to complete the Contract on time.

The Contractor shall:

(1) Pay liquidated damages for each working day beyond the Contract deadline date for completion, as set forth in the Form of Agreement; and

(2) Authorize the Owner to deduct these liquidated damages from any money due or coming due to the Contractor.

When the Contract work is completed to the extent that the Owner has full and unrestricted use and benefit of the facilities, both from the operational and safety standpoint, and only minor incidental work, replacement of temporary substitute facilities, or correction or repair remains to complete the total Contract, the Engineer may determine the Contract Work is substantially complete. The Engineer will notify the Contractor in writing of the substantial completion date. For overruns in Contract Time occurring after the date so established, liquidated damages will not apply. After the substantial completion date, liquidated damages shall be assessed on the basis of direct engineering and related costs assignable to the project from the Substantial Completion Date to the Actual Completion Date of all the Contract Work. The Contractor shall complete the remaining work as promptly as possible. Upon request by the Engineer, the Contractor shall furnish a written schedule for completing the Contract.

Liquidated damages will not be assessed for any days for which an extension of time is granted. No deduction or payment of liquidated damages will, in any degree, release the Contractor from further obligations and liabilities to complete the entire Contract.

1-08.10 TERMINATION OF CONTRACT

1-08.10(1) TERMINATION FOR DEFAULT

If the Contractor:

(1) Refuses or fails to supply sufficient properly skilled workers or materials of the proper quality; or

(2) Fails to prosecute the Work continuously to completion with promptness and diligence;

(3) Fails to perform any of the Contractor's obligations pursuant to the Contract Documents; or

(4) Becomes insolvent or is declared bankrupt or commits any acts of bankruptcy or insolvency or makes an assignment for the benefit of the Contractor's creditors; or

the Owner may, by serving written notice to the Contractor and the Contractor's surety,

(1) Transfer the performance of the Work from the Contractor to the Contractor's surety; or

(2) Provide such sufficiency of labor or materials as required and deduct the costs from any money due or coming due to the Contractor pursuant to the Contract Documents; or

(3) Terminate the Contract.

The decision of the Owner to pursue one remedy will not bar the Owner from pursuing other remedies on the same or subsequent breaches.

Upon receipt of a notice that the Work is being transferred to the Surety, the Surety shall enter upon the premises and take possession of all materials, tools, and appliances for the purpose of completing the Work pursuant to the Contract Documents and employ any person or persons satisfactory to the Owner to finish the Work and provide the materials without termination of the Contract. Such employment shall not relieve the Surety of its obligations pursuant to the Contract Documents and the Bond. If there is a transfer to the Surety,

payments on estimates covering the Work subsequent to the transfer shall be made to the extent permitted under law to the Surety or its agent without any right of the Contractor to make any claim.

If the Owner terminates the Contract by any of the means provided above, the Contractor shall not be entitled to receive any further payment on the Work until the Work has been fully performed, at which time, if the unpaid balance of the amount to be paid pursuant to the Contract Documents due the Contractor shall exceed the expenses incurred by the Owner in completing the Work including all increased costs for completing the Work, and all damages sustained, or which may be sustained, by the Owner by reason of such refusal, neglect, failure, or discontinuance of work by the Contractor, the excess shall be paid by the Owner to the Contractor. If the expenses and damages exceed the unpaid balance, the Contractor and the Contractor's Surety shall be jointly and severally liable to the Owner and shall pay the difference to the Owner on demand.

1-08.10(2) TERMINATION FOR PUBLIC CONVENIENCE

The Owner may terminate the Contract in whole, or from time to time in part, whenever:

(1) The Contractor is prevented from proceeding with the Work as a direct result of an Executive Order of the President with respect to the prosecution of war or in the interest of national defense; or an Executive Order of the President or Governor of the State with respect to the preservation of energy resources;

(2) The Contractor is prevented from proceeding with the Work by reason of a preliminary, special, or permanent restraining order of a court of competent jurisdiction where the issuance of such restraining order is primarily caused by acts or omissions of persons or agencies other than the Contractor; or

(3) The Owner determines that such determination is in the best interests of the public.

Whenever the Contract is terminated in accordance with this Section, payment will be made for actual work performed at unit contract prices for completed items of work. An equitable adjustment for partially completed articles of work and disposal of materials will be made as provided in Section 1-09.5.

After receipt of a Notice of Termination of Contract for Public Convenience the Contractor shall submit to the Engineer a termination claim in sufficient detail to enable the Engineer to ascertain the basis and amount of the claim. The claim shall be submitted promptly but in no event later than 60 days from the effective date of termination. The Contractor shall pursue resolution of the claim through the established administrative channels of the Owner. The Contractor agrees to make business and office records available to the extent necessary for the Engineer to verify the Contractor's claim and to determine the amount of entitlement. If the Contractor considers the determination of the Engineer to be unacceptable the Contractor may file written Notice of Protest. The written Notice of Protest shall state in clear detail the basis of the Contractor's objection. The decision of the Owner shall be final.

1-08.10(3) TERMINATION BEFORE COMPLETION

Pursuant to RCW 60.28.010(5), if after a substantial portion of the Work has been completed, an unreasonable delay will occur in the completion of the remaining portion of the Contract for any reason not the result of a breach thereof, the Owner may, if the Contractor agrees, delete from the Contract the remaining work and accept as final the improvement at the stage of completion then attained and make payment in proportion to the amount of the Work accomplished and in such case any amounts retained and accumulated under this section shall be held for a period of thirty days following such acceptance. In the event that the Work shall have been terminated before final completion as provided in this section, the Owner may thereafter enter into a new contract with the same Contractor to perform the remaining Work or improvement for an amount equal to or less than the cost of the remaining Work as was provided for in the original Contract without advertisment or bid.

1-08.10(4) TERMINATION FOR DELAYS DUE TO LITIGATION

Pursuant to RCW 60.28.080, if the delay caused by litigation exceeds six months, the Contractor may then elect to terminate the Contract and to delete the completion of the Contract and receive payment in proportion to the amount of the work completed plus the cost of the delay. Amounts retained and accumulated under RCW 60.28.010 shall be held for a period of thirty days following the election of the Contractor to terminate.

1-08.10(5) RESPONSIBILITY OF THE CONTRACTOR AND SURETY

Termination of the Contract shall not relieve the Contractor of any responsibilities under the Contract for work performed, nor shall termination of the Contract relieve the Surety or Sureties of obligations under the Contract Bond, and Retainage Bond if applicable, for work performed.

SECTION 1-09 MEASUREMENT AND PAYMENT

1-09.1 MEASUREMENT OF QUANTITIES

Items of work completed pursuant to Contract Documents will be measured by the Engineer according to United States standard measure. Measurements will be made as provided in this section unless otherwise provided for by individual measurement paragraphs. The methods of measurement and computations to be used in determination of quantities of material furnished or of work performed under the contract will be those methods generally recognized as conforming to good engineering practice and will be carried to the proper significant figures of fractions of units for each item.

Unless otherwise specified, measurements will be made horizontally or vertically. In determining the area for items bid on a square yard or square foot basis, the measurements will be on the neat line dimensions indicated on the Drawings or as altered in the field by the Engineer. Deductions in area will not be made for individual fixtures having an area of nine square feet or less.

Structures will be measured according to neat lines indicated on the Drawings or as altered in the field by the Engineer to fit field conditions.

Items which are measured by the linear foot, such as pipe, culverts, guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise indicated on the Drawings.

In computing volumes of excavation and embankment, the average end area method will be used. Corrections for curvature will be made where deemed advisable by the Engineer. Computations for determining volumes of excavation and embankment may be based in whole or in part upon ground elevations and related data determined by photogrammetric methods.

The term "gauge," (or "gage") when used in connection with the measurement of plates, means the U.S. Standard Gauge, except that when reference is made to the measurement of galvanized sheets used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing, the term "gauge" (or "gage") or thickness means that specified in AASHTO M 36, M 167, M 196, M 197 or M 219. When the term "gauge" (or "gage") refers to the measurement of wire, it means the wire gauge specified in AASHTO M32.

The term "ton" means the short ton consisting of 2,000 pounds avoirdupois. All materials which are measured or proportioned by weight will be weighed according to the requirements of Section 1-09.2. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material be paid for. However, car weights will not be acceptable for material to be passed through mixing plants.

Trucks used to haul material being paid for by weight shall be weighed empty at least twice daily or at such times as the Engineer directs. Each truck shall bear a plainly legible identification mark or number. Duplicate weight tickets shall be prepared and accompany each truck load of material delivered to the project. The duplicate weight tickets shall be submitted to the Engineer on the day of delivery. The tickets shall be legible and contain the following information:

(1) Preprinted ticket serial number.
(2) Identification number of truck/truck trailer.
(3) Date and hour of weighing.
(4) Type of material.
(5) Weight of load, including Gross, Tare and Net Weights. If the scale has a tare beam so the net weight can be read directly, only the net weight need be recorded on the ticket.
(6) Weighman's identification.
(7) Item number.
(8) Contract number.
(9) Unit of measure.
(10) Legal gross weight in remarks section.
(11) Location of delivery (station or by street name).

The net weight of material measured by the ton that is being placed in each truck shall be printed on the ticket by an automatic weighing device from a certified scale. Minor incidental construction items for which the Contract Documents require measurement by weight may, at the Contractor's request and with the Engineer's approval, be converted to weight from volume measurements using the factor of 1.25 tons per cubic yard of volume measure.

Mineral aggregates measured by the cubic yard will be measured compacted in place to the neat line dimensions indicated on the Drawings or Standard Plans.

Asphalt will be measured by the gallon or ton. Volumes will be measured at 60 degrees F. or will be corrected to the volume at 60 degrees F. in accordance with ASTM D 1250. Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when asphalt material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work. When asphalt is shipped by truck or transport, net certified weights or volumes, subject to correction for loss or foaming, will be used for computing quantities.

CONVERSION FACTORS

AVERAGE WEIGHTS AND VOLUMES OF ASPHALTS

Grade	Gallons per Ton at 60°F.	Pounds per Gallon at 60°F.
LIQUID ASPHALTS		
70	253	7.90
250	249	8.03
800	245	8.16
3000	241	8.30
PAVING ASPHALTS		
AR 2000W	237	8.44
AR 4000W	235	8.51
EMULSIFIED ASPHALTS		
All Grades	240	8.33

Cement shall be measured by the pound, ton, or sack. When measured by the sack, a sack shall mean a sack weighing 94 pounds.

Timber will be measured by the board foot (BF) or the thousand feet board measure (MBM) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

Measurement by "lump sum" shall be for all the work described for that item in the Contract Documents complete, whole, functional, and in place.

When a complete structure or structural unit is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

Measurement will not be made for:

(1) Work performed or materials placed outside lines shown on the Drawings or set by the Engineer,
(2) Material wasted, used, or disposed of in a manner contrary to the Contract Documents,
(3) Rejected material, including material rejected after it has been placed by reason of a failure of Contractor to conform to the provisions of the Contract Documents,
(4) Hauling and disposing of rejected material,
(5) Material remaining on hand after the Work is completed, except as provided in Section 1-09.5, or
(6) Any other work or material for which payment is contrary to any provision of the Contract Documents.

1-09.2 WEIGHING

1-09.2(1) WEIGHING EQUIPMENT

Materials proportioned, or measured and paid for by weight shall be weighed on accurate, approved scales by competent, qualified personnel at locations satisfactory to the Engineer.

Scales for the weighing of natural, manufactured, or processed construction materials obtained from natural deposits, stockpiles, or bunkers which are required to be proportioned or measured and paid for by weight, shall be furnished, erected and maintained by the Contractor, or shall be certified, permanently installed commercial scales.

1-09.2(1)A GENERAL REQUIREMENTS FOR WEIGHING EQUIPMENT

Equipment for weighing construction materials shall be accurate within 1/2 percent of the correct weight throughout the range of use. Beam or dial scales or other reliable equipment shall be built and erected in a manner which will prevent displacement, binding or vibration of the various components. The use of spring balances will not be permitted.

Beams, dials, platforms and other scale equipment shall be so arranged that the operator and trainer can safely and conveniently view ther dials, beams, rods, and operating mechanism of the scale. Working parts of scales or connections shall be protected from material falling upon or against them and shall be protected from wind and weather. Special care and protection of knife edges shall be exercised. Bunkers and platforms shall be kept clean of material which may accumulate and introduce errors.

Each batching and platform scale installation shall have available throughout the period of use 10 standard 50-pound weights for calibrating and testing the weighing equipment, or suitable weights and devices for other approved equipment.

1-09.2(1)B SPECIFIC REQUIREMENTS FOR BATCHING SCALES

The weighing equipment and hopper shall be arranged so that the operator can conveniently remove material from the hopper and view beams or dials simultaneously. Scales shall be a type well suited for supporting a weighing hopper. Weighing hoppers mounted on platform scales shall have the center of gravity directly over the center line of the platform.

Batch scales shall be tested for accuracy and serviced by the scale company's representative before use at a new site and every 6 months thereafter. The Engineer shall be provided with a copy of the final test results each time the scales are checked. Subsequently, the scales at such times as are requested by the Engineer shall be checked by the operating personnel under the observation of the Engineer. The scales used for weighing Portland cement and asphalt cement shall be separate from those for weighing other materials. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and based on the nominal rated capacity of the scale. Graduated intervals for scales shall not exceed 1/10 of 1 percent of the nominal rated capacity of the scale or 1 pound, whichever is the lesser amount.

1-09.2(1)C SPECIFIC REQUIREMENTS FOR PLATFORM SCALES

Platform scales shall be certified scales which automatically print the net, tare, and gross weights on the ticket and shall have the size and capacity to weigh an entire hauling vehicle or combination of connected vehicles at one time. No part of the connected vehicle or combination shall be off the platform at the time of weighing.

A platform scale operator shall be designated by the Contractor to weigh all materials on the Contractor's platform scales and make the records thereof. The Contractor may also elect to use commercial scales. The Contractor shall furnish approved load tickets at the scale and legible duplicate copies to the Engineer at the delivery point and guarantee permission for Owner personnel to periodically observe the weighing and to check and compile the daily record of scale weights. Tare weights shall be taken of each conveyance at least twice daily.

Commercial and certified weighers shall check the scales at least daily. The scale check methods and documentation procedures for scale checks and tare weights will require approval by the Engineer. Checks shall be made throughout each day to see that the scales are balanced and return to zero when no load is on them.

Any Contractor-supplied scale shall include a scale house with a floor space of at least 6 by 10 feet. The scale house shall be wind and weather tight, shall have windows for light and ventilation, shall include a door, and shall be lockable. It shall include a table, a chair, electrical power, and a space heater. The Contractor shall provide a rest room near the scale house.

Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end to eliminate binding and shifting. The platform scale beam or dial shall have graduated intervals of no more than 40 pounds. When testing the scales, the weights shall be read and recorded to the nearest 20 pounds and during weighing operations, weights shall be read and recorded to the nearest hundred weight (cwt).

Before use at a new site and every six months thereafter, the scales shall be approved in accordance with local ordinances or rules of the State Department of Agriculture's Weights and Measures Section, or be serviced and tested by a scale company representative with at least 10,000 pounds, with a copy of the final test results provided to the Engineer.

1-09.2(1)D SPECIFIC REQUIREMENTS FOR BELT CONVEYOR SCALES

Conveyor belt weighing may be accepted for untreated materials provided that this method or device meets the general requirements of weighing equipment.

Belt conveyor scales shall meet the requirements for belt-conveyor scales as specified in the National Bureau of Standards, Handbook No. 44, except as modified by these Specifications.

A daily static load test shall be made after about 1/2 hour of continuous running of the belt conveyor and whenever the air temperature varies signficantly. A chain test will be required whenever a need for adjustment has been determined by the daily static load test.

The test chain calibration computation, calibration procedures and results, and related documents shall be available for review by the Engineer. The test chain shall be clearly marked with its calibration. It shall be carried in a suitable container and shall be immediately available for testing of the best conveyor scales.

Comparisons of accuracy may be made by checking the average of 5 or more sequential hauling unit payloads on platform scales meeting the requirements of these Specifications. A comparative accuracy of 0.5 percent (plus or minus) of the payload of the average hauling unit will be acceptable. Since the recording odometer of conveyor belt scales in general use is graduated in 0.1 ton (i.e. 200 lbs.) increments, and since the recording is a cumulative process, minor differences in reading or variations smaller than 0.1 ton carry over from one vehicle unit to another. Confirmation of the conveyor weights will, for greater accuracy, be based on the tonnage values obtained from readings taken from the sealed odometer at the beginning and end of each check period. The number of check loads may be increased by the Engineer should the test results fluctuate.

The Contractor shall furnish appropriate serially numbered tickets as approved by the Engineer for self-printing of the time and date of loading and the approximate load out weight. Each ticket shall be imprinted from a recording device at the loading point by the truck driver and delivered to the Engineer at the job site. The delivered ticket shall be marked with hauling conveyance equipment number.

The recording tape, odometer, totalizer, calibration adjustment and clock- time imprinter shall be secured and locked. All keys shall be in the possession of the Engineer.

1-09.2(1)E MEASUREMENT

In the event inspection reveals that scales have been underweighing the scales should be adjusted and no additional payment to the Contractor will be allowed for materials previously weighed and recorded. Scales overweighing (indicating more than true weight) will not be permitted to operate and all materials received subsequent to the last previous corrected weighing accuracy test will be reduced by the percentage of error in excess of one-half of one percent. No payment will be made for materials received by weight which have not been weighed in accordance with the foregoing specification or other methods specifically approved in writing for the individual project.

1-09.2(1)F PAYMENT

All costs in connection with furnishing, installing, certifying and maintaining scales for furnishing check weights and scale house and for all other items specified in this section for the weighing of construction materials for proportioning or payment shall be included in the unit Bid Item prices for the various items of work which comprise the Contract.

1-09.3 SCOPE OF PAYMENT

1-09.3(1) GENERAL

The Contractor shall receive and accept compensation provided for in the Contract Documents as full payment for the following:

(1) furnishing all materials and for performing all work under the Contract in a complete and acceptable manner including changes in the work, materials, or Drawings as provided for by approved Change Orders;
(2) all risks, loss, damage, or expense of whatever character arising out of the nature or prosecution of the Work;
(3) all expense incurred in consequence of the suspension or discontinuance of the Work as specified in the Contract Documents.

Unless the Contract Documents provide otherwise, the unit Bid Item prices for the various items of the Work shall be full compensation for all labor, materials, supplies, equipment, tools, and all things of whatever nature required for the complete incorporation of the item into the Work, the same as though the item were to read "in place."

The term, "lump sum," when used as an item of payment means complete payment for the work described for that item in the Contract.

Unless modified otherwise in the Project Manual, the Bid Items listed or referenced in the "Payment" clause of each Section of the Standard Specifications, will be the only items for which compensation will be made for the Work described in or specified in that particular Section when the Contractor performs the specified Work. Should a Bid Item be listed in a "Payment" clause but not in the Bid Form, and Work for that item is performed by the Contractor, then payment for that Work will be made as for Extra Work pursuant to a Change Order.

The words "Bid Item," "Contract Item," and "Pay Item," and similar terms used throughout the Contract Documents are synonymous.

If the "payment" clause in the Specifications relating to any unit Bid Item price in the Bid Form requires that said unit Bid Item price cover and be considered compensation for certain work or material essential to the item, then the work or material will not be measured or paid for under any other Unit Bid Item which may appear elsewhere in the Bid Form or Specifications.

Pluralized unit Bid Items appearing in these Specifications are changed to singular form.

Certain unit Bid Items appearing in the Specifications may be modified in the Contract Documents to include words such as:

(1) "For Structure," or "For Concrete Barrier," or "For Bridge," etc. with the intent of clarifying specific use; or
(2) "Site (site designation)," with the intent of clarifying where a specific item of work is to be performed.

Modifications of the unit Bid Items in this manner shall not change the intent of the Specifications relating to these items.

Payment for Bid Items listed or referenced in the "Payment" clause of any particular Section of the Specifications shall be considered as including all of the Work required, specified, or described in that particular Section. Payment items will generally be listed generically in the Specifications, [e.g., "Manhole (type)"] and specifically in the bid form (e.g., "Manhole, Type 130"). When items are to be "furnished" under one payment item and "installed" under another payment item, such items shall be furnished FOB project site, or, if specified in the Project Manual, delivered to a designated City site. Materials to be "furnished," or "furnished and installed" under these conditions, shall be the responsibility of the Contractor with regard to storage until such items are incorporated into the Work or, if such items are not to be incorporated into the work, delivered to the applicable City storage site when provided for in the Specifications. Payment for material "furnished," but not yet incorporated into the Work, may be made on monthly estimates to the extent allowed.

1-09.3(2) LUMP SUM BREAKDOWN

The Contractor shall submit a breakdown of costs for each lump sum Bid Item. The unit price values may be used as a guideline for determining partial payments or deductions for authorized changes in the Work.

1-09.3(3) ADJUSTMENTS

Adjustments in the amount to be paid by the Owner under the terms and conditions of the Contract will not be made as a result of any change in laws, ordinances or regulations except as specifically provided by the following:

(1) Changes in Laws: The Owner will not adjust payment to compensate the Contractor for changes in legal requirements unless those changes are specifically within the scope of RCW 39.04.120. For changes under RCW 39.04.120 the Owner will compensate the Contractor by negotiated Change Order or by force account.
(2) Changes in Taxes: The Owner will adjust payment to compensate for tax changes under the following conditions:
   (a) the changes involve Federal or State taxes on materials used in or consumed for the Work;
   (b) the changes increase Contractor-paid taxes by more than $100;
   (c) for items in the original Contract, the tax change must occur after the Bid opening date;
   (d) for negotiated contracts or items in a supplemental agreement the tax change must take place after the execution date of the contract or agreement;
   (e) the Contractor if requested by the Engineer certifies in writing that the Awarded Contract Price does not include an extra amount to cover a possible change in taxes; and
   (f) the Contractor permits the Owner to audit the Contractor's records to the extent necessary to substantiate any claim for compensation under the provisions of this section.

Within the above conditions the Owner will adjust compensation by the actual dollar amounts of increase caused by the tax changes.

1-09.4 PAYMENT FOR CHANGES

Payment for work pursuant to a Change Order (other than deleted work) shall be full compensation for any such change. The amount of payment shall be determined by one or more of the following methods:

(1) by unit prices contained in the Bid;
(2) by unit prices mutually agreed upon.
(3) by mutual acceptance of a lump sum price; or
(4) by Force Account;

When the Work performed can be measured and paid for at unit Bid Item prices, it will be measured and paid for at such prices. When payment is by Method (3), the Contractor shall provide substantiation of the lump sum price in a form acceptable to the Engineer. Payment by methods (1), (2) and (3) shall include all costs for overhead and profit except that any mark-ups for overhead and profit included in any computation requested to justify a lump sum agreed price shall be limited to those permitted for method (4) force account. If the Contractor and Engineer are unable to agree on compensation the Engineer will determine the compensation or if deemed appropriate by the Engineer compensation will be paid by method (4) Force Account.

When payment for extra work is by lump sum, agreed price or by unit prices mutually agreed upon, the Contractor shall include in the agreed prices retail sales tax on taxable materials when such extra work is for improving public roads. When the extra work is for water systems, sanitary sewer systems, sewage disposal facilities, electrical distribution, or other work not related to public roads, the Contractor shall not include retail sales tax in the agreed price.

1-09.5 DELETED OR TERMINATED WORK

When the Contract is terminated in accordance with Section 1-08.10 or when any item is deleted in whole or in part in accordance with Section 1-04.4, payment will be made for the actual number of units of work completed at the unit contract prices. Payment for partially completed lump sum items will be as mutually agreed or as determined by the Engineer in the proportion that the partially completed work is to the total lump sum item. To the extent not paid for by the Contract prices, as provided above, the Owner will pay to the Contractor an amount covering all direct costs associated with the deleted work actually incurred prior to the effective date of the termination or the Change Order. The total payment for any one item including those direct costs associated with that item shall not exceed 100 percent of the original bid as modified by approved Change Order. No claim for damages of any kind or for loss of anticipated profits on deleted or uncompleted work will be allowed because of the termination or the Change Order.

Contract time shall be adjusted as the parties agree. If the parties cannot agree, the Engineer will determine the equitable adjustment for Contract time.

Acceptable materials ordered by the Contractor or delivered on the work prior to the date the Work was terminated as provided in Section 1-08.10 or deleted as provided in Section 1-04.4 by the Engineer, will either be purchased from the Contractor by the Owner at the actual cost and shall become the property of the Owner, or the Owner will reimburse the Contractor for the actual costs connected with returning these materials to the suppliers.

1-09.6 FORCE ACCOUNT

1-09.6(1) GENERAL

If the contract calls for work or materials to be paid for by Force Account, payments will be determined as shown below.

The payments provided herein shall be full payment for all work done on a Force Account Basis. The payment shall cover all expenses of every nature, kind, and description, including all overhead expenses, profit, occupational tax and any other Federal or State revenue acts, premiums on public liability and property damage insurance policies, and for the use of small tools and equipment for which no rental is allowed.

No claim for Force Account shall be allowed except upon written order by the Engineer prior to the performance of the work. No work shall be construed as Force Account work which can be measured under the specifications and paid for at the unit prices named in the Contract.

The amount and costs of any work to be paid by Force Account shall be computed by the Engineer, and the amount certified by the Engineer shall be final as provided in Section 1-05.1.

The Contractor's cost records pertaining to work paid for on a Force Account basis shall be open to inspection or audit by representatives of the Owner during the life of the Contract and for a period of not less than three years after the date of acceptance of the Contract. The Contractor shall retain these records for that period. The Contractor shall also guarantee that these cost records of all subcontractors and agents shall be open to similar inspection or audit for the same period of time. If an audit is to be commenced more than 60 calendar days after the acceptance date of the Contract, the Contractor will be given 20 calendar days notice of the time when the audit is to begin.

1-09.6(2) LABOR

The Contractor will be reimbursed for labor and for supervision by foremen dedicated solely to the particular force account item of work (but not for supervision by general superintendents, project managers, or general foremen). The Engineer will compute the labor payment on the basis of these four factors:

(1) Weighted Wage Rate. The Weighted Wage Rate combines:
   (a) The current basic wage and fringe benefits the Contractor is required and has agreed to pay
   (b) Federal Insurance Compensation (FICA)
   (c) Federal Unemployment Tax Act (FUTA)
   (d) State Unemployment Compensation Act (SUCA)

   A Weighted Wage Rate shall be computed for each classification of labor used. This rate shall reflect the Contractor's actual cost. It shall neither exceed what is normally paid to comparable labor nor fall below the minimum required by Section 1-07.9. If the Engineer authorizes overtime, the Weighted Wage Rate shall be determined on the same basis.

(2) Travel Allowance and Subsistence. This includes the actual costs of allowances for travel or subsistence paid to employees in the course of their work on the item. This reimbursement will be made only if such allowances are required by a regional labor agreement or are normally paid by the Contractor to comparable labor for performing other work.
(3) Industrial Insurance and Medical Aid Premiums. The Owner will reimburse Contractor-paid premiums for Marine Industrial Insurance, for State of Washington Industrial Insurance, and Medical Aid premiums which become an obligation of the Contractor and are

chargeable to the Force Account work on the basis of time worked. Reimbursement will be for the composite rate (the full Industrial Insurance premium plus one-half the Medical Aid premium) which the regulatory body sets for the Contractor doing the work. The composite rate will be adjusted if the regulatory body changes this rate.

(4) Overhead and Profit. The Owner will pay the Contractor 20 percent of the sum of the costs listed in (1), (2), and (3) above to cover project overhead, general company overhead, profit, and any other costs incurred.

1-09.6(3) MATERIALS

The Owner will reimburse actual invoice cost for Contractor-supplied materials. This cost includes actual freight and express charges and taxes as described in Section 1-07.2 provided that these costs have not been paid in some other manner under the Contract. A deduction will be made for any offered or available discounts or rebates if the Owner has provided the Contractor with the means to comply with the provisions allowing the discount. The Owner will then add 15 percent of the balance to cover project overhead, general company overhead, profit, and any other cost of supplying materials.

To support charges for materials, the Contractor shall provide the Engineer with valid copies of vendor invoices, including freight and express bills. if invoices are not available for materials from the Contractor stocks, the Contractor shall certify actual costs by affidavit.

If claims for materials costs are too high, inappropriate, or unsupported by satisfactory evidence, the Engineer may determine the cost for all or part of the materials. When determined in this manner, the cost will be the lowest current wholesale price from a source that can supply the required quantity (including delivery costs).

The Owner reserves the right to provide materials. In this case, the Contractor will receive no payment for any costs, overhead, or profit.

1-09.6(4) EQUIPMENT

The approval of the Engineer shall be required for the selection of machine- power tools or equipment prior to their use on Force Account.

The payment for machine-power tools or equipment shall be made according to the current AGC/WSDOT Equipment Rental Agreement which is in effect at the time the Force Account is authorized. The rates as set forth in the Rental Rate Blue Book (as modified by the current AGC/WSDOT Equipment Rental Agreement) are the maximum rates allowable for equipment of modern design and in good working condition. These rates shall be full compensation for all fuel, oil, lubrication, repairs, maintenance, and all other costs incidental to furnishing and operating the equipment except labor for operation.

The Owner will add 15 percent to equipment costs to cover project overhead, general company overhead, and profit.

Current copies of the Rental Rate Blue Book and the AGC/WSDOT Equipment Rental Agreement will be maintained at each District office of the Department of Transportation and at each of the offices of the Associated General Contractors of America (in Seattle, Spokane, Tacoma, and Wilsonville, Oregon) where they are available for inspection.

1-09.6(5) FORCE ACCOUNT MOBILIZATION

Force Account mobilization is defined as the preparatory work performed by the Contractor including transportation of tools, equipment, and personal travel time (when included in a bargaining agreement).

The Owner may pay for mobilization of equipment and labor if the Force Account item is not an item included in the original Contract proposal or such other Contract items as may be included in the special provisions as being eligible for reimbursement for mobilization. Off-site work in preparation for the travel to the project, costing $300.00 or less will not be paid. The Owner will not pay for mobilization for off-site preparatory work for Force Account items under any circumstances unless the Contractor specifically makes a request in writing in advance of any such mobilization work. The written request shall include an estimate for mobilization costs involving off-site preparatory work and the basis for reimbursement. The approval of the Engineer will be required prior to commencing the mobilization for all Force Account. To the agreed final amount of mobilization for Force Account shall be added an amount equal to 15 percent of that sum for all other costs, including project overhead, general company overhead, and profit.

1-09.6(6) SUBCONTRACTORS

The subcontractors will be allowed a 5 percent markup of the total cost computed for labor, materials, equipment, and mobilization (per Sections 1-09.6(2) through 1-09.6(5) above) for insurance, B&O tax, and bonding.

1-09.6(7) CONTRACTOR MARKUP ON SUBCONTRACTORS

When work is performed on a Force Account basis by approved subcontractors, the Contractor will be allowed an additional markup equal to 5 percent of the total subcontractor's cost computed for labor, materials equipment, mobilization, and subcontractor's markup (per sections 1-09.6(2) through 1-09.6(6) above), for all administrative costs.

1-09.6(8) INSURANCE, B&O TAX, AND BONDING

The Contractor will be allowed an additional markup equal to 5 percent of the total cost computed for labor, material, cquipment, mobilization, Subonctractor's markup, and contractor's markup on subcontractors (per Section 1-09.6(2) through 1-09.6(7) above) for insurance, B&O tax, and bonding.

1-09.7 PAYMENT FOR MOBILIZATION

Mobilization shall consist of preconstruction expenses and costs of preparatory work and operations performed by the Contractor which occur before 10% of the Awarded Contract Price is earned from other Bid Items. Items which are not to be included in the item of mobilization are:

(1) Any portion of the Work covered by a specific Bid Item or incidental work which is to be included in a Bid Item or Items.

(2) Profit, interest on bond money, overhead or management costs.

Based on the lump sum Bid Item price for "Mobilization" partial payments will be made as follows:

(1) when 5% of the Awarded Contract Price is earned excluding mobilization and amounts paid for materials on hand, 50% of the amount Bid for mobilization or 5% of the Awarded Contract Price whichever is less will be paid.

(2) When 10% of the Awarded Contract Price is earned from other Bid Items excluding mobilization and amounts paid for materials on hand, 100 percent of the amount Bid for mobilization or 10% of the Awarded Contract Price whichever is less will be paid.

(3) Upon completion of all work, payment of any amount Bid for mobilization in excess of 10% of the Awarded Contract Price will be paid.

1-09.8 PAYMENT FOR MATERIAL ON HAND

Partial payments, to the extent of 90% of the invoiced cost of materials excluding taxes, or the unit Bid Item price whichever is less, may be made on monthly estimates for materials not yet incorporated into the Work if the materials:

(1) Meet the requirements of the Contract based upon inspections or testing by the Engineer.

(2) Are delivered to project site or are stockpiled at an offsite storage facility approved by the Engineer.

(3) Are properly stored and protected.

(4) Are insured against loss or damage.

In addition to the requirements of (1) and (3) above, material delivered to the project site or to an off-site storage facility as permitted in (2) above will be considered for partial payment only if the following additional conditions are met:

(1) The storage of materials is required for more than 30 calendar days.

(2) The material stored off-site is segregated from materials for any other project.

(3) The material is tagged, labeled, or otherwise identified as belonging to the project.

(4) The cost of transportation to the Project Site is excluded from payment or other provisions acceptable to the Engineer are made with regard to eventual delivery to the Project Site.

The cost of other materials on hand will be determined by invoices from a materialman in sufficient detail to determine the actual cost. The Contractor shall furnish the Engineer an invoice marked "paid" within 60 days of the initial payment by the Engineer for the material on hand. If the paid invoice is not furnished in the prescribed time, and the material has not been incorporated in the Work, a payment that has been made will be deducted from the next progress estimate and the material will not be eligible for future payment as material on hand.

Requests for payment for individual items or group of items of material on hand, amounting to an invoice total of less than $500 will not be considered by the Engineer for partial payments. Payment for sales taxes due on the purchase of such material or equipment will not be made unless said taxes were paid by the Contractor to the materialman or fabricator for transmittal to the State by the materialman or fabricator and such tax is included on the bill of sale issued by the materialman.

Payment for materials will not constitute acceptance. Faulty material will be rejected even though payment may have been made for such material in a progress payment.

Deductions at the same rates and equal in amount to the payment for material on hand will be made to future progress payments as material is incorporated into the Work and paid at the Bid Item unit price or, for a lump sum item, the estimates percentage of the lump sum price. Deductions, at the same rates and equal in amount to the payment for material on hand, will also be made for material on hand which is rejected after a payment was made.

1-09.9 PAYMENTS

1-09.9(1) PROGRESS PAYMENTS

Progress payments for completed work and material on hand will be based upon progress estimates prepared by the Engineer. A progress estimate cutoff date will be established at the preconstruction meeting.

Within 3 days after the progress estimate cutoff date (but not more often than once a month) the Contractor shall submit to the Engineer for review an Application for Payment, filled out and signed by the Contractor, covering the work completed prior to the progress estimate cutoff date. The Application for Payment shall be accompanied by documentation supporting the Contractor's Application for Payment. If payment is requested for materials and equipment not incorporated in the Work, but delivered and stored at approved sites pursuant to the Contract Documents, the Application for Payment shall be accompanied by a bill of sale, invoice, or other documentation warranting that the Contractor has received the materials and equipment and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect the Owner's interest therein.

The initial progress estimate will be made not later than 30 days after the Contractor commences the Work, and successive progress estimates will be made every month thereafter until Acceptance. Progress estimates made during progress of the Work are tentative, and made only for the purpose of determining progress payment. The progress estimates are subject to change at any time prior to Acceptance Date.

The value of the progress estimate will be the sum of the following:

(1) Unit Price Items in the Bid Form - the approximate quantity of acceptable units of Work completed multiplied by the Unit Price.

(2) Lump Sum Items in the Bid Form - the estimated percentage complete multiplied by the Bid Forms amount for each Lump Sum Item.

(3) Materials on Hand - 90 percent of invoiced cost of material delivered to Jobsite or other storage area approved by the Engineer.

(4) Change Orders - entitlement for approved extra cost or completed extra work as determined by the Engineer.

Progress payments will be made in accordance with the progress estimate less:

(1) Five (5) percent for retained percentage.

(2) The amount of Progress Payments previously made.

(3) Funds withheld by Owner for disbursement in accordance with the Contract Documents.

Progress payments for work performed shall not be evidence of acceptable performance or an admission by the Owner that any work has been satisfactorily completed.

Payments will be made by warrants, issued by the Owner's fiscal officer, against the appropriate fund source for the project.

1-09.9(2) RETAINAGE

Pursuant to RCW 60.28 there will be reserved and retained from monies earned by the Contractor on estimates during the progress of the Work a sum not to exceed five percent of the monies earned by the Contractor. Such retainage shall be used as a trust fund for the protection and payment (1) to the State with respect to taxes imposed pursuant to Title 82, RCW which may be due from such Contractor, and (2) of any person or persons, mechanic, subcontractor or materialman who shall perform any labor upon such contract or the doing of said Work, and all persons who shall supply such person or persons or subcontractors with provisions or supplies for carrying on such work.

Monies reserved under provisions of RCW 60.28 shall, at the option of the Contractor, be:

(1) Retained in a fund by the Owner until 30 days following Acceptance of the Work; or

(2) Deposited by the Owner in an interest-bearing account in a bank, mutual savings bank, or savings and loan association, not subject to withdrawal until after Acceptance of the Work or until agreed to by both parties;

(3) Placed in escrow with a bank or trust company by the Owner until 30 days following Acceptance of the Work. When the monies reserved are to be placed in escrow the Owner will issue a check representing the sum of the monies reserved payable to the bank or trust company and the Contractor jointly. Such check shall be converted into bonds and securities chosen by the Contractor and approved by the Owner and the bonds and securities held in escrow.

The Contractor shall designate the option desired on the Agreement Form at the time the Contractor executes the Contract with the City and shall be part of the contract. The Contractor in choosing option (1) or (2) agrees to assume full responsibility to pay all costs which may accrue from escrow services, brokerage charges or both, and further agrees to assume all risks in connection with the investment of the retained percentages in securities.

Release of retained percentage will be made 30 days following Acceptance by the Owner provided the following conditions are met:

(1) Releases have been obtained from the State Department of Labor and Industries, the State of Washington Employment Security Department, and all other departments and agencies having jurisdiction over the activities of the Contractor.
(2) On contracts totalling more than $20,000.00, a release has been obtained from the Washington State Department of Revenue.
(3) No claims, as provided by law, have been filed against the retained percentage.
(4) Affidavit of Wages Paid is on file with The City Comptroller for the Contractor and all Subcontractors.

In the event claims are filed the Contractor will be paid such retained percentage less an amount sufficient to pay any such claims together with a sum determined by the Owner sufficient to pay the cost of foreclosing on claims and to cover attorney's fees.

Retainage will not be reduced for any reason below the minimum limit provided by law.

1-09.9(3) OWNER'S RIGHT TO WITHHOLD AND DISBURSE CERTAIN AMOUNTS

In addition to monies retained pursuant to RCW 60.28, the Contractor authorizes the Engineer to withhold progress payments due or deduct an amount from any payment or payments due the Contractor which, in the Engineer's opinion, may be necessary to cover the Owner's costs for or to remedy the following situations:

(1) Failure of the Contractor to submit and obtain approval of a progress schedule.
(2) Failure of the Contractor to remedy defective Work.
(3) Failure of the Contractor to provide the Engineer with a field office when required by the Project Manual.
(4) For overtime work performed by Owner personnel.
(5) Lack of construction progress based upon the Engineer's review of the Contractor's approved progress schedule which, indicates that the Work will not be completed within the Contract Time. When calculating an anticipated time overrun, the Engineer will make allowances for weather delays, approved unavoidable delays, and suspensions of the Work. The amount withheld under this subparagraph will be based upon the liquidated damages amount per day set forth in the Project Manual multiplied by the number of days the Contractor's approved progress schedule, in the opinion of the Engineer, indicates the Contract may exceed the Contract Time.
(6) Damage to another contractor when there is evidence thereof and a claim has been filed.
(7) Failure to submit weekly payrolls or correct underpayments to Contractor or subcontractor employees.
(8) Where the Contractor has not paid fees or charges to public authorities or municipalities which the Contractor is obligated to pay.
(9) Failure of the Contractor to perform any of the Contractor's other obligations under the contract.

The Contractor authorizes the Engineer to act as agent for the Contractor disbursing such funds as have been withheld pursuant to this paragraph to a party or parties who are entitled to payment. Disbursement of such funds, if the Engineer elects to do so, will be made only after giving the Contractor 15 days prior written notice of the Owner's intent to do so, and if prior to the expiration of the 15 day period,

(1) no legal action has commenced to resolve the validity of the claims, and
(2) the Contractor has not protested such disbursement.

A proper accounting of all funds disbursed on behalf of the Contractor in accordance with this section will be made. A payment made pursuant to this section shall be considered as payment made under the terms and conditions of the Contract. The Owner shall not be liable to the Contractor for such payment made in good faith.

If legal action is instituted to determine the validity of the claims prior to expiration of the 15 day period mentioned above, the Engineer will hold the funds until determination of the action or written settlement agreement of the parties.

1-09.9(4) FINAL PAYMENT

Upon Acceptance of the Work by the Owner the final amount to be paid the Contractor will be calculated based upon a Final Progress Estimate made by the Engineer. Acceptance by the Contractor of the Final Payment shall be and shall operate as a release:

(1) to the Owner of all claims and all liabilities of the Contractor, other than claims in stated amounts as may be specifically excepted in writing by the Contractor;
(2) for all things done or furnished in connection with the Work;
(3) for every act and neglect by the Owner; and
(4) for all other claims and liability relating to or arising out of the Work.

A payment (monthly, final, retainage, or otherwise) shall not release the Contractor or the Contractor's Surety from any obligation required under the terms of the Contract Documents or the Contract Bond; nor shall such payment constitute a waiver of the Owner's ability to investigate and act upon findings of non-compliance with the WMBE Ordinance; nor shall such payment preclude the Owner from recovering damages, setting penalties, or obtaining such other remedies as may be permitted by law.

Before the Work will be accepted by the Owner, the Contractor shall satisfy the WMBE Reporting Requirements of Section 1-07.12(5).

DIVISION 2
EARTHWORK

SECTION 2-01 CLEARING, GRUBBING, AND ROADSIDE CLEANUP

2-01.1 DESCRIPTION

The Contractor shall clear, grub, and clean up those areas staked by the Engineer or described in the Project Manual. This work includes protecting from harm all trees, bushes, shrubs, or other objects selected to remain.

Clearing work shall consist of removing and disposing of trees, vegetation or other unwanted materials from the ground surface. Grubbing work shall consist of removing and disposing of such materials from below the ground surface. Roadside cleanup shall consist of work done to give the roadside an attractive finished appearance.

2-01.2 DISPOSAL

Unless otherwise specified in the Project Manual, waste sites shall be provided by the Contractor. Borrow and waste sites shall be operated in such a manner as to meet the grading, safety and health requirements of the State, county and local political subdivision. Sites, operations, or results of such operations, which create a definite nuisance problem, or which result in damage to public or private properties will not be permitted.

Copies of permits for borrow and waste sites, and reclamation plans for pits shall be furnished to the Engineer by the Contractor.

The Contractor shall submit to the Engineer at the pre-construction conference a list of waste and borrow sites the Contractor proposes to use during the course of construction. The list shall identify, in addition to each location, the estimated quantities and type of material to be wasted at, or removed from, each site. Should additional or alternate sites become necessary during the life of the Contract, the locations and preceding information for each site shall be submitted to the Engineer for approval, prior to their use.

Waste and borrow sites and their operation shall be at all times subject to the Engineer's approval. No waste or borrow site shall be utilized by the Contractor until the proper grading permits and property owner agreements have been obtained by the Contractor and copies submitted to the Engineer. Sites utilized by the Contractor without a legal grading permit, an agreement from the property owner, and approval of the Engineer will be considered unauthorized.

Waste and borrow sites located within the City limits of Seattle are subject to the rules and regulations set forth in Seattle Grading and Drainage Control Ordinance (Ord. No. 108080 as amended by Ord. No. 111043, or as otherwise provided in the Seattle Municipal Code 22.800) and shall require a grading permit issued to the property owner by the Director of Construction and Land Use.

Waste and borrow sites located outside the City limits of Seattle but within unincorporated King County, shall be subject to the rules and regulations set forth in the King County Grading Ordinance (Ord. No. 1488) Sites may also be subject to rules and regulations of a local governmental authority if located within their jurisdiction.

Surplus material shall not be wasted within the public rights of way without a grading permit and, if within the City limits of Seattle, a street use permit issued by the Director of Engineering.

Upon completion of the work and before final acceptance and payment, the Contractor shall clean up all properties and sites on which the Contractor has operated. The Contractor shall perform all operations necessary to put the sites in a neat, clean and orderly condition.

Final cleanup shall be in accordance with the requirements specified in the Grading Ordinance, permits, property agreements and other Contract Documents. Upon completion of grading operations at any site for which a written agreement between the Contractor and property owner is required, the Contractor shall obtain and furnish to the Engineer a release from all damages, duly executed by the property owner, stating that the restoration of the property has been satisfactorily accomplished. Retainage withheld from the Contractor's payments will not be released until all such property owner releases have been furnished to the Engineer. Should the release be, in the opinion of the Owner, arbitrarily withheld, then the Owner may, in its sole discretion, accept that portion of the work involved and cause final payment to be made.

2-01.3 CONSTRUCTION REQUIREMENTS

2-01.3(1) CLEARING

Clearing shall consist of removing and disposing of all unwanted material from the surface including, but not limited to, trees, brush, down timber and rotted wood, rubbish, etc.; removing building sheds, fences, and other obstructions interfering with the work when removal and disposal of such surface obstructions are not specifically provided for in Section 2-02; and protecting from all harm any trees, bushes, shrubs, or other existing improvement which are to remain. Only those trees marked for removal on the Drawings or designated by the Engineer will be removed by the Contractor.

Tree branch pruning on Seattle Parks Department property shall be performed by the crews from the Parks Department. Tree branch pruning on street right of way shall not be performed without permission from the City Arborist.

All trees shall be felled within the area to be cleared. Where the tree limb structure interferes with utility wires, or where the tree to be felled is in close proximity to utility wires, the tree shall not be taken down without permission from City Light.

All buildings, fences, lumber piles, trash, and obstructions, except utility poles, within the area to be cleared shall be removed and disposed of by the Contractor.

The refuse resulting from the clearing operation shall be disposed by the Contractor. In no case shall refuse material be left on the project site, shoved onto abutting private properties, or be buried in embankments or sewer trenches on the project site. Debris shall not be deposited in any stream or body of water, or in any street or alley, or upon any private property except by written consent of the private property owner.

2-01.3(2) GRUBBING

The work shall consist of removing and disposing of all unwanted vegetative matter from below the surface including, but not limited to, stumps, roots, buried logs and timber, etc.; and removing and disposing of drains, culverts, wood catch basins, foundations, stairways, steps, and such other obstructions interfering with the work when removal and disposal of such underground obstructions are not specifically provided for in Section 2-02.

All stumps, roots, foundations and planking embedded in the ground within the limits described herein shall be removed to a minimum depth of 2 feet below subgrade or 2 feet below existing ground level, whichever is lower. Disposal requirements for grubbing shall be the same as those described for clearing.

2-01.3(3) LIMITS OF CLEARING AND GRUBBING

The limits of clearing and grubbing shall be as indicated on the Drawings or in the Project Manual.

2-01.3(4) ROADSIDE CLEANUP

From time to time or as may be ordered by the Engineer and immediately after completion of the work, the Contractor shall clean up and remove all refuse and unused materials of any kind resulting from the work. Upon failure to do so within 24 hours after request by the Engineer, the work may be done by the Owner and the cost thereof be charged to the Contractor and deducted from the Contractor's final estimate.

All cleanup shall be performed as specified in the various Sections of these Specifications.

2-01.3(5) PROTECTION OF EXISTING IMPROVEMENTS

Existing utilities and existing trees, shrubs and other landscape items designated to remain, shall be protected from damage as specified in Section 1-07.16 and 1-07.17.

2-01.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

2-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-01 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Clearing," per square foot.
(2) "Grubbing," per square foot.
(3) "Clearing and Grubbing," per square foot.

The unit contract price for "clearing", "Grubbing", or "Clearing and Grubbing" shall include all costs to complete the work as specified in Section 2-01.

If the Bid Form does not include a pay item pertaining to the work of "Clearing", "Grubbing", or "Clearing and Grubbing", then the work specified shall be considered as incidental to the construction of the project and all costs incurred by the Contractor shall be included in the prices bid for other items of the construction.

Roadside cleanup shall be considered as incidental to the construction of the project.

All costs and expenses involved in securing, operating and maintaining any waste or borrow site (including final cleanup and any erosion or anti-pollution controls required in the permits, property owner agreements, grading regulations, and other contract documents) will be considered as incidental to the Contract and such costs and expenses shall be included in the contract prices for the various pay items shown in the Bid Form.

SECTION 2-02 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

2-02.1 DESCRIPTION

This work shall consist of removing and disposing of, or salvaging, materials named in the Project Manual or identified by the Engineer. The work also includes the backfilling of trenches, holes, or pits that result from such removal.

Work in this section shall also consist of removal, salvage, disposal, and abandonment of selected existing items of improvements listed in the Bid Form, and located within an improved street right of way or area of existing improvements. Care must be exercised to prevent damage to existing utilities or portion of improvements that are to remain.

2-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Non-structural concrete..... 5-05
Aggregates 9-03

Concrete for plugging outlet pipes shall be Class 5 (3/4) meeting the requirements of Section 5-05.

Concrete for filling inlets shall be Class 6.5 (1-1/2) H.E.S. meeting the requirements of Section 5-05.

Backfill material for filling structure voids and structures (other than inlets) shall be Mineral Aggregate Type 9 or Type 17 meeting the requirements of Section 9-03.16; selected material excavated on the project site; or such other material as designated by the Engineer.

2-02.3 CONSTRUCTION REQUIREMENTS

2-02.3(1) GENERAL REQUIREMENTS

With certain exceptions as specified elsewhere in these Specifications, the Contractor shall raze, remove, and dispose of all buildings and foundations, structures, fences, and other obstructions that lie wholly or partially within the right of way. The exceptions are utility-owned equipment and any other items the Engineer may direct the Contractor to leave intact. The Contractor shall:

(a) Remove foundations to a depth of at least 5 feet below finished ground elevation or subgrade elevation, whichever is lower.
(b) Break up basement floors to promote drainage.
(c) Fill basements or other cavities left by the removal of structures. The fill shall match the level of surrounding ground. Any such fill within the slopes of the roadbed shall be compacted to meet the requirements of Section 2-03.3(14)D, Method B.

When salvageable material is to remain Owner property, the Project Manual or these Specifications will identify the material and describe how the Contractor shall remove it. Such material shall be stored on the project site as the Engineer directs or delivered to location given in Project Manual.

Any material not named in the Project Manual or these Specifications as Owner property will belong to the Contractor. The Contractor shall store or dispose of such material so that it cannot be seen from any public highway.

The Contractor shall dispose of surplus or waste material per Section 2-01.2. The Contractor shall not under any circumstance dispose of surplus or waste material within a wetland as defined in Section 2-03.3(7). Costs of disposal shall be included in the bid prices for other work.

The removal of street improvements shall be conducted in such a manner as not to damage utilities or any portion of the improvement that is to remain in place.

2-02.3(2) REMOVAL OF BRIDGES, BOX CULVERTS AND OTHER DRAINAGE STRUCTURES

In salvaging any steel or wooden bridge that will remain Owner property, the Contractor shall prevent unnecessary damage to the material. Steel members shall be match-marked.

Unless otherwise directed, the Contractor shall remove foundations of existing structures to a point 2 feet below the finished ground level, the adjacent ground level, or the natural stream bottom. If a foundation lies wholly or partially on the site of a new structure, it shall be removed to a level that accommodates building the new structure.

Any blasting shall be subject to the Engineer's approval. The Contractor must complete all blasting before the placement of new work.

2-02.3(3) REMOVAL OF EXISTING STREET IMPROVEMENTS

2-02.3(3)A REMOVE NON-RIGID PAVEMENT AND UNTREATED ROADWAY SURFACES

Non-rigid pavements shall be streets, driveways, alleys, sidewalks or other surfaces constructed from a bituminous mix, or any combination of bituminous mixes or surface treatments, upon an earth or granular base. Untreated roadway surfaces shall be oil mat, crushed rock, and gravel surfaces. Untreated roadway surfaces shall not be considered pavements.

Removal of non-rigid pavements and untreated roadway surfaces shall be considered part of the work of excavation. Removal shall be to the neat line trench width with the following exceptions:

(a) Open cuts which straddle the edge of roadway shall be removed to the neat line or 2 feet from the edge of roadway, whichever is greater;
(b) Removal shall be to the edge of roadway if the strip remaining between the edge of roadway and neat line is less than 2 feet in width.

Non-rigid pavement shall be precut prior to removal by use of an asphalt cutting wheel, sawcutting, or line drilling at the Contractor's option to ensure a neat straight line. Cutting shall be completely through the non-rigid pavement.

If the Contractor's work and equipment causes damage beyond the cut line, the Contractor shall make good the damages and replacement of asphalt shall be to the width as directed by the Engineer.

2-02.3(3)B REMOVE ASPHALT OVERLAY

When removing an asphalt overlay from a rigid base pavement the Contractor shall use methods and equipment that will not structurally damage the existing rigid base. The methods and equipment shall be subject to the Engineer's approval.

2-02.3(3)C REMOVE RIGID PAVEMENT

Rigid pavements are streets, driveways, alleys, and other rigid slabs greater than 4 inches in thickness, constructed from concrete, brick, cobble-stones, or any combinations of these materials, with or without an asphaltic overlay.

Rigid concrete pavement shall be removed to the maximum pay width shown on Standard Plan No. 404A, or beyond, subject to the following requirements:

(a) Pavement shall be removed to any longitudinal joint, crack, or edge of pavement that is less than 3 feet from the neat line trench area.
(b) Pavement shall be removed to any transverse joint or crack that is less than 5 feet from the neat line trench area.
(c) Minimum restoration shall be full panel replacement if one or more of the following conditions exist:
  (1) On any panel less than 3 years old.
  (2) On any panel where the cut removes (or requires removal of) more than half of the panel.
  (3) On any panel in a street in the Central Business District or on any principal arterial where the cut measure more than 24 square feet.
(d) In areas of asphalt pavement over rigid base, the following requirements shall apply:
  (1) If joints or cracks show through the asphalt paving, then all of the requirements extending pavement removal beyond neat lines shall apply.
  (2) If no joints or cracks are visible, or their location cannot be determined, no additional removal beyond the trench neat line area will be required.
  (3) The existing asphalt surfacing abutting the trench line or cut shall be "stepped back" a minimum of 4 inches to completely expose the rigid base.

After removal and before restoration, the Contractor shall trim the edges of the remaining pavement leaving clean vertical faces.

Rigid pavement shall be line drilled full depth or saw cut at the Contractor's option, except when sawing is specifically required on the Drawings. No sawing or line drilling is required where pavement removal extends to a full depth joint or crack.

After line drilling or saw cutting the pavement, the Contractor shall not proceed with pavement removal until he has demonstrated to the satisfaction of the Engineer, the method he will use to break and remove the concrete pavement will not damage the existing utilities, or pavement that is to remain in place. A backhoe may be used to remove broken concrete only after the concrete portion that is to be removed is clearly broken away from the pavement that is to remain in place.

Use of a "headache ball" to break concrete pavement will not be permitted.

2-02.3(3)D REMOVE CATCH BASIN, SANDBOX, VALVE CHAMBER, MANHOLE, OR INLET

The Contractor shall excavate and completely remove the structure including casting and outlet trap, concrete encasement, and bricks, as applicable to each removal item listed in the Bid Form.

Connecting pipes shall be plugged by filling with Class 5 (3/4) concrete for a minimum length of 12 inches. Backfill shall be with selected material, Mineral Aggregate Type 17, or other mineral aggregate as designated by the Engineer. Backfill material shall be compacted to meet the requirements of Section 7-17.3(3)A.

2-02.3(3)E REMOVE CURB, CURB AND GUTTER

Curb removal shall be classified as Class A or Class B. Class A is removal by cutting the curb horizontally and preserving the slab or base material below the curb. Class B is removal by cutting the base vertically at the face of the curb and removing the curb with the base material.

Except as otherwise specified, removal of curb placed on top of rigid pavement or base shall be Class A, and removal of full depth curb shall be Class B. Removal of curb for construction of curb ramps, driveways, and monolithic curb and sidewalk shall be Class B irrespective of the type of curb to be removed.

Curb shall be sawcut at the neat line limits of removal, or removed to the nearest joint at the Engineer's option.

2-02.3(3)F REMOVE SIDEWALK

For removal purposes, all concrete slabs that average 4 inches or less in thickness shall be considered as sidewalk removal.

Cement concrete sidewalk shall be removed by sawcutting at the nearest scribe marks beyond the neat line limits subject to the following requirements:

(a) Removal shall be extended to a through joint or to the edge of the sidewalk if within 4 feet of a neat line.
(b) The minimum width of new or remaining concrete walk shall be as follows:
  (1) Two feet when sidewalk is or will be supported on each side by properly placed concrete walk or other improvement that will prevent the sidewalk from shifting.
  (2) Four feet when sidewalk is or will be bounded by earth planting strip.

The depth of saw cut shall be a minimum of 2 inches. Saw cuts shall leave straight edges and vertical faces. No diagonal cuts in sidewalk will be allowed unless otherwise indicated on the Drawings or directed by the Engineer.

A concrete walk that is to remain in place will be protected from equipment damage by using planking or with rock free 8-inch blanket of excavated soil.

Where sidewalk adjacent to a sidewalk opening is in poor condition, removal shall be extended to the nearest through joint or scribe mark as may be directed by the Engineer.

Pavement breakers shall be approved by the Engineer before use.

After construction of adjacent curbs and pavement, the Contractor will be required to remove any additional sidewalk necessary to provide proper connections and grades, as determined by the Engineer.

Asphalt sidewalk shall be removed to the limits designated by the Engineer.

2-02.3(3)G REMOVE ELECTRICAL AND TRAFFIC CONTROL DEVICES

The Contractor shall submit a written schedule for removing the existing traffic systems to the Engineer for approval prior to proceeding with the removal.

The Contractor shall notify the Engineer 3 working days prior to any removal of traffic signals in which no traffic signal devices are to be reinstalled. Within 3 working days after the removal the Contractor shall again notify the Engineer, in writing, stating the location, exact date and time of the actual removal.

The Contractor shall remove equipment from the span wire before the span wire is disconnected from the poles. Existing span wire shall not be cut without first releasing the tension in the span.

2-02.3(4) ABANDON CATCH BASIN, MANHOLE, OR INLET (New Section)

As applicable to each abandon item, the Contractor shall remove the casting and debris; dewater; break down the structure to a depth of the cone sections, or 4 feet below the surface, whichever is greater, and plug the outlet pipe with concrete Class 5 (3/4) for a minimum length of 12 inches; and fill the remaining structure and void with mineral aggregate or concrete as specified below.

Catch basins and manholes shall be filled with Mineral Aggregate Type 9 or Type 17 compacted to 95% of maximum dry density per Section 2-03.3(14)E; old Type 164 inlets shall be filled with Class 6.5 (1-1/2) H.E.S. concrete.

For cement concrete pavement, the surface of the concrete shall match the grade of the existing pavement and shall be brush finished.

2-02.3(5) ABANDON AND FILL PIPE

Pipes designated on the Drawings to be filled and abandoned shall be filled with material as specified in the Project Manual. At each end of the pipe, the pipe shall be plugged with Class 5 (3/4) concrete for a minimum length of 12 inches.

2-02.3(6) SAWING AND LINE DRILLING

When sawing rigid pavement, driveway, or sidewalk, the depth of saw cut shall be 2 inches or half the depth of pavement, driveway, or sidewalk, whichever is greater. All mortared decorative or special pavement (e.g., brick, cobblestone, paver block, etc.) shall be sawcut full depth along a neat line with intent of salvaging as many units as possible.

Curb shall be saw cut full height and width.

Asphalt shall be saw cut full depth.

When line drilling, spacing of drilled holes center to center shall be 6 inches maximum. Holes shall be perpendicular to the surface and shall penetrate completely through the pavement.

When the Drawings indicate or the Engineer requires sawcutting pavement which comprises of rigid base and asphalt overlay, the minimum sawcut-depth for the rigid base shall be as follows:

(a) For concrete rigid base, the depth shall be 2 inches or half the thickness of the rigid base whichever is greater, and
(b) For rigid base constructed with mortared decorative or special pavement (e.g., brick, cobblestone, paver block, etc.) or any combination of such materials the depth shall be full thickness of the rigid base along a neat line with intent to salvage as many special pavement units as possible.

2-02.3(7) SALVAGE

2-02.3(7)A GENERAL

Unless otherwise indicated, all materials of recoverable value taken from the discarded facilities shall be carefully salvaged and delivered to the Owner in good condition and in such order of salvage as the Engineer may direct. Materials and things deemed of no value by the Engineer shall be removed by the Contractor and become his property to be disposed of as he wishes.

All castings and other materials removed from the existing utilities which are not to be re-used elsewhere on the project, and which in the opinion of the Engineer are suitable for salvage, shall have excess concrete, debris and dirt removed and shall be delivered to the location designated by the Engineer. Contact the Engineering Department Warehouse Supervisor for coordination.

2-02.3(7)B WATER MAINS AND APPURTENANCES

The Contractor shall excavate and completely remove hydrants, valves, and any other item specified in the Bid Form, using care not to damage those items to be salvaged. Cast iron water mains designated for removal shall be disposed of by the Contractor. Backfill shall be with selected material, Mineral Aggregate Type 17, or other mineral aggregate as designated by the Engineer. Backfill material shall be compacted to meet the requirements of Section 7-17.3(3)B.

2-02.3(7)C ILLUMINATION, SIGNALS, AND ELECTRICAL

Electrical and traffic items to be salvaged shall include the following:

(a) High pressure sodium luminaires, lamps and photo cells.
(b) Aluminum bracket arms.
(c) Aluminum lighting poles.
(d) Wood and steel lighting poles.
(e) Traffic poles, including joint lighting and traffic poles.
(f) Mast arms.
(g) Pedestals.
(h) Traffic signal controller assemblies and cabinets.
(i) Signal heads.
(j) Illuminated signs.
(k) Handholes.
(l) Junction and Terminal boxes.
(m) Traffic signs - overhead.
(n) Traffic sign.
(o) Designated signal appurtenances.
(p) Miscellaneous channelization items.

Items (a) through (d) shall be delivered by the Contractor to City Light South Service Center at 4th Avenue South and South Spokane Street. Call 386-1766 prior to delivery of wood poles, or 386-1704 prior to delivery of metal poles, high pressure sodium luminaires, lamps, photo cells, and aluminum bracket arms.

Items (e) through (p) shall be returned to Seattle Engineering Department Traffic Shops at 1010 8th Avenue. Call 386-1206 prior to delivery.

2-02.3(7)D REINSTALLING SALVAGED ELECTRICAL MATERIAL

When salvaged electrical equipment is to be reinstalled, the Contractor shall furnish necessary materials, hardware and equipment required to install the equipment in the new installation. Any new hardware required to complete the reinstallation shall be of the same quality and type as hardware required in these Specifications for all other new work.

2-02.3(8) STREET SADDLES AND STEEL PLATES

2-02.3(8)A GENERAL

When backfilling operations cannot be completed by the end of the working day, street saddles or steel plates meeting the requirements below may be used to temporarily cover the excavation.

2-02.3(8)B STREET SADDLES

Saddle board shall be made of 4-inch roughcut, construction grade timbers with no warp. Saddle iron flanges shall be 6 inches wide x 8 inches long. They shall be made of 3/4-inch steel and have chamfered edges. The support iron shall be of adequate size so that there is no significant deflection with traffic. At any time the saddle iron flanges do not get full bearing on the roadway surface, shims shall be used. Saddle boards and irons may be bolted together providing hoist equipment is provided to the Seattle Engineering Department for their removal.

Saddle irons and boards shall be firmly wedged on sides and ends. The boards shall be flush with the roadway surface. All holes shall be cut to provide a good fit, with no excessive openings. Saddle boards shall be notched to receive the irons or scabbing shall be added to the sides of the board so that the board is flush along the pavement opening. There shall be no more than 3 feet of unsupported board between irons. Saddle boards and irons shall be used only on those streets which have a concrete or other surface which can safely support them.

2-02.3(8)C STEEL PLATES

Steel plates shall have a minimum of 12 inches bearing on all sides of a cut and shall be anchored by driving steel pins on all corners or alternate method if approved by the Engineer.

Flanges or angle irons will be welded to the underneath side conforming basically to the size of the street opening. Where the street surface is uneven, plates will be bedded on MC250 asphaltic mix.

Steel plates shall be capable of carrying a minimum of H20 loading.

All steel plates or saddles located in pedestrian crosswalks or within 3 feet of pedestrian crosswalks shall have their edges shimmed with cold mix asphalt. The shims shall be striped with Omaha orange paint or substitute approved by the Engineer. The paint stripes shall be a nominal 2 inches wide and no more than 16 inches on center.

Steel plates in crosswalks or sidewalks shall have a non-skid surface in dry and wet conditions.

Any pedestrian crosswalk containing steel plates or saddles may be closed at the discretion of the Engineer.

2-02.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for saw cutting will be by the linear foot along the slope of the surface cut.

During trench excavation, measurement for removal and sawing of street improvements will be based on the removal and replacement limits indicated on Standard Plan No. 404A as modified by the extended limits provided for in Section 2-02.3(3)C and 2-02.3(3)F, or the limits designated by the Engineer.

Abandon pipe will not be measured.

Measurement for "Abandon and Fill Pipe" shall be by the actual number of linear feet of pipe filled with material as designated in the Project Manual.

Measurement for "Remove Paint Striping" and "Remove Thermoplastic Striping" will be by the actual linear feet of pavement marking removed.

2-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-02 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Remove (Item)," per square yard.
(2) "Remove (Item)," per linear foot.
(3) "Remove (Item)," per each.
(4) "Remove (Item)," per lump sum.
(5) "Saw Concrete, 2 Inch Minimum Depth," per linear foot.
(6) "Saw Asphalt, Full Depth," per linear foot.
(7) "Abandon (Item)," per each.
(8) "Abandon and Fill Pipe," per linear foot.
(9) "Removal of Structures and Obstructions," per lump sum.

The unit contract price for "Remove (Item)" shall include all costs for the work required to completely remove and dispose of or salvage the item as applicable.

Removal of items not listed in the Bid Form shall be considered as incidental to the construction, and the costs thereof shall be included in the various items comprising the improvement.

Removal of non-rigid pavement over granular base will be measured and paid as "Common Excavation" in accordance with Section 2-03, with the following exceptions:

(a) When excavating through non-rigid pavement over granular base to install underground improvements, the costs of removal of non-rigid pavement shall be considered as incidental to the bid item cost of installing the new improvement.
(b) Removal of non-rigid pavement over granular base on street improvement projects shall be paid as "Remove Pavement" if the average thickness of the pavement as determined by the Engineer is greater than 6 inches.
(c) When the Project Manual has been amended to make removal of non-rigid pavement incidental to a particular bid item within the project. No separate payment will be made.

Removal of non-rigid pavement without removal of any underlying cement concrete base will be paid as "Remove Asphalt Overlay."

Removal of rigid pavement greater than 4 inches in total thickness will be paid as "Remove Pavement." Removal of rigid pavement 4 inches or less in total thickness will be paid as "Remove Cement Concrete Sidewalk."

When rigid base is to be removed, the removal of the asphalt overlay from edge of step-back to edge of step-back on each side of the trench shall be considered incidental to the bid item "Remove Pavement."

Removal of trees within the limits of clearing and grubbing shall not be paid under a "Remove Tree" Bid item, but shall be paid as specified in Section 2-01.5. Removal of trees 6" or smaller in caliper measured 1 foot above the base of the trunk shall be considered incidental to the various bid items comprising the improvement.

All minor utility structures, such as meter boxes, handholes, inlets, sandboxes, pipe, identified as removal on the Drawings and located within the excavation area of the trench neat line or within the structure excavation neat lines shown on the drawings, shall be considered as incidental to the bid price for installation of pipe or structure excavation. Removal of catch basin and manhole shall be paid for at the unit price bid for their removal.

Removal of cast-in-place curb will be paid as "Remove Curb," regardless of whether removal is Class A or Class B. All costs for removing other types of curb, such as traffic curb, shall be included in the prices bid for the various bid items shown in the Bid Form. All costs for removal of curb when underlying pavement is being removed shall be considered incidental to "Remove Pavement".

Removal of traffic buttons or traffic islands shall include all costs to restore the surface if required. If there is no specific bid item listed for the removal of existing traffic buttons or lane markers, the cost shall be considered incidental to the various bid items comprising the improvement.

Removal of traffic sign posts shall include all costs for the removal of the post, traffic sign, mounting hardware and restoration of the surface where sign posts were removed.

The unit contract price for "Remove Paint Striping," "Remove Paint Legend/Symbol," "Remove Thermoplastic Striping," and "Remove Thermoplastic Legend/Symbol" shall include all costs for the work required to remove pavement markings as indicated on the Drawings or as directed by the Engineer and to restore the surface if required.

The unit contract price for "Remove Luminaire" and "Remove Luminaire and Bracket Arm" shall be full compensation for removal of the existing luminaire, or luminaire and bracket arm and its ballast, wiring and appurtenances.

The lump sum payment for "Remove Signalization (Location)" shall be full compensation for all labor, material and equipment required to complete the removal, disposal, and salvage work as specified and shown on the Drawings, and shall include salvaging, stockpiling and delivering equipment as determined by the Engineer; and shall include disposal of removed items not salvaged.

The unit contract price for "Remove Pole, Metal," shall be full compensation for all work to remove and salvage the pole.

The unit contract price for "Remove Pole, Wood" shall include costs of all the work required to remove and salvage the pole, and to backfill and compact the void left after pole removal.

The unit contract price for "Remove Foundation, (Type)" shall include costs of all work required to remove and dispose the foundation, and to backfill and compact the void left after removing the foundation.

The unit contract price for sawcutting shall include all costs for the work required to saw cut concrete, or asphalt only at the locations indicated specifically on the Drawings, Specifications, or designated by the Engineer. No payment will be made for sawcutting concrete or asphalt which is done at the option of the Contractor.

In sawcutting of the rigid base, sawcutting through the asphalt overlay will not be measured as a separate item of work and shall be included in the unit contract price of the bid item "Saw Concrete, 2 Inch Minimum Depth."

When the Drawings or the Engineer requires sawcutting to neat edge to remove the asphalt overlay step-back, all costs for the work shall be paid in accordance with the bid item "Saw Asphalt, Full Depth."

No payment will be made to abandon pipe or other subsurface items identified on the Drawings and for which no work is required. Plugging the exposed or open ends of pipes to be abandoned shall be considered incidental to the installation of new pipe.

The unit contract price for "Abandon (Item)" shall include all costs for the work required to abandon the utility structure as specified.

The unit contract price for "Abandon and Fill Pipe", shall be full compensation for all work including plugging the pipe where indicated on the Drawings, furnishing and filling the pipe with lightweight foam concrete and, incidental work necessary to complete the work specified.

All costs for furnishing, placing, and compacting backfill material after removing or abandoning utility structures shall be considered incidental to "Remove (Item)" or "Abandon (Item)" for each structure.

All costs for salvaging and cleaning castings, electrical components, or other items, and delivering to the Engineer shall be considered to be included in the prices bid for the various items comprising this improvement.

All costs for furnishing and installing Street Saddles and Steel Plates to cover street excavations shall be considered to be incidental to the various bid items requiring the excavation.

SECTION 2-03 ROADWAY EXCAVATION AND EMBANKMENT

2-03.1 DESCRIPTION

2-03.1(1) GENERAL

This work shall consist of excavating and grading the roadway; excavating below grade; removing and replacing slide material; furnishing, placing, temporarily stockpiling, and compacting select or other backfill material; removing and disposing of unsuitable or excess material; and all work necessary for the construction and completion of cuts, embankments, slopes, roadway ditches, side street

approaches, alley and alley approaches, driveways and driveway approaches, sidewalks and planting areas, and such subsidiary work described in this section and not otherwise provided for separately in other Sections of these Specifications.

This work shall be performed in reasonably close conformity with the lines, grades, and cross sections indicated in the Contract Documents or established by the Engineer.

2-03.1(2) CLASSIFICATION

Roadway excavation shall be classified as common excavation, solid rock excavation and unsuitable foundation excavation. Trench excavation shall be as specified elsewhere.

Solid Rock Excavation shall consist of the removal and disposal of solid rock, i.e. ledge rock that requires systematic drilling and blasting for its removal and also boulders exceeding 1/2 cubic yard in volume. Hard pan, hard clay or glacial till shall not be classified as solid rock excavation. Sandstone, siltstone, shale or other sedimentary rocks which are soft, weathered or extensively fissured shall not be classified as solid rock excavation. Soft rock is defined as one which has a modulus of elasticity of less than 200,000 psi.

Unsuitable Foundation Excavation shall consist of the removal and disposal of unstable material including, but not limited to, peat, muck, swampy or other unsuitable materials such as buried logs and stumps, but only when the removal is as specified in Section 2-03.3(14)F or 2-03.3(14)G and such methods are specified in the Project Manual and included in the Bid Form, or are specifically ordered in writing by the Engineer. Removal of soft or spongy spots in the prepared subgrade shall be considered excavation below grade pursuant to Section 2-03.3(3).

Common Excavation shall consist of all other material not classified as solid rock excavation, unsuitable foundation material excavation, or excavation which is considered to be incidental to other contract bid items in the Contract. The widening of roadway cuts and ditches and excavation below the designated subgrade when ordered by the Engineer shall be considered as common excavation.

2-03.1(3) PROTECTION OF EXISTING IMPROVEMENTS

In addition to the requirements of Section 1-07.16 and 1-07.17 the Contractor shall insure that mineral aggregates, debris from the work area, and materials from roadway excavation, are prevented from entering existing manholes. Manholes in the vicinity of roadway excavations or material stock piles shall have shields placed over the manhole channel. Shields shall remain in place until excavation and grading operations are complete. Within 24 hours thereafter, any material which has collected on the shields and the shields shall be removed. Removal shall be such that no debris or material falls into the channel.

2-03.2 VACANT

2-03.3 CONSTRUCTION REQUIREMENTS

2-03.3(1) WIDENING OF CUTS

If routine cuts do not supply enough material to form the embankment, the Contractor shall obtain more fill from cuts inside or outside the right of way as the Engineer may direct or from widening one or both sides of existing cuts as staked by the Engineer.

In either case, the Contractor shall dress the sides of the cuts to any slopes the Engineer may require.

2-03.3(2) ROCK CUTS

(a) **Preserving rock below subgrade.** The Contractor shall take care not to break down, loosen, or damage the rock under the subgrade line. Normally, cuts will be made from the top, lift by lift, to protect the rock bench that will remain. The Contractor shall be responsible for methods used and for any damage caused to the roadbed, regardless of any previous approvals by the Engineer.
(b) **Scaling and dressing.** To leave rock cuts in a safe, stable condition, the Contractor shall scale and dress them, removing all loose fragments and rocks not firmly fastened to the rock slope. The Contractor shall also remove any overhanging rock the Engineer sees as a hazard to roadway users.

If the Engineer requires it, the Contractor shall remove loose fragments and rocks lying outside the slope stakes. Payment for such extra work shall be by force account as provided in Section 1-09.6. The Owner will pay for loading and hauling these materials at the unit contract prices that apply or as provided in Section 1-04.4.

(c) **Controlled blasting:** No blasting will be permitted until the Contractor submits and obtains the approval of the Engineer for a blasting plan outlining how drilling, loading, and shooting will be done.

See Section 1-07.22 Use of Explosives for additional requirements.

When blasting to establish slopes 1/2 to 1 or steeper, and more than 10 feet high, the Contractor shall use controlled blasting. The Engineer may require the Contractor to use controlled blasting to form the faces of other slopes, even if the slopes could be formed by nonblasting methods.

Controlled blasting refers to the controlled use of explosives and blasting accessories in carefully spaced and aligned drill holes to provide a free surface or shear plane in the rock along the specified backslope. Controlled blasting techniques covered by this specification include presplitting and cushion blasting. Other controlled blasting techniques may be used. The Contractor shall notify the Engineer the drilling and blasting method(s) he will use.

Not less than 2 weeks prior to commencing drilling and blasting operations or at any time the Contractor proposes to change the drilling and blasting methods, the Contractor shall submit a blasting plan to the Engineer for review. The blasting plan shall contain the full details of the drilling and blasting patterns and controls the Contractor proposes to use for both the controlled and production blasting. The blasting plan shall contain the following minimum information:

(1) Station limits of proposed shot.
(2) Plan and section views of proposed drill pattern including free face, burden, blasthole spacing, blasthole diameter, blasthole angles, lift height, subdrill depth and length of powder column.
(3) Loading diagram showing type and amount of explosives, primers, initiators, location and depth of stemming, and any necessary decking.
(4) Initiation sequence of blastholes including delay times and delay system, type of firing system and type of blasting machine.
(5) Manufacturer's data sheets for all explosives, primers, and initiators, firing system and blasting machine to be employed.
(6) On-site explosive storage and methods and means of explosive transportation.
(7) Name of licensed blaster in charge of on-site blasting and explosives.

(8) Any necessary vibration monitoring device(s) with latest calibration report. Method of anchoring device(s) and location(s) at blast site.

Review of the blast plan by the Engineer shall not relieve the Contractor of the responsibility for the accuracy and adequacy of the plan when implemented in the field. When using control blasting the Contractor shall:

(1) Prior to commencing full-scale blasting operations, the Contractor shall demonstrate the adequacy of the proposed blast plan by drilling, blasting, and excavating short test sections, up to 100 feet in length, to determine which combination of method, hole spacing, and charge works best. When field conditions warrant, the Contractor may be ordered to use test section lengths less than 100 feet.

Unless otherwise approved by the Engineer, the Contractor shall begin the tests with the controlled blast holes spaced 30 inches apart, then adjust if needed, until the Engineer approves the spacing to be used for full-scale blasting operations.

(2) The Contractor shall completely remove all overburden soil and loose or decomposed rock along the top of the excavation for a distance of at least 30 feet beyond the end of the production hole drilling limits, or to the end of the cut, before drilling the presplitting holes.

(3) The controlled blast holes shall be not less than 2-1/2 inches nor more than 3 inches in diameter.

(4) The Contractor shall control drilling operations by the use of the proper equipment and technique to ensure that no hole shall deviate from the plane of the planned slope by more than 9 inches either parallel or normal to the slope. Drill holes exceeding these limits shall not be paid for unless satisfactory slopes are being obtained.

(5) Controlled blast holes shall extend a minimum of 30 feet beyond the limits of the production holes to be detonated, or to the end of the cut as applicable.

(6) The length of controlled blast holes for any individual lift shall not exceed 20 feet unless the Contractor can demonstrate to the Engineer the ability to stay within the above tolerances and produce a uniform slope. If greater than 5 percent of the presplit holes are misaligned in any one lift, the Contractor shall reduce the height of the lifts until the 9-inch alignment tolerance is met. Upon satisfactory demonstration, the length of holes may be increased to a maximum of 60 feet with written approval of the Engineer.

(7) When the cut height requires more than one lift, a maximum 2-foot offset between lifts will be permitted to allow for drill equipment clearances. The Contractor shall begin the control blast hole drilling at a point which will allow for necessary offsets and shall adjust, at the start of lower lifts, to compensate for any drift which may have occurred in the upper lifts.

(8) Before placing charges, the Contractor shall determine that the hole is free of obstructions for its entire depth. All necessary precautions shall be exercised so that the placing of the charges will not cause caving of material from the walls of the holes.

(9) The maximum diameter of explosives used in presplit holes shall not be greater than 1/2 the diameter of the presplit hole.

(10) Only standard explosives manufactured especially for controlled blasting shall be used in controlled blast holes, unless otherwise approved by the Engineer. Bulk ammonium nitrate and fuel oil (ANFO) shall not be allowed to be loaded in the presplit holes.

If fractional portions of standard explosive cartridges are used, they shall be firmly affixed to the detonating cord in a manner that the cartridges will not slip down the detonating cord nor bridge across the hole. Spacing of fractional cartridges along the length of the detonating cord shall not exceed 30 inches center to center and shall be adjusted to give the desired results.

Continuous column cartridge type of explosives used with detonating cord shall be assembled and affixed to the detonating cord in accordance with the explosive manufacturer's instructions, a copy of which shall be furnished to the Engineer.

(11) The bottom charge of a presplit hole may be larger than the line charges but shall not be large enough to cause overbreak. The top charge of the presplitting hole shall be placed far enough below the collar, and reduced sufficiently, to avoid overbreaking and heaving.

(12) The upper portion of all presplit holes, from the top most charge to the hole collar, shall be stemmed. Stemming and decking materials shall be sand or other dry angular material, all of which passes a 3/8-inch sieve.

(13) If presplitting is specified, the detonation of these holes shall be fired first.

(14) If cushion blasting is specified, the detonation of these holes shall be fired last on an instantaneous delay after all other blasting has taken place in the excavation.

(15) Production blast holes shall not be drilled closer than 6 feet to the controlled blast line, unless approved by the Engineer. The depth of production holes shall include the required amount of subdrilling that would yield the desired level of working floor of cut after blasting. Production holes shall not exceed 6 inches in diameter, unless approved by the Engineer. Detonation of production holes shall be on a delay sequence toward a free face.

(16) The use of horizontal blast holes for either production or controlled blasting is prohibited.

2-03.3(3) EXCAVATION BELOW GRADE

When the Contractor finds rock or other hard material at the subgrade elevation, it shall be excavated the full width of the roadbed to at least 6 inches below subgrade, then backfilled with rock fragments, gravel, or other free-draining material not more than 4 inches in diameter.

If the Contractor uses a subgrade trimmer, the backfill shall be rock, gravel, or other free-draining material not more than 2 inches in diameter. The Contractor shall save the finer granular material from excavations or borrow pits to use in backfilling the top 6 inches of the subgrade. All such material shall be approved by the Engineer.

Draining rock pockets. If blasting below subgrade leaves a rock pocket that will not drain, the Contractor shall, at his cost, dig a trench from the pocket bottom to the roadside ditch, then backfill both the pocket and the trench with rock fragments, gravel, or other material approved by the Engineer.

Compaction. If the density of the natural earth under any area of the roadway is less than that required in Section 2-03.3(14)D, Method B, the Engineer may direct the Contractor to:

(a) Scarify the earth to a depth of 6 inches.
(b) Aerate or water.
(c) Compact the scarified area to the required density.
(d) Excavate to a specific depth.
(e) Backfill the excavated area in layers, using the previously excavated material or other material.
(f) Compact each layer to meet the compaction requirements for embankments.

Roadway excavation shall be to the depths indicated on the Drawings and staked by the Engineer except where excavation below grade is designated in the field by the Engineer. Excavation below grade shall be the same classification of excavation as that above.

2-03.3(4) SLUICING

The Contractor shall not excavate by sluicing unless the Project Manual specifically calls for it.

2-03.3(5) SLOPE TREATMENT

The tops of all roadway cut slopes, except solid rock cuts, shall be rounded in accordance with WSDOT Standard Plan No. H-8. Unless otherwise noted in the Drawings or Project Manual, Class A slope treatment shall be utilized.

If a layer of earth covers a rock cut, the slope shall be rounded above the rock as if it were an earth slope.

When the Contractor removes stumps or any embedded material from the rounded area, the void shall be backfilled and stabilized to prevent erosion.

2-03.3(6) DEPOSIT OF ROCK FOR OWNER'S USE

At the Engineer's direction, the Contractor shall deposit excavated rock at the roadside or elsewhere. If this requires the Contractor to use material that would otherwise have gone into an embankment, the Owner will pay for the extra cubic yards of excavation needed to complete the embankment. Any such rock deposit shall be Owner property. The Contractor shall be responsible for safe-keeping the deposit until the Owner has removed it or until the Contract is completed.

2-03.3(7) DISPOSAL OF SURPLUS MATERIAL

Material obtained from all excavation within the project boundary shall not be wasted unless the excavated material is designated by the Engineer as unsuitable for use in embankment construction, trench backfill, or for other purposes.

Excess material shall not be disposed of within a wetland area.

Disposition of surplus material from trench excavation shall be as specified in Section 2-03.3(10).

Material which is surplus to the needs of the project or determined to be unsuitable by the Engineer shall be wasted in accordance with Section 2-01.2.

2-03.3(8) WASTING MATERIAL

If the Contractor wastes excavated material which is deemed suitable by the Engineer for embankments or other backfills, and material is later needed for embankments or fills, the Contractor shall, at his own cost, replace the wasted material with material meeting the Engineer's approval.

2-03.3(9) ROADWAY DITCHES

At each transition from cut to fill, the Contractor shall divert any roadway ditch away from the embankment in natural ground. Ditches shall never permit water to flow into or upon embankment material.

All ditches shall be constructed as shown on the Drawings and shall be graded to direct the flow of the water to catch basins, culverts or channels.

2-03.3(10) SELECTED MATERIAL

Selected material shall be considered as that material designated by the Engineer as suitable for selected fill applications, which is obtained from the excavation or widening of the roadway prism, or any other excavation within the street right of way, including trench excavation. Selected material shall be used first before new borrow material is imported for construction of project embankments, finishing the top portion of the subgrade, structure backfill, or such other backfill applications the Engineer may designate.

Selected material shall be used for any of the following purposes as determined by the Engineer:

(a) Embankment construction
(b) In lieu of Mineral Aggregate (Type) meeting the requirements of Section 9-03
(c) Trench backfill
(d) Planting soil
(e) Other selected uses as determined by the Engineer

Excavated material which is in excess to the needs of the project shall be disposed of per Section 2-01.2.

Selected material shall be placed and compacted in accordance with the requirements for the type of work for which the material is being used.

Material deemed suitable by the Engineer for embankments and other uses shall be hauled to, and placed in, the nearest embankment or other fill, or temporarily stockpiled for later use.

If necessary, stockpiling of selected material shall be at locations approved by the Engineer. Thereafter, such material shall be removed from stockpile and used when needed.

Excavated material stockpiled for use as selected materials shall be protected from contamination by other materials and from damage by weather by covering with waterproof sheeting or such other means as the Contractor deems necessary. Materials stockpiled and later found unsuitable by the Engineer shall be disposed of and replaced with material acceptable to the Engineer.

2-03.3(11) SLIDES

The Contractor shall slope the sides of cuts and embankments to comply with lines staked or reestablished by the Engineer. If a slide occurs on a finished slope before final acceptance of the work, the Contractor shall remove or replace the slide material. The Contractor shall also refinish the slope to the condition and with the materials required by the Engineer.

The Owner will pay for the excavation at the unit contract price and for resloping on a force account basis. The Engineer may authorize payment for the excavation by agreed price or force account if:

(a) The slide material cannot be measured accurately; or
(b) Excavation of slide material requires equipment not available on the project.

If the Contractor undercuts or destroys a slope, it shall be resloped to the original alignment or to a new one established by the Engineer.

2-03.3(12) OVERBREAK

Overbreak includes that part of any material excavated, displaced, or loosened outside the staked or reestablished slope or grade. Such material is considered overbreak whether its movement resulted from blasting, from the character of the material itself, or from any other cause. Overbreak, however, does not include material from slides as described in Section 2-03.3(11).

If the Engineer does not approve use of the overbreak, the Contractor shall remove, haul, and dispose of it. In this case the Contractor shall follow the procedure for handling surplus material described in Section 2-03.3(7).

If the Engineer approves, the Contractor may use overbreak:

(a) To complete an embankment when the excavated material unexpectedly falls short of the amount required.

(b) To replace borrow excavation originally planned for an embankment.

2-03.3(13) BORROW

Borrow is imported material obtained from sources other than the roadway prism, trench excavation, or other excavation on the project. When suitable native excavated material is insufficient, borrow shall be used to construct embankments, subgrade, shoulders, or other roadway components to the neat lines shown on the Drawings. Sources of borrow material shall be approved by the Engineer.

Borrow shall be classified as "Unclassified Borrow" or "Borrow (Type)" as follows:

(a) "Unclassified Borrow" shall be an imported soil which meets the suitability requirements set forth in Section 2-03.3(14).

(b) "Borrow (Type)" shall be an imported soil which meets the suitability requirements set forth in Section 2-03.3(14), and in addition shall meet all gradation and other requirements listed in Section 9-03.16 for the type of Mineral Aggregate specified (e.g., "Borrow, Type 17", etc.).

2-03.3(14) EMBANKMENT CONSTRUCTION

2-03.3(14)A GENERAL

The Owner classifies embankment construction as:

(a) Rock embankment–in which the material in all or any part of an embankment contains 25 percent or more, by volume, gravel or stone 4 inches or more in diameter. Section 2-03.3(14)B.

(b) Earth embankment–made of any material other than that used in rock embankment. Section 2-03.3(14)C.

Unstable base. If the Engineer believes the natural earth base will impair an embankment or make it unstable, the Contractor shall stablize or remove and dispose of the base material in keeping with this Section or Section 2-03.3(14)F.

Hillside terraces. Unless the Engineer directs otherwise, the Contractor shall terrace the original ground or embankment on hillsides, on the sides of existing embankments, and in transitions from cuts to fills. Each terrace shall penetrate the slope at least 5 feet and shall not be more than 5 feet high. The horizontal face of the terrace shall slope outward at approximately .05 foot per foot. The Engineer may order the Contractor to place gravel backfill, pipe drains or both to drain any seepage.

Soft base. On wet or swampy ground, the Contractor shall haul and spread embankment material by methods that will disturb the base as little as possible. If the Engineer approves, the Contractor may place the lower part of the fill by dumping and spreading successive loads to form a uniform layer just thick enough to support equipment used to place and compact upper layers.

Normally the Contractor shall not increase the planned depth of the embankment over a soft base merely to permit the use of heavier equipment. But if the Contractor proves that the planned depth will not support light hauling vehicles, the Engineer may approve a deeper fill. The Contractor shall not claim extra pay if these restrictions require the use of lighter equipment or different construction methods than originally planned for use on the soft base.

In the order of priority, material used for embankment shall be:

(a) Selected material obtained from Common Excavation and Trench Excavation

(b) Borrow of the type specified

Selected excavated material shall be used for the construction of all required project embankments per Section 2-03.3(10).

Excavated material will be considered suitable for general fill applications which do not require a material meeting specific Mineral Aggregate specifications found in Section 9-03 if it:

(a) Is capable of attaining the degree of compaction specified in Section 2-03.3(14)D;

(b) Is within plus or minus 3 percent of optimum moisture content as determined in accordance with ASTM D698;

(c) Is free from deleterious material and does not contain more than 5% total by volume of organic material; clay; frozen lumps; and rocks, concrete, asphalt, or other debris and rubble having a dimension greater than 6 inches;

Embankment material which contains less moisture than required for proper compaction with the compacting equipment being used shall be watered in the amount ordered by the Engineer. Compaction of embankment material which contains excessive moisture shall not be started until the moisture content is reduced to the maximum amount specified above.

2-03.3(14)B ROCK EMBANKMENT CONSTRUCTION

The Contractor shall build rock embankments in horizontal layers. No layer shall be deeper than 18 inches unless the rocks in the fill material average more than 18 inches in diameter. The Contractor shall separate and distribute the larger pieces of rock and fill the spaces between them with smaller rocks and earth. With the Engineer's approval, the Contractor may dispose of rocks larger than the average size instead of placing them in the embankment.

Compacting. The Contractor shall use a 50-ton compression roller or a vibratory roller having a dynamic force of at least 40,000 pounds impact per vibration and at least 1,000 vibrations per minute. In either case, the roller shall make one full coverage for each 6 inches, or any fraction of 6 inches, of lift depth.

When lift depth is 18 inches or less, the Contractor may use a 10-ton compression roller or a vibratory roller having a dynamic force of at least 30,000 pounds impact per vibration and at least 1,000 vibrations per minute. In either case, the roller shall make four full coverages for each 6 inches, or any fraction of 6 inches, of lift depth.

Rollers must exert reasonably even pressure over the area covered. The Contractor shall limit the speed of compression rollers to no more than 4 miles per hour; and the speed of vibratory rollers to no more than 1.5 miles per hour.

If possible, the Contractor shall compact the material even further by routing empty and loaded hauling equipment evenly over the entire width of the embankment.

When the Engineer believes rolling to be physically impractical, rolling may be omitted on part or all of a layer.

Should excessive moisture threaten the stability of the embankment the Engineer may order the Contractor to alter the operation. This may include alternating layers of wet and dry materials, drying materials before placing, or halting work in the problem areas.

Top layer. The Contractor shall build each rock embankment up to 6 inches below subgrade. The top 6-inch layer of embankment shall be of rock, gravel, or other free-draining material that does not exceed 4 inches in diameter. When the Drawings require use of a subgrade trimmer, these materials in the top layer may not exceed 2 inches in diameter.

When practical, and as approved by the Engineer, the Contractor shall save the finer granular material from excavations or borrow pits for use in topping rock fills.

2-03.3(14)C EARTH EMBANKMENT CONSTRUCTION

The Contractor shall place earth embankments in horizontal layers of uniform thickness. These layers shall run full width from the top to the bottom of the embankment. Slopes shall be compacted to the required density as part of embankment compaction.

During grading operations, the Contractor shall shape the surfaces of embankments and excavations to uniform cross-sections and eliminate all ruts and low places that could hold water.

On a tangent, the Contractor shall raise the center of the embankment above the sides. On a sidehill, the high point of any layer shall intersect the original ground and shall slope uniformly toward the lower side. This slope shall not exceed 1 foot in 20 feet.

2-03.3(14)D COMPACTING EARTH EMBANKMENTS

This section describes three methods (A, B, and C) for building earth embankments. The Contractor shall use Method B unless the Project Manual requires another method.

Method A. Each embankment shall be made of layers no more than 2 feet thick. The Contractor shall compact each layer by routing loaded haul equipment over its entire width. If the Engineer approves, the Contractor may use end dumping to begin placing a sidehill fill too narrow for hauling equipment. When the fill is wide enough, the remaining layers shall be compacted by the loaded hauling equipment.

Method B. The top 2 feet of each embankment shall be compacted to 95 percent of the maximum density as determined by the compaction control tests described in Section 2-03.3(14)E. All material below the 2-foot level shall be compacted to 90 percent of the same maximum density.

In the top 2 feet, horizontal layers shall not exceed 4 inches in depth before compaction. No layer below the top 2 feet shall exceed 8 inches in depth before compaction.

The Contractor shall use compacting equipment approved by the Engineer.

Method C. Each layer of the entire embankment shall be compacted to 95 percent of the maximum density as determined by the compaction control tests described in Section 2-03.3(14)E.

In the top 2 feet, horizontal layers shall not exceed 4 inches in depth before compaction. No layer below the top 2 feet shall exceed 8 inches in depth before compaction.

The Contractor shall use compacting equipment approved by the Engineer.

Under Methods B or C, the Engineer may permit the Contractor to increase layer thickness up to 18 inches before compaction, provided:

(a) The layer is more than 2 feet below the top of the embankment.

(b) An approved vibratory roller is used, and

(c) The required density is obtained throughout the full depth and width of each layer.

Whatever the method used, any embankment inaccessible to large compacting equipment shall be compacted with small mechanical or vibratory compactors.

Moisture content. Within the limits described below, the Contractor shall adjust moisture content during compaction to produce a firm, stable embankment. The Contractor shall not begin compaction until the moisture content is so adjusted.

Under Methods B, the moisture content of the material shall not exceed 3 percent above the optimum determined by the tests described in Section 2-03.3(14)E. If the material contains too little moisture to compact properly, the Engineer may order the Contractor to water the material in specific amounts. See Section 2-07.

Under Method C, the moisture content shall not vary more than 3 percent above or below optimum determined by the tests described in Section 2-03.3(14)E.

The Engineer may permit the Contractor to place materials having a higher moisture content than specified in this Section if:

(a) The material consists of free-draining rock, gravel, or sand that produces a firm, stable embankment, and

(b) The excess moisture will not impair the embankment.

However, the Engineer may at any time requires the Contractor to return to normal moisture-content specifications.

If weather prevents drying excavation or borrow materials to the required moisture content, the Engineer may order the Contractor to alter normal procedures or equipment to prevent damage to the partial or complete embankment. In this case, the Owner will not increase payment, but will pay the unit contract prices for the pay items that apply.

The Contractor shall repair any partial or complete embankment that loses stability because of continued hauling across it. Evidence of lost stability shall include pumping or rutting. The Contractor shall also alter hauling equipment or procedures to prevent further damage.

If it appears that rain or snow will soak an area that has been aerated, the Contractor shall temporarily seal it against the weather.

2-03.3(14)E COMPACTION CONTROL TESTS

In-place density will be determined by one or more of the following methods:

(a) **ASTM D1556,** Test for Density of Soil In-place by the sand cone method

(b) **ASTM D2167,** Test for Density of Soil In-place by the rubber balloon method

(c) **ASTM D2922,** Test for Density of Soil In-place by the nuclear method

Laboratory densities may be determined by one of the following methods:

(a) **ASTM D698,** Moisture-Density Relations of Soils and Soil-Aggregate Mixtures

(b) **ASTM D4253,** Maximum Index Density of Soils using a Vibratory Table.

ASTM D698 will be used for computing the maximum density of all fill soils except for those granular soils yielding, in the opinion of the Engineer, an unsatisfactory moisture-density curve. In that case the maximum density will be determined by the method specified in **ASTM D4253.**

The Contractor shall excavate pits for density sampling at locations designated by the Engineer. Density sampling will be performed by Owner forces.

Degree of compaction in trench backfill shall be as specified in Section 7-17.3(3)B. All other fills and earth embankments shall be as specified in Section 2-03.3(14)D.

2-03.3(14)F UNSUITABLE FOUNDATION EXCAVATION

When the Contract or the Engineer requires it, the Contractor shall excavate unstable natural ground before building any embankment over it. This unstable material may include peat, muck, swampland, buried logs and stumps, or other material not fit for an embankment base. The Contractor shall excavate such material to the boundaries set by the Engineer.

The work will not be considered unsuitable foundation excavation if the materials:

(a) Came from the roadway cut, ditch, or channel-change prisms as defined by Section 2-03.1(2).
(b) Resulted from structure excavation.
(c) Are covered in Section 2-03.3(3).

Materials excavated from the roadway or channel change prisms will not be classified as unsuitable foundation excavation as defined by Section 2-03.1(2) unless the removal is accomplished by dragline operation or by special excavation methods requiring different equipment from that used for roadway excavation, as determined by the Engineer.

2-03.3(14)G DISPLACEMENT OF UNSUITABLE FOUNDATION MATERIALS

If the Contract requires it, the Contractor shall displace or remove any overburden of peat, muck, or other unstable material to permit placing the embankment on underlying firm ground. The Engineer will determine the elevation at which the ground is firm enough to support the embankment.

To displace such material, the Contractor shall use explosives or any other method the Engineer requires. If this work upheaves overburden material outside the slopes of the new fill, the Contractor shall level the material to make it presentable.

2-03.3(14)H BACKFILLING

When water fills an area after the removal of soft or unstable materials, the Contractor shall, if possible, drain the site so that he may compact any backfill. If drainage is not possible, the Contractor shall use granular material for backfilling in water, including areas where blasting has displaced the soft material. The Project Manual may require other backfilling methods.

2-03.3(14)I PREFABRICATED VERTICAL DRAINS

If the Contract requires it, the Contractor shall install prefabricated vertical drains and a sand drainage blanket to stabilize the soft or unstable material that overlays firm ground.

The Contractor shall furnish all necessary labor, equipment and materials, and perform all operations necessary for the installation of prefabricated vertical drains in accordance with the details shown on the Drawings and with the requirements of these Specifications.

The prefabricated drain shall consist of a continuous plastic drainage core wrapped in a non-woven geotextile material as specified in the Contract.

The drains shall be free of defects, rips, holes, or flaws. During shipment and storage, the drain shall be wrapped in a heavy duty protective covering. The storage area shall protect the drain material from sunlight, mud, dirt, dust, debris, and detrimental substances. Manufacturer certification shall be provided for all drain materials delivered to the project.

Vertical drains shall be staked by the Contractor and constructed prior to embankment construction.

Prior to installation of vertical drains, a sand drainage blanket shall be placed on the ground surface for use as a working platform. This platform shall have a minimum depth of 2 feet and shall consist of uncompacted material meeting the requirements of Section 9-03.13(2).

Vertical drains shall be installed with equipment which will cause a minimum of subsoil disturbance. A mandrel or sleeve shall be advanced through the subsoil using vibratory, constant load, or constant rate of advance methods. The mandrel shall have a maximum cross-sectional area of 14 square inches, shall protect the prefabricated drain material from tears, cuts, and abrasions during installation, and shall be provided with an "anchor" plate or rod. The "anchor" plate or rod shall provide sufficient strength to prevent the soil from entering the bottom during installation and shall anchor the bottom of the drain at the required depth when the mandrel is removed. Use of falling weight impact hammers or jetting will not be allowed within the compressible subsoil to be drained.

The prefabricated drains shall be installed vertically from the working surface to the required elevations and in a sequence that will not require equipment to travel over previously installed drains. The Contractor shall provide the Engineer with a suitable means of verifying the plumbness of the equipment and determining the depth of the drain at any time. The equipment shall not deviate more than 0.25 inch per foot from vertical.

Splices or connections in the prefabricated drain material shall be done in a professional manner to ensure continuity of the wick material. The prefabricated drain shall be cut to leave at least 6 inches protruding above the working platform at each drain location.

Where obstructions are encountered which cannot be penetrated the Contractor shall abandon the hole. A maximum of two attempts shall be made to install a new drain within 18 inches of the obstructed hole. Drains that otherwise deviate from the Drawing location by more than 6 inches, or that are damaged or improperly installed, will be rejected.

Installation of the drains should consider and be coordinated with the geotechnical instrumentation shown on the Drawings. Special care shall be taken when installing drains near instrumentation already in place. Replacement of instrumentation damaged by the Contractor will be the responsibility of the Contractor.

The Contractor shall demonstrate that the equipment, method, and materials produce a satisfactory installation in accordance with these Specifications. For this purpose, the Contractor shall be required to install trial drains at different locations within the work area.

At least 2 weeks prior to the installation of the drainage wicks, the Contractor shall submit to the Engineer, for review and approval, details of the sequence and method of installation. The submittal shall, at a minimum, contain the dimensions and length of mandrel, a detailed description of the proposed method(s) for overcoming obstructions, and the proposed method(s) for splicing drains.

Approval by the Engineer will not relieve the Contractor of the responsibility to install prefabricated vertical drains in accordance with the Drawings and Specifications. If, at any time, the Engineer considers the method of installation does not produce a satisfactory drain, the Contractor shall alter the method and equipment as necessary.

2-03.3(14)J EMBANKMENTS AT BRIDGE AND TRESTLE ENDS

This work consists of filling around the ends of trestles and bridges, the area defined in Section 1-01.3. The Contractor shall begin and complete this work as soon as possible after each bridge is completed or when the Engineer requires.

The Contractor shall select fill material from the excavation sources elsewhere on the project. Bridge approach embankments shall be compacted to at least 95 percent of the maximum density as determined by the tests described in Section 2-03.3(14)E. In any embankment area where piles will be installed, the Contractor shall remove all solid material, rocks, broken concrete, etc., larger than 3 inches across that would interfere with pile driving.

To prevent the bridge from being distorted or displaced, the Contractor shall place material evenly around all sides and parts of the structure. After the superstructure is in place, use of small compactors may be required and embankments must be layered and compacted concurrently at either end of the structure. The difference in embankment height from one end to the other must never exceed 2 feet.

The Contractor shall build the embankment under the bridge to the dimensions shown in WSDOT Standard Plan No. H-9 or detailed in the Drawings.

2-03.3(14)K GRAVEL BORROW INCLUDING HAUL

When required by the Drawings or the Engineer, the Contractor shall use gravel borrow meeting the requirements of Section 9-03.14 to:

(a) Build embankments.
(b) Backfill excavation of unsuitable foundation Material.
(c) Backfill below-grade excavation.

2-03.3(15) AERATION

The Contractor shall use methods known to be effective in building embankments with wet materials. Such methods include open ditching to drain excavation areas or alternating layers of wet and dry materials.

Aeration equipment. The Engineer may direct the Contractor to use aeration equipment in these areas: roadway excavation, borrow sites, or embankments. The Owner does not guarantee the moisture-reducing effectiveness of any single type of equipment. The Engineer may, however, require the use of any type he believes will best aerate a given area.

If the Contractor uses any of the following types of equipment, it shall meet these minimum requirements:

(a) Heavy duty power grader. This machine shall have a moldboard measuring 12 feet long, 24 inches high, and 3/4 inch thick. Each grader shall carry its maximum number of standard scarifier-rippers or discs.
(b) Heavy duty gang plow. It shall have at least five 16-inch bottoms. Its tractor shall be able to move no less than 1-1/2 miles per hour while plowing at least 9 inches deep through fairly wet material.
(c) Heavy duty tandem dics. This machine shall cut a swath at least 8 feet wide with discs no less than 28 inches in diameter. Its tractor shall be able to turn fairly wet material at least 6 inches deep while moving at 2 miles per hour or more.
(d) Heavy duty self-propelled, rotary pulverizer. This machine shall have paddles attached to a transverse shaft. It shall travel 1-1/2 miles per hour or more while aerating a swath at least 6 feet wide to a depth of 6 inches.

The Contractor shall not use any aerating equipment listed above in tandem nor use any of this equipment to carry out other bid items of work while aerating.

The Engineer may halt aerating work when weather conditions prevent satisfactory results.

2-03.3(16) END SLOPES

The Engineer will determine when and where to build end slopes, whether these occur at the beginning or end of a project, at the borders of excavation or embankments, at bridge ends, or elsewhere. The Contractor shall build end slopes not detailed in the Drawings to the line and grade staked by the Engineer regardless of center line limits shown in the Drawings. All work to complete and maintain these end slopes shall be considered as work to be performed under the Contract.

2-03.3(17) SNOW REMOVAL

If snow is deep enough to interfere with the work that covers a cut or an embankment, the Contractor shall remove and deposit it outside the slope stakes. Snow removal must be done at least 100 feet ahead of excavation and embankment work.

2-03.3(18) STEPPED SLOPE CONSTRUCTION

When the Drawings or the Engineer requires it, the Contractor shall shape slopes cut in soft rock to a stepped pattern conforming closely to the typical cross-section in the Drawings. Stepped slopes shall meet these requirements:

(a) Each step shall be 1 to 2 feet high.
(b) The horizontal depth of each step will depend on its relationship to the staked slope ratio. The approximate midpoint of each horizontal tread shall occur on the staked slope line.
(c) The treads shall be approximately level in all directions.
(d) The ends of the steps shall be blended into the natural ground, with loose material removed from transitional areas.
(e) If the Contractor cannot rip a rock outcropping within a cut, the steps shall be blended into the rock.
(f) Large rocks and material that may fall into the ditch line or onto the roadway shall be removed, but scaling is not required.

The compaction and seeding requirements of Section 8-01.3(1)B shall not apply to stepped slope construction.

The Owner will measure stepped slope excavation by the area defined by the staked slope line. The unit contract price per cubic yard for roadway or borrow excavation shall be full pay for all labor and equipment required to build stepped slopes.

2-03.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Excavation of the class specified will be measured by the cubic yard in its original position by cross sectioning. Quantities will be computed to the neat lines of the cross sections as staked or thereafter modified by the Engineer, except where such modification is the result of excavating beyond the limits established to remove and replace roadway material which has become unsuitable because of the Contractor's neglect, negligence or method of operation.

Borrow will be measured by the ton at the point of delivery in accordance with Section 1-09.1.

Unsuitable foundation excavation will be measured by the cubic yard in its original position by cross sectioning.

Prefabricated vertical drains will be measured by the vertical foot from the top of the working table to the bottom of the holes.

Sand borrow for drainage blanket will be measured by the cubic yard or by the ton as indicated on the Bid Form, provided that moisture in excess of 8 percent will be deducted in ascertaining the pay quantities when measured by the ton.

Embankment compaction will be measured by the cubic yard of embankment material compacted pursuant to Section 2 03.3(14)B or Method B or C in Section 2-03.3(14)D. Quantities will be computed based upon measurements taken to the neat lines of the staked cross section and no allowance will be made for settlement.

When existing material in a cut section is stabilized by scarifying, aerating and compacting, measurement for the embankment compaction will be based upon the length and width of cut section compacted and a maximum depth of 6 inches.

2-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-03 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Common Excavation," per cubic yard.
(2) "Solid Rock Excavation," per cubic yard.
(3) "Unclassified Borrow," per ton.
(4) "Borrow (Type)" per ton.
(5) "Embankment Compaction," per cubic yard.
(6) "Unsuitable Foundation Excavation," per cubic yard.
(7) "Drain, Vertical Sand," per vertical foot.
(8) "Drainage Blanket, Sand," per ton or per cubic yard.

The unit contract price for "Common Excavation" and "Solid Rock Excavation" shall include the costs for all work described in Section 2-03 and not otherwise provided for hereinafter. When excavation below the designated subgrade elevation is ordered by the Engineer, that portion of the excavation 3 feet or less below subgrade will be considered as "Common Excavation." If the Engineer orders excavation more than 3 feet below subgrade that portion below subgrade will be paid as extra work per Section 1-09.4. Payment for such types and classes of excavation listed above shall be full compensation for excavating, loading, hauling, stockpiling, placing as backfill, or otherwise disposing of the material as shown on the Drawings, as specified herein, or as directed by the Engineer.

Excavation or embankment work required to bring the subgrade in sidewalk areas to the level of the top of the sidewalk will be paid per Section 2-03.5. Excavation of the subgrade to the depth of the sidewalk will be paid per Section 8-14.

Where earthwork is required and a bid item is not provided in the Bid Form, all costs for excavation shall be included in the prices bid for the various bid items shown in the Bid Form.

Where solid rock is encountered on a project for which a pay item "Solid Rock Excavation" is not included in the Bid Form, then the work and materials involved in the excavation of the solid rock shall be considered as Extra Work and be paid for in accordance with Section 1-09.4.

The unit contract price for "Unclassified Borrow" or "Borrow (Type)" shall include all costs required to excavate, haul, stockpile, and place the material as shown on the Drawings or as directed by the Engineer. Compaction of borrow material will be paid as "Embankment Compaction."

The unit contract price for "Embankment Compaction" shall include all costs for the work necessary to compact embankments per Section 2-03.3(14) and earth embankments by Methods B or C per Section 2-03.3(14)D.

Compaction of approved on-site excavated native material used for backfill and compaction of borrow shall be paid as "Embankment Compaction" per cubic yard, as indicated above.

The unit contract price for "Unsuitable Foundation Excavation" shall include all costs for the excavation or displacement of unsuitable foundation material only by the methods set forth in Section 2-03.3(14)F and 2-03.3(14)G. Costs shall include disposal of the unsuitable material, and leveling the upheaved material outside of the embankment slopes when the unsuitable material is displaced. Replacement material will be paid separately.

The unit contract price for "Drain, Vertical Sand" shall be full compensation for excavating the drain holes and for selecting, loading, hauling and placing the material.

All costs for excavation, backfill, and recompaction of sampling pits shall be considered incidental to the various bid items in the Bid Form and no separate payment will be made.

Density testing by Owner forces will be performed at no charge to the Contractor for the first test series at a designated location. If these tests indicate a failure to achieve required densities, retesting shall take place after recompaction. The Contractor will be charged $55 for each additional test required until the testing indicates the required densities have been achieved. These charges will be deducted from monies due or to become due the Contractor on Monthly Estimates.

Payment for overbreak material used in lieu of borrow will be made either at the unit contract price for the class of roadway excavation which is applicable or the unit contract price for the type of borrow specified, whichever proves to be most economical to the Owner.

The unit contract price for "Drainage Blanket, Sand," shall include all costs for processing, hauling, and placing the material.

If the Contractor has dressed a cut per Section 2-03.3(1) before the Engineer orders it widened, the Owner will pay for the resloping as provided in Section 1-04.4.

Excavation below grade required to remove a portion of the subgrade made unsuitable by the Contractor's operations or failure to adequately protect the subgrade shall be at the Contractor's cost.

All work required to complete slope treatment, including excavation, haul, and slope rounding, shall be included in the unit bid price for roadway excavation.

All costs for building terraces as specified in Section 2-03.3(14)A shall be included in the prices for other work.

All costs and expenses involved in drying embankment materials with whatever method is appropriate shall be considered incidental to the various unit contract prices.

If the Bid Form does not include mineral aggregates for rock embankment construction, payment will be as provided in Section 1-09.4.

If the Bid Form does not have a bid item for unsuitable foundation excavation, the Owner will pay as provided in Section 1-04.4.

The costs of pumping or digging temporary drainage ditches as required per Section 2-03.3(14)H shall be incidental to and included in other items of work that apply.

Cost related to all work described in Section 2-03.3(14)J shall be incidental to other work and included in the unit contract prices that apply.

All costs to remove, haul, and dispose of overbreak material which is not approved to be used by the Engineer shall be borne by the Contractor.

When excavated material unexpectedly falls short of the amount required to complete an embankment, the City will pay the roadway excavation contract price for the volume of material the overbreak replaces. However, no payment will be made if overbreak is used when other material is available within the neat lines of the roadway prism.

If an undue amount of excavated material deemed suitable by the Engineer is wasted, the Contractor shall secure and furnish borrow of the type acceptable to the Engineer to replace the wasted suitable material at the Contractor's own cost.

Any partial or complete embankment that loses stability because of continued hauling across it due to the Contractor's operation shall be made good by the Contractor at his own cost.

Should the Contractor fail to protect an embankment, which has been aerated, from weather and additional aeration is required to make good the area, all costs for the work shall be borne by the Contractor.

Snow removal shall be at the cost of the Contractor.

SECTION 2-04 HAUL

2-04.1 DESCRIPTION

This work shall consist of transporting excavated material from its original site to its final resting place on the project or at a waste site.

2-04.2 VACANT

2-04.3 CONSTRUCTION REQUIREMENTS

Off-highway earthmoving equipment shall not haul on or across any street not being improved in the Contract.

2-04.4 MEASUREMENT

Haul work will not be measured.

2-04.5 PAYMENT

All costs for the work described in Section 2-04 will be considered incidental to excavation. All costs for haul shall be included in the costs associated with the excavation.

SECTION 2-05 VACANT

SECTION 2-06 SUBGRADE PREPARATION

2-06.1 DESCRIPTION

This work shall consist of the preparation of subgrade for new and existing streets, alleys, driveways, sidewalks or other public places, upon which surfacing is to be placed, or the preparation of the surfaced roadbed, either new or existing, upon which cement concrete pavement is to be placed. All work shall be in accordance with the Contract Documents and in reasonably close conformity with the lines, grades, and typical cross sections indicated in the Drawings or as established and staked by the Engineer.

2-06.2 VACANT

2-06.3 CONSTRUCTION REQUIREMENTS

2-06.3(1) SUBGRADE FOR SURFACING

In preparing the roadbed for surfacing, the Contractor shall:

(a) Remove from the roadbed, immediately before placing surfacing materials, all brush, weeds, vegetation, grass, and other debris.
(b) Dispose of all debris as the Engineer directs.
(c) Drain water from all low spots or ruts.
(d) Shape the entire subgrade to a uniform surface running reasonably true to the line, grade, and cross-section staked by the Engineer.
(e) If necessary, the Contractor shall process the subgrade in cut areas to remove materials too coarse for mechanical trimming and recompaction.
(f) Compact the subgrade to a depth of 6 inches. Compaction shall achieve 95 percent of maximum density determined by tests described in Section 2-03.3(14)E. Compaction shall be to a width of at least 1 foot beyond the pavement edge or to a width that will accommodate the paving equipment without visible distortion of the subgrade. All portions of the surface on the subgrade which are inaccessible to large compactor units shall be thoroughly compacted with smaller compactor units or mechanical tampers. If the underlying material is too soft to permit proper compaction of the subgrade the Contractor shall, at the Engineer's option, loosen, aerate, and compact or excavate, remove, and replace the subgrade material until compaction can be obtained.
(g) Remove excess material that does not drift to low spots during blading and shaping. The Contractor shall dispose of this excess by placing it where the subgrade lacks material or by wasting it, as the Engineer directs.
(h) Add materials as the Engineer directs where the subgrade needs more to bring it up to grade. The Contractor shall water and compact these added materials as needed to produce a true finished subgrade.
(i) Underground work in the area of the subgrade shall be completed and properly backfilled and compacted before subgrade work is started. This shall include contract work and work performed by the Owner or others.
(j) If the underlying subgrade is soft, spongy, or yielding and will not permit proper compaction, the Contractor shall stabilize the subgrade per Section 2-06.3(3).
(k) Where normal crown sections are being constructed, stakes will be set at convenient offsets at intervals not to exceed 50 feet and at closer intervals where necessary, such as at street and alley intersections. It shall be the responsibility of the Contractor to set centerline grades which may be needed except in cases where the street grades are warped or otherwise do not conform with the typical section, in which case the Engineer will set the stakes.
(l) When ordered by the Engineer, the Contractor shall sprinkle the subgrade with water in such quantities as directed.
(m) Grade and line, throughout the stages of constructing the subgrade, shall be secured from the reference stakes. The subgrade shall be maintained in the finished condition until the first course of surfacing is placed upon it.

If the Contract requires a trimming machine, it shall:

(a) Maintain the grade and transverse slopes automatically through sensors that respond to reference lines on both edges of each roadway.
(b) Create a smooth, uniform surface free from chatter and ripples.

2-06.3(2) SUBGRADE FOR PAVEMENT

Before any paving is placed, the Contractor shall bring the subgrade to the required line, grade, and cross-section. The Contractor shall compact the subgrade to a depth of 6 inches to 95 percent standard density as determined by the compaction control tests for granular materials. The compacted area shall be wide enough to let paving machines operate without visible distortion of surfacing material. If the underlying subgrade is soft, spongy or yielding and will not permit proper compaction, the Contractor shall stabilize the subgrade per Section 2-06.3(3).

Profile grade is the point of gradient or vertical curve at the position indicated on the Roadway Section. Before any paving material is placed, the subgrade shall be brought to the proper line, grade, and cross section and shall be so maintained until the concrete is placed, except that extra depth of subgrade for increased thickness of the pavement, for pavement anchors, for pavement headers, and for increased thickness at the edges of the pavement may be removed just before the concrete is placed.

The subgrade shall be brought to a firm unyielding surface meeting the requirements of Section 2-06.3(3) and the entire area rolled to a width of at least 1 foot outside the edge of the pavement with a compacting unit. All portions of the surface on the subgrade which are inaccessible to the compactor shall be thoroughly compacted with a mechanical tamper.

If directed by the Engineer, The full width of the roadway shall be kept well sprinkled with water before and during process of rolling the subgrade. The subgrade shall be rolled both before and after the forms are set.

When the pavement is to be constructed over an old roadbed composed of gravel and macadam, the old gravel or macadam shall be scarified and the material shall be uniformly spread and rolled until thoroughly compacted.

The subgrade shall be thoroughly wetted down with water from 12 to 48 hours before the concrete is to be placed, and shall be thoroughly wet just before the concrete is placed. The work of saturating the subgrade shall be started and continued at the direction of the Engineer.

The elevation of the subgrade from 1-1/2 feet inside of the edge of the proposed pavement (or form) to 1 foot outside of the edge of the pavement (or form) shall be brought to an elevation that is not more than 1 inch above or below the elevation for the finished subgrade over this area before stakes will be set for the forms.

2-06.3(3) SUBGRADE STABILIZATION

When the density of the native earth in any area of the roadway section is determined by the Engineer to be less than the density requirement for whichever method of compaction is specified for the earth embankment, or where the nature or condition of the earth existing below the designated subgrade is such that, in the judgement of the Engineer, it may impair the stability of the subgrade, the Contractor shall stabilize the subgrade by whichever of the following methods is designated by the Engineer:

(a) Thoroughly loosen the earth to a depth of 6 inches by scarifying, aerating or watering as applicable, and compact to the required density, or;

(b) Excavate below grade to the limits and depth designated by the Engineer. As directed by the Engineer, the excavated material shall be stockpiled temporarily for use as backfill, used in adjacent embankments, or, if unsuitable, wasted and replaced with selected material or other designated backfill material. If deemed necessary by the Engineer, the earth remaining in the bottom of the excavation shall be loosened to a depth of 6 inches by scarifying, aerating or watering as applicable, and compacted to the required density. The excavated area shall then be backfilled with the previously excavated and stockpiled material, with selected material, or with such other mineral aggregate backfill as may be ordered by the Engineer. Backfill material shall be placed and compacted in successive layers in accordance with the method of compaction required for embankments under the provisions of the Contract. Excavation below grade as set forth above shall be classified the same as the excavation above grade.

2-06.3(4) MAINTENANCE AND PROTECTION OF SUBGRADE

Once prepared, the subgrade for surfacing shall be maintained in a finished condition until the first course of surfacing has been placed. The Contractor shall maintain the subgrade by blading and rolling as frequently as may be necessary. All cuts, ruts, and breaks in the surface of the subgrade shall be repaired prior to placing surfacing, treated base, or paving materials.

The Contractor shall take whatever steps are necessary to protect the prepared subgrade from inclement weather, the Contractor's operations, and public traffic prior to the placement of crushed surfacing, gravel base, pavement, etc. These steps shall include, but are not limited to, the use of plastic sheeting to protect the subgrade from inclement weather, planking to protect the subgrade from the Contractor's equipment, and the placing of paving materials or base materials from an adjacent lane in lieu of operating equipment over the prepared subgrade. Traffic detours shall be in accordance with Section 1-07.

Hauling over finished subgrade shall be limited to that which is essential for construction purposes. Equipment used for transporting materials over the prepared subgrade shall be equipped with pneumatic tires. Equipment used for hauling over the prepared subgrade which, in the opinion of the Engineer, causes undue damage to the subgrade or to the underlying materials shall be removed from the work upon request of the Engineer. If ordered by the Engineer, the Contractor shall plank the subgrade before hauling materials or operating equipment over it.

During extended periods of seasonal inclement weather in which the Engineer deems it impractical or infeasible to protect the prepared subgrade with plastic sheeting or planking and where the Contractor is required to operate equipment over the prepared subgrade in order to construct a crushed surfacing base course, treated base, or finished pavement, the Engineer may order the use of a ballast material to stabilize and protect the subgrade prior to paving. Stabilization shall be by Method B of Section 2-06.3(3) except the roadway ballast shall be either Mineral Aggregate Type 2 or Type 14, whichever is designated by the Engineer. Roadway ballast shall be used for subgrade stabilization only when specifically authorized by the Engineer.

2-06.3(5) EQUIPMENT

The trimming machine shall be equipped with automatic controls with sensors for both sides of the trimmer capable of sensing grade from outside reference lines and providing the automatic signals which operate the trimmer to maintain the desired grade and transverse slopes. The trimmer shall provide a smooth, uniform surface without chatter or ripples.

Equipment used shall be subject to the Engineer's approval.

2-06.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Preparation of the subgrade is incidental to the various items included in the Contract and therefore no measurement is required.

Subgrade stabilization by Method A in Section 2-06.3(3) will be measured by the cubic yard of embankment compaction in accordance with Section 2-03.

Subgrade stabilization by Method B in Section 2-06.3(3) will be measured by the cubic yard of the same class of excavation as that above grade, in accordance with Section 2-03.

The imported mineral aggregate of the type specified when ordered by the Engineer, used in lieu of select native material, will be measured in accordance with Section 1-09.1.

2-06.5 PAYMENT

Unless otherwise specified, all costs for the subgrade preparation shall be included in the prices bid for the various items included in the Contract.

Subgrade stabilization by Method A in Section 2-06.3(3) will be paid as embankment compaction in accordance with Section 2-03.

Subgrade stabilization by Method B in Section 2-06.3(3) will be paid as excavation of the same class as the excavation above grade, in accordance with Section 2-03.

Mineral aggregate backfill of the type ordered by the Engineer used in lieu of select native material will be paid as mineral aggregate in accordance with Section 4-01.5.

Water used in subgrade preparation shall be considered as incidental to the construction in accordance with Section 2-07.

SECTION 2-07 WATERING

2-07.1 DESCRIPTION

This work shall consist of furnishing, hauling, and applying water for compacting embankments, constructing subgrade, placing of crushed surfacing, dust control, testing and as the Engineer requires.

2-07.2 VACANT

2-07.3 CONSTRUCTION REQUIREMENTS

2-07.3(1) GENERAL

The Contractor shall apply water upon streets by means of tank trucks equipped with spray bars. Spray controls shall ensure that the water flows evenly and in the amounts required by the Engineer. The Engineer may direct that the Contractor apply water at night or early in the morning to reduce evaporation losses.

Where hauled water is required, the tank truck and/or trailer shall meet all safety and licensing regulations and shall be provided with a pump of such size and capacity as to provide for a discharge equivalent to that required for hydrant settling water.

When the source of water is hydrants within the work area, the Contractor may, with approval of the Engineer, apply water by means of a hose and double check valve directly connected to the hydrant. Contractor shall furnish hose, equipment, or tank truck necessary to do the required watering, and strictly comply with the provisions of the permit.

2-07.3(2) SOURCE OF WATER SUPPLY AND REGULATIONS PERTAINING TO HYDRANT USE

Within the Seattle Water Department service area, the source of water to be used on a project is subject to approval by the Seattle Water Department. When the source of water is to be a hydrant, a hydrant use permit must be obtained from, and use fees paid to the Water Service Section of the Seattle Water Department.

The Contractor shall use only those sources approved or hydrants designated by SWD and in strict accordance with the requirements of City of Seattle Ordinance 65877 and the conditions of the permit.

2-07.4 MEASUREMENT

Water work described in Section 2-07 will not be measured.

2-07.5 PAYMENT

Water shall be obtained at the Contractor's cost. Providing and applying water shall be considered incidental to the various pay items comprising the improvement.

SECTION 2-08 ROCK FACING

2-08.1 DESCRIPTION

This work shall consist of constructing, rebuilding, and relocating rock facings with rock facing height of 8 feet or less used for erosion control or the containment of cuts and embankments. Rock facings shall be constructed, rebuilt, or relocated at the locations and to the limits indicated on the Drawings or designated by the Engineer. Work shall be performed in accordance with these Specifications and Standard Plan No. 141.

2-08.2 MATERIALS

Materials shall meet the requirements of the following sections of these Specifications:

Rock Facing Material	9-03
Drainage Material, Mineral Aggregate Type 2 or 14	9-03

Crushed gravel with at least 90% or more having two or more fractured surfaces and which meets grading requirements of Mineral Aggregate Type 2 or 14, may be used in lieu of ledge rock.

2-08.3 CONSTRUCTION REQUIREMENTS

2-08.3(1) ROCK FACING

The subgrade elevation of the rock facing shall be as staked by the Engineer or, in the absence of such staked elevation, shall be established from the depth below existing ground level set forth in the table shown in Standard Plan No. 141 for rock facing. The Contractor shall use the rock sizes as set forth in this table and shall insure a distribution of rock sizes with the largest rocks on the bottom and progressively smaller rocks up to the top.

Rock facings shall be constructed by interlocking the rocks so that each rock is in contact with at least two other rocks with each rock having a minimum of three bearing surfaces per rock. Each rock shall be laid with a flat surface on the face of the rock facing and with the long dimension horizontal. The top rocks shall slope backward from the face of the rock facing. Voids shall be kept to a minimum.

The face of the rock facing shall be built to a line as indicated in Standard Plan No. 141 and shall not vary more than 6 inches. The batter shall be one horizontal to four vertical. A 6-inch layer of drainage backfill shall be placed and compacted along the back slope of the facing between the vertical portion of the undisturbed bank and the back of the rock facing.

2-08.3(2) REBUILD ROCK FACING

This work shall consist of dismantling an existing rock facing and reconstructing the facing in the same location. Reconstruction work shall be in accordance with the requirements of Section 2-08.3(1). Rock dismantled from the existing facing shall be used in reconstructing the rock facing. Additional rock ordered by the Engineer to complete the facing shall be furnished by the Contractor and shall meet the requirements of Section 2-08.2.

2-08.3(3) RELOCATE ROCK FACING

This work shall consist of dismantling an existing rock facing and rebuilding a similar rock facing in a different location using the rock obtained from the dismantled facing. Work shall be in accordance with the requirements of Section 2-08.3(1). Additional rock ordered by the Engineer to complete the facing shall be furnished by the Contractor and shall meet the requirements of Section 2-08.2.

2-08.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Rock Facing" and "Relocate Rock Facing" will be by the square foot of rock face for the new rock facing or the relocated rock facing.

Measurement for "Rebuild Rock Facing" will be by the Square foot based on measurement of the existing rock facing before dismantlement.

Measurement will include that portion of the rock facing constructed below the existing ground elevation.

Mineral aggregate of the type specified for drainage backfill will be measured by the ton in accordance with Section 1-09.1.

2-08.5 PAYMENT

Compensation for the costs necessary to complete the work described in Section 2-08 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Rock Facing," per square foot.
(2) "Rebuild Rock Facing," per square foot.
(3) "Relocate Rock Facing," per square foot.

The unit contract price for "Rock Facing," shall include all costs for the work required to furnish and place the rock, including excavation of the facing foundation.

The unit contract price for "Rebuild Rock Facing" or "Relocate Rock Facing," shall include all costs for the work required to dismantle and reconstruct the rock facing as specified using the existing rock and including temporary stockpiling of the rock and such excavation as may be necessary for rebuilding or relocating the rock facing.

Costs required to import and place additional rock in order to rebuild the rock facing to original condition shall be included under this item.

Additional new rock facing area ordered by the Engineer during rebuilding or relocation of an existing rock facing will be paid in accordance with Section 1-09.4.

Payment for mineral aggregate of the type specified for drainage backfill will be made in accordance with Section 4-01.5.

SECTION 2-09 STRUCTURE EXCAVATION

2-09.1 DESCRIPTION

This work shall consist of excavation, removing, and disposing of all formations, debris, and materials, natural or manmade, irrespective of nature or condition, encountered within the limits hereinafter defined which are necessary for the construction of footings, bases, or other foundation work required to support pump stations, headwalls, water tanks, tranmission towers, bridges, retaining walls, cribbing, sign support structures, and other similar structures, all in accordance with the Contract Documents and in reasonably close conformity with the lines, grades, and dimensions indicated therein or staked by the Engineer. This work shall further consist of stockpiling, hauling, and placing suitable excavated material in fill areas, and disposing of excess or unsuitable soil.

This work shall also include the construction and subsequent removal of shoring and cribbing, or cofferdams, along with necessary pumping, sealing, and dewatering of the excavated area, the furnishing, stockpiling, placing and compacting of select excavated or imported material over and around the completed structure.

Excavation for roadways, sanitary sewers, water mains and their appurtenances, manholes, inlets, catch basins, conduits, utility structures, and such other related miscellaneous work are covered elsewhere in these Specifications and shall not be considered as structure excavation.

2-09.2 VACANT

2-09.3 CONSTRUCTION REQUIREMENTS

2-09.3(1) GENERAL REQUIREMENTS

2-09.3(1)A STAKING, CROSS-SECTIONING, AND INSPECTING

The Contractor shall not begin excavating until after the Engineer has set stakes to locate and/or outline the structure and taken cross-sections to determine how much material to remove. The Engineer will occasionally inspect material taken from and material remaining in the excavation.

When any foundation excavation is completed, the Contractor shall notify the Engineer, and no concrete or other permanent structural material shall be placed therein until permission to proceed is given by the Engineer.

2-09.3(1)B DEPTH OF EXCAVATION

The Contractor shall excavate foundation pits to the depth the Drawings require, or to any revised depth ordered by the Engineer.

2-09.3(1)C REMOVAL OF UNSTABLE BASE MATERIAL

When the material at the bottom of an excavation is not stable enough to support the structure, the Contractor shall excavate below grade and replace the unstable material with gravel backfill.

Gravel backfill shall meet the requirements of Section 9-03.12. It shall be placed in layers not more than 6 inches thick with each layer compacted to 95 percent of the maximum density determined by the Compaction Control Test, Section 2-03.3(14)E.

2-09.3(1)D DISPOSAL OF EXCAVATED MATERIAL

The material obtained from structure excavation shall be used for backfilling over and around the structures after they are complete. Material not required for this purpose shall be used in the construction of embankments, stockpiled per Section 2-03.3(10) or if deemed unsuitable by the Engineer per Section 2-03.3(14), wasted per Section 2-01.2. Material which meets the requirements for Mineral Aggregate Type 17 shall be selectively stockpiled for use as wall or abutment backfill.

2-09.3(1)E BACKFILLING

Openings made for structures shall be backfilled with selected material from the structure excavation or from other excavations. In general, selected backfill material from the excavation shall be as defined in Section 2-03.3(10).

(a) **Alternative Source.** When material from structure excavation is unsuitable for use as backfill, the Engineer may: require the Contractor to obtain material elsewhere; require the Contractor to substitute selected material in accordance with Section 2-03.3(10); or require the Contractor to use other material covered by the Contract, if such substitution involves work that does not differ greatly from what would otherwise have been

required. The Contractor shall provide backfill material as provided in Section 1-04.4 if neither selected materials nor other contract materials are available.

(b) **Stockpiling.** The Engineer may require the Contractor to selectively remove and stockpile any usable material excavated for a structure. If this material meets the requirements for gravel backfill for walls it may replace gravel as wall or abutment backfill.

If the Contractor stockpiles excavated material for use as backfill, it shall be protected with plastic sheeting or by some other method from contamination and weather damage. If the material becomes too wet or contaminated in the stockpile, the Contractor shall dispose of and replace it with an equal amount of suitable material.

(c) **Compaction.** Backfill from structure excavation shall be placed and compacted in keeping with these requirements:

(1) Backfill supporting roadbed or roadway embankments–placed in horizontal layers no more than 6 inches thick with each layer compacted to 95 percent of the maximum density determined by the Compaction Control Test, Section 2-03.3(14)E.
(2) Gravel backfill for drains–placed in horizontal layers no more than 12 inches thick, with each layer compacted by at least 3 passes of a vibratory compactor approved by the Engineer.
(3) All other structure excavation backfill–placed in layers no more than 2 feet thick (loose), with each layer tamped and graded so that final settling will leave the backfill flush with surrounding ground.

(d) **Timing.** Backfill shall not be placed against any concrete structure until the concrete has attained 90 percent of its design strength and has cured for at least 14 days. However, the Contractor may backfill footings and columns as soon as forms have been removed, so long as the backfill is brought up evenly on all sides.

The Engineer may order the Contractor to use lean concrete in backfilling around piers and in front of abutments and walls.

If water prevents the Contractor from properly placing and compacting backfill, it shall be removed by pumping or other means.

Spaces excavated and not occupied by abutments, piers, or other permanent structures shall be backfilled up to the surface of the surrounding ground with a sufficient allowance for settlement and the top surface of the backfill shall be neatly graded.

Special precautions shall be taken to prevent any wedging action against abutments and wing walls. If the excavation has sloping sides, the slopes shall be broken up by stepping or serrating to prevent wedge action before the backfill is placed. Fill placed around culverts, piers or underground utilities shall be deposited on both sides to approximately the same elevation at the same time.

Backfill for walls shall conform to the requirements for Mineral Aggregate Type 17, shall be placed in layers not to exceed 12 inches thick, and shall be compacted to 95% of maximum dry density. Compaction control tests shall be performed per Section 2-03.3(14)E.

Backfill for foundation shall conform to the requirements for Mineral Aggregate Type 2 or Type 14 per Section 9-03.16, and shall be placed in layers not to exceed 6 inches thick, with each layer being thoroughly compacted in accordance with Method C as described in Section 2-03.3(14)D before the next succeeding layer is placed.

If the material used in making the backfill is too dry to permit proper compaction sufficient water shall be added to allow satisfactory compaction results.

2-09.3(2) CLASSIFICATION OF STRUCTURE EXCAVATION

Structure excavation will not be further classified into solid rock excavation or common excavation, nor into wet or dry excavation.

2-09.3(3) STRUCTURE EXCAVATION

2-09.3(3)A PRESERVATION OF CHANNEL

When foundations or substructures are to be built in or next to running streams, the Contractor shall:

(a) Excavate inside cribbing, cofferdams, caissons, or sheet piling unless dredging or open pit excavation is permitted.
(b) Never disturb the natural stream bed next to the structure.
(c) Backfill after foundations are placed inside cofferdams and any open pit or dredged area behind sheet piling. This backfill shall be level with the original stream bed and shall prevent scouring.
(d) Remove any excavation material that may have been deposited in or near the stream so that the stream bed is free from obstruction.
(e) Maintain water depth and horizontal clearances required for traffic to pass on navigable streams, furnishing any channel signals or lights required during construction.
(f) Place riprap around the outside of cofferdams to repair local scour.

2-09.3(3)B EXCAVATION IN OPEN PITS–EXTRA EXCAVATION

The Contractor may dig open pits or perform extra excavation without shoring, cofferdams, or cribbing, if:

(a) Footings can be placed in dry material away from running water.
(b) The integrity of the completed structure and its surroundings is not reduced.
(c) Worker safety is ensured as required by law.
(d) The excavation does not disturb the existing pavement or any other adjacent facilities.

If a slide occurs in an open pit, the Contractor shall remove the slide material. If the slide disturbs an area over which a highway will be built, the Contractor shall backfill and compact the site to the original ground line as the Engineer directs.

The Contractor shall drain or pump any water from the pit, taking care not to stir up or soften the bottom. If equipment in the pit or inadequate water removal makes the foundation material unstable, the Contractor shall, at no expense to the Owner, remove and replace it with material the Engineer approves.

When the Engineer believes ground water flow may impair a concrete footing, the Contractor shall place under it a layer of gravel at least 6 inches thick. Before placing the gravel, the Contractor shall excavate to whatever grade the Engineer requires. This provision shall not apply to the building of concrete seals.

The Contractor may omit forms when the earthen sides of a footing excavation will stand vertically. In this case, the Contractor may excavate to the neat line dimensions of the footing and pour concrete against the undisturbed earth. If the hole is larger than neat line dimensions, the Contractor shall bear the cost of the extra concrete.

2-09.3(3)C PREPARATION FOR PLACING FOUNDATIONS

When a foundation will rest on rock, excavation shall penetrate it at least 1 foot, or more if the Drawings require, to form a key for the footing. The Contractor shall cut the bottom of the excavation to a firm surface, level, stepped, or serrated as the Engineer directs, and remove all loose material.

For an arch abutment, the back face shall be trimmed to true lines so that concrete can be poured against undisturbed material.

If concrete will rest on any excavated surface other than solid rock, the Contractor shall not disturb the bottom of the excavation. The Contractor shall also remove all loose or soft material just before pouring the concrete.

Upon completing any foundation excavation, the Contractor shall notify the Engineer. No concrete or other permanent part of the structure may be placed until the Engineer has given permission to proceed.

2-09.3(3)D SHORING, CRIBBING, AND COFFERDAMS

The Contractor shall provide Shop Drawings showing proposed methods and construction details of shoring, cribbing, or cofferdams in accordance with Section 6-02.3(16). These Shop Drawings shall be designed by (or under the direction of) a Professional Engineer, licensed under Washington State's Title 18 RCW. The Shop Drawings must carry the Professional Engineer's signature and seal. Sheet sizes for the Shop Drawings must conform to Section 1-05.3. The Contractor shall not begin construction until approval has been given by the Project Engineer. The Contractor shall remain responsible for satisfactory results.

All excavations within 15 feet of the traveled way and 4 feet or more in depth shall be shored, cribbed, or protected by cofferdams. All other excavation 4 feet or more in depth shall be shored, cribbed, or protected by cofferdams or shall meet the open-pit requirements of Section 2-09.3(3)B.

The Contractor shall use cofferdams in all excavation that is under water or affected by ground water.

In using cofferdams, cribbing, or shoring, the Contractor shall:

(a) Extend them well below the bottom of the excavation.
(b) Provide enough clearance for building forms, inspecting concrete exteriors, and pumping water that collects outside the forms. If cofferdams or cribbing tilt or move laterally during placement, the Contractor, at no expense to the Owner, shall straighten or enlarge them to provide the required clearance.
(c) Secure the cribbing or cofferdam in place to prevent tipping or movement.
(d) Place shoring and cofferdams so that they will not interfere with any pile driving required.
(e) Vent cofferdams at the elevation commensurate with seal weight design, or as shown in the Drawings or approved by the Engineer.
(f) Remove any bracing that would extend into the concrete being placed.

When the work is completed, the Contractor shall:

(a) Remove all shoring to at least 2 feet below finished ground line.
(b) Remove all cofferdams and cribbing to the natural bed of the water way.

Cofferdams shall be classified as any watertight enclosure that surrounds the excavated area of the structure and which is used in conjunction with a concrete footing seal. Within the protection of the cofferdam the excavation is carried to the desired level and the concrete seal is poured, the enclosure is dewatered and the structure is constructed.

If the Contract Documents require cofferdam and should water conditions at the time of construction be such that in the opinion of the Engineer, seals are not required, the Engineer may specify that seals be omitted.

Excavation outside the cofferdam shall not continue below the elevation of the top of the seal, or if no seal is used, below the top of the footing, except with the written permission of the Engineer. If permission is given, it shall not relieve the Contractor of his obligation to anchor or otherwise hold the crib or cofferdam in place and secure it against tipping or displacement.

Cofferdams shall be constructed so as to protect green concrete against damage from sudden rising of the stream and to prevent damage to the foundation by erosion. No timber or bracing shall be left in the cofferdams or crib in such a way as to extend into the substructure without permission of the Engineer.

Calculations supporting the shoring design must be submitted with the shoring plans. The shoring plans shall contain details such as member sizes, plate thickness, weld details, bolted connections, etc. and shall be based on AASHTO specifications.

2-09.3(3)E BEARING TESTS

The Engineer may stop the excavation to make bearing tests at any time. The Contractor shall assist with these tests in any way the Engineer requires.

During any test period, the Contractor shall, at no expense to the Owner, maintain ordinary working conditions at the bottom of the hole. A single test shall not exceed 72 hours.

2-09.3(3)F DEWATERING

When conditions are encountered which, in the opinion of the Engineer, make it impracticable to dewater the foundation pit before placing concrete, he may require the construction of a concrete foundation seal in accordance with Section 6-02.3(6)C "Placing Concrete in Water", and dewatering in accordance with Section 6-02.3(6)D, "Dewatering Concrete Foundation Seals".

2-09.3(4) CONSTRUCTION REQUIREMENT FOR TRENCH (OR OTHER EXCAVATIONS) 4 FT OR MORE IN DEPTH

The requirements of Section 2-09 shall apply to all types of excavation in so far as they do not conflict with the excavation requirements found in other Sections of the Contract Documents for a specific kind of work (see Division 7). For safety systems required for trench excavation, refer to Section 7-17.3(1)A.

If workers enter any trench or other excavation 4 feet or more in depth that does not meet the open pit requirements of Section 2-09.3(3)B, it shall be shored and cribbed. Safety systems for trench excavation work shall be in accordance with Section 7-17.3(1)A. The Contractor alone shall be responsible for worker safety and the Owner assumes no responsibility.

2-09.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

The materials excavated will be measured in their original position by volume in cubic yards. The quantity measured for payment will include only the material excavated from within

the neat line shown on the Drawings, regardless of whether the excavation is made within a cofferdam enclosure or in an open pit.

The vertical neat line limits for measuring the excavation will be a vertical plane 1 foot (measured horizontally) outside of and parallel to the neat line of a pile cap, footing, or seal. No measurement as structure excavation will be made for material removed (1) outside of vertical planes 1 foot outside of and parallel to the neat lines of a pile cap, footing, or seal, (2) more than 3 feet beyond the roadway side of a wing wall, and (3) more than 1 foot beyond the other sides and end of a wing wall.

The bottom limits for measuring the excavation for pile caps, footings, or seals will be the bottom elevation as shown in the Drawings or as otherwise established by the Engineer. In pile foundations, the material resulting from the swell due to driving piles will not be included in the measured quantity. The bottom limit for a wing wall will follow a line 1 foot below and parallel to the bottom.

The upper limit for measuring excavation will be the top surface of the ground, or the bed of the stream as it exists at the time the excavation is started. When the Contract designates removal of the materials through a graded section above the structure excavation, and when there is a designated pay item in the Contract for the excavation above the upper limit for structure excavation will be the lower neat lines of the designated grading section, as shown in the Drawings.

Measurement for imported Mineral Aggregate, when ordered for backfill in lieu of native material by the Engineer, will be by the cubic yard based on the neat line excavation area shown on the Drawings for the depth designated by the Engineer.

Backfill for foundations, drains, and walls will be measured by the cubic yard per Section 1-09.1.

Measurement for concrete seal will be as "Concrete (Class) (Use)" as specified in Section 6-02.4.

2-09.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-09 will be made at the unit contract prices bid only for the pay items listed and referenced below:

(1) "Structure Excavation," per cubic yard.
(2) "Shoring and Cribbing or Extra Excavation," lump sum.
(3) "Cofferdam," lump sum.

The unit contract price for "Structure Excavation," shall include all costs for all work specified in Section 2-09 and not provided for otherwise in this payment section which is necessary to complete excavation within the neat line limits specified. Any additional excavation outside of these limits will be considered as having been made for the Contractor's benefit, and shall be incidental to the various items comprising this improvement. All costs for preserving and protecting excavated materials to be used for backfilling structure excavation, and for disposal (including haul) of material obtained from structure excavation which is not used for backfill shall be incidental to and included in the unit contract price for "Structure Excavation".

All costs for storing, protecting, rehandling, and placing stockpiled material as specified in Section 2-09 shall be included in the unit contract price for structure excavation.

Payment for structure excavation carried below the elevations shown in the Drawings, when ordered by the Engineer, will be made at the unit contract price for "Structure Excavation."

Whenever excavation is carried below the elevation shown on the Drawings without written approval from the Engineer, all costs for materials, labor and equipment necessary to bring excavation back to plan elevation, shall be borne by the Contractor. Replacement shall be made with concrete or other material acceptable to the Engineer.

The lump sum contract price for "Shoring and Cribbing or Extra Excavation" shall include all costs for the construction and subsequent removal of all shoring and cribbing.

No change will be made to the lump sum contract price for "Shoring and Cribbing or Extra Excavation" for increased depth, to and including a depth of 3 feet below the elevations shown in the Drawings. If depths greater than 3 feet below the elevations shown are required by the Engineer, allowance for extra costs will be made in accordance with Section 1-09.4.

When extra excavation is used in lieu of constructing the shoring, cribbing, cofferdam or caisson, the lump sum contract price shall be full pay for all excavation, backfill, compaction, and other work required.

If select backfill material is required for backfilling within the limits of structure excavation, it shall also be required as backfill material for the extra excavation at the Contractor's cost.

Shoring and cribbing or extra excavation for other classes of excavation shall be incidental to and included in the unit contract price for Bid Items requiring the excavation and shall include removal of the shoring and cribbing, or backfilling of the extra excavation.

Payment for safety systems required for trench excavation work shall be made in accordance with Section 7-17.5.

The lump sum contract price for "Cofferdam" shall include all costs for the construction, dewatering and subsequent removal of the cofferdam.

Payment for imported Mineral Aggregate backfill used shall be per Section 4-01.5.

Concrete seal will be paid as "Concrete (Class) (Use)" per Section 6-02.5.

Payment for reconstruction of surfacing and paving within the limits of structure excavation will be at the applicable unit prices for the items involved.

Stockpiled excavated material for use as backfill that is contaminated and/or weather damaged shall be disposed of and replaced at the Contractor's own cost.

When ordered by the Engineer to use lean concrete in backfilling around piers and in front of abutments and walls, the Owner will pay such backfill in accordance with Section 1-04.4.

If a slide occurs in an open pit as specified in Section 2-09.3(3)B, the Contractor shall pay all costs related to removing slide material and restoring a slide area.

The Owner will pay force account for all labor and materials the Contractor supplies for the bearing tests as specified in Section 2-09.3(3)E.

All costs not defined in Section 2-09.3(1)E that relate to providing, placing, and compacting backfill shall be at the Contractor's cost.

SECTION 2-10 DITCH AND CHANNEL EXCAVATION

2-10.1 DESCRIPTION

This work shall consist of excavating open ditch and channel changes to the required lines, grades, and cross-sections. The work shall also include disposing of excess and unsuitable excavated material.

Ditch excavation: Includes all excavation in open ditches less than 8 feet wide at the bottom, but excludes ditches that are part of the roadway.

Channel excavation: Includes all excavation in open ditches 8 or more feet wide at the bottom.

2-10.2 VACANT

2-10.3 CONSTRUCTION REQUIREMENTS

Before excavating any open ditch, the Contractor shall clear and grub the area as required by Section 2-01.

The Contractor may build dikes or berms with excavated material, or may dispose of it as the Drawings or the Engineer requires.

2-10.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

The Owner will measure ditch and channel excavation by the cubic yard in its original site, and will calculate quantities by the neat lines of the staked cross-sections.

2-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-10 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Ditch Excavation", per cubic yard.
(2) "Channel Excavation", per cubic yard.

The unit contract price for "Ditch Excavation" and "Channel Excavation" shall be full pay for excavating, loading, placing, or otherwise disposing of the material.

SECTION 2-11 TRIMMING AND CLEANUP

2-11.1 DESCRIPTION

This work shall consist of dressing and trimming the entire roadway(s) improved under the Contract, including frontage roads, connecting ramps, auxiliary lanes, and approach roads. This work extends to roadbeds, shoulders, and ditches.

2-11.2 VACANT

2-11.3 CONSTRUCTION REQUIREMENTS

The Contractor shall:

(a) Trim shoulders and ditches to produce smooth surfaces and uniform cross-sections that conform to the grades set by the Engineer.
(b) Open and clean all channels, ditches, and gutters to ensure proper drainage.
(c) Dress the back slope of any ditch or borrow pit that will remain adjacent to the roadway. Round off the top of the back slope and distribute the material evenly along its base.
(d) Remove and dispose of all weeds, brush, refuse, and debris that lie on the roadbed, shoulders, ditches, and slopes.
(e) Remove from paved shoulders all loose rocks and gravel.
(f) Distribute evenly along the embankment any material not needed to bring the shoulders to the required cross-section.

The Contractor shall not:

(a) Use heavy equipment (tractors, graders, etc.) to trim the shoulders of an existing or new bituminous surface.
(b) Drag, push, or scrape shoulder material across completed surfacing or pavement.

When the contract requires the Contractor to rebuild part of a roadway only the rebuilt areas shall be trimmed and cleaned up. If the Contractor's work obstructs ditches or side roads, they shall be cleared and the debris disposed of as the Engineer directs.

2-11.4 MEASUREMENT

Work described in Section 2-11 will not be measured for payment.

2-11.5 PAYMENT

The work of trimming and cleanup shall be incidental to the various bid items comprising the project.

DIVISION 3

PRODUCTION FROM QUARRY AND PIT SITES AND STOCKPILING

SECTION 3-01 PRODUCTION FROM QUARRY AND PIT SITES

3-01.1 DESCRIPTION

This work shall consist of manufacturing and producing crushed and screened aggregates including pit run aggregates of the kind, quality, and grading specified for use in the construction of portland cement concrete, asphalt concrete, asphalt treated base, crushed surfacing, maintenance rock, ballast, gravel base, gravel backfill, gravel borrow, riprap, and bituminous surface treatments of all descriptions.

The requirements specified shall apply whether the source is ledge rock, talus, gravel, sand, or any combination thereof.

3-01.2 MATERIALS

3-01.2(1) GENERAL SOURCE

3-01.2(1)A APPROVAL OF SOURCE

Material sources must be approved in advance of use in the work in accordance with the requirements of Section 1-06.

3-01.2(1)B STRIPPING QUARRIES AND PITS

Stripping of quarries and pits shall consist of the removal, after clearing and grubbing, of the surface material and overburden which is unsuitable for the kind of material to be borrowed or produced for use. Materials from stripping, to be used later as provided on the site reclamation plan specified in Section 3-03, shall be deposited within the quarry or pit site at such a location as not to interfere with future development within the site.

3-01.2(1)C PREPARATION OF SITE

The portion of the quarry or pit site to be used shall be cleared and grubbed, and the area from which materials are to be taken shall be stripped of overburden as provided in Section 3-01.2(2). All combustible debris resulting from these operations shall be disposed of by the Contractor in a manner satisfactory to the Engineer.

3-01.2(1)D PRODUCTION REQUIREMENTS

3-01.2(1)D1 SIZE SELECTION

All oversize stones, rock fragments, or boulders occurring in the source, up to and including those measuring 18 inches in the greatest dimension, shall be utilized in the manufacture of crushed material.

If the grading or quality of raw material in sources used for the manufacture of products covered by this Section is such that the fracture, grading, or quality of the product specified cannot be obtained by utilizing the natural material, fine portions of the raw material shall be rejected to the extent necessary to produce products meeting all requirements of these Specifications. Failure of the Owner to include a scalping requirement in the Project Manual shall not relieve the Contractor of the responsibility for rejecting fine portions of the material if such becomes necessary to produce products meeting all requirements of these Specifications. Scalping shall be performed after the pit-run or quarry-run material has passed through the primary crusher.

When scalping over a screen of a specified size is required in the Project Manual, the scalping screen shall be of such size and capacity that enough of the fine material will be removed to produce material as specified.

Washing and reclaiming of the reject material and subsequent addition of this material to any finished products will not be allowed unless specifically authorized in writing by the Engineer.

Surplus screenings accumulated during the crushing and screening of specified roadway materials will be considered separate and distinct from reject material resulting from scalping operations.

Both fine and coarse concrete aggregates shall be thoroughly washed in order to remove clay, loam, alkali, bark, sticks, organic castings, or other deleterious matter. Washing will be required in the production of other materials if necessary to produce products meeting all the quality requirements of these Specifications.

When producing screened gravel or sand materials, the Contractor shall remove all oversize material by screening at the pit site. The Contractor's operations in the pit shall be conducted so that the grading of individual loads will be reasonably uniform. In general, the Contractor shall utilize the most suitable materials available and shall make as many moves of the loading equipment as may be necessary to fulfill these requirements.

Where pit-run materials meet the requirements of the specifications, screening or processing will not be required.

3-01.2(1)D2 WATER CONTENT

Naturally occured water content in all crushed, screened, or other quarry materials shall be as follows:

% By Weight Passing 1/4 inch Sieve %	Maximum Water Content By Weight
Less than 20%	4%
20% or more	8%

3-01.2(1)E FINAL CLEANUP

Upon completion of the Contractor's operation, the quarry or pit shall be cleared of all rubbish, temporary structures, and equipment, and shall be left in a neat and presentable condition. The pit or quarry shall be reclaimed in accordance with the approved site reclamation plan specified in Section 3-03.

3-01.2(2) CONTRACTOR FURNISHED MATERIAL SOURCE

3-01.2(2)A GENERAL

In addition to the requirements of Section 1-06 the Contractor shall make all necessary arrangements for obtaining material from borrow sites, approved by the Engineer, in the quantities necessary for the work. Use of Mineral Aggregate will not be permitted until representative samples have been taken by the Engineer and tested, the source approved, and authorities granted for use of the aggregate.

3-01.2(2)B MINERAL AGGREGATE

The Contractor is to provide his own source of mineral aggregate of the type required. The material shall be produced from sources approved by the Engineer in accordance with the requirements of Section 3-01. The grading and quality shall be as specified in Section 9-03.

3-01.3 VACANT

3-01.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this section.

All crushed, screened, or other quarry materials will be measured by the tonnage of total weight of material source minus water in excess of the maximum permissible amounts naturally occurred.

Water in excess of the maximum permissible amounts naturally occurring in the material source, as determined by the Engineering, will be deducted from the tonnage of material to be paid for on a daily basis.

3-01.5 PAYMENT

All costs, unless otherwise specified, in connection with the production of materials meeting all quality requirements of these Specifications shall be included in the unit contract prices of the various bid items involved.

Payment for the particular materials or aggregates to be produced will be as specified in the appropriate sections of these Specifications.

SECTION 3-02 VACANT

SECTION 3-03 SITE RECLAMATION

3-03.1 DESCRIPTION

This work shall consist of reclaiming land used for borrowing material, mining for aggregates, sorting or wasting materials as specified.

3-03.2 GENERAL REQUIREMENTS

3-03.2(1) VACANT

3-03.2(2) SITES

3-03.2(2)A CONTRACTOR-PROVIDED SITES

All borrow, quarry, and pit sites over three acres in size of disturbed land or resulting in pit walls more than thirty feet high and steeper than a one to one slope which are owned or furnished by the Contractor shall be reclaimed in accordance with the conditions and requirements of an approved operating permit acquired from the Department of Natural Resources. When material is acquired exclusively for use on this Contract, the Seattle Engineering Department may approve reclamation plans as allowed by the Surface-Mined Land Reclamation Act of Washington and the rules and regulations adopted by the Department of Natural Resouces.

When the Contractor obtains an operating permit from the Department of Natural Resources, evidence of such approval shall be furnished to the Engineer prior to any work within the site.

Ultimate reclamation plans are not required for borrow, quarry, or pit sites not meeting the above criteria or for stockpile or waste sites. However, all such sites shall be reclaimed to the extent necessary to control erosion and provide satisfactory appearance consistent with anticipated future use.

Compliance with the State Environmental Policy Act (SEPA) is required for sites involving more than 100 cubic yards of excavation or landfill throughout the lifetime of the site unless the local agency in which the project is located establishes a greater amount. Sites involving more than 500 cubic yards of excavation or landfill throughout the lifetime of the site always require compliance with SEPA. Those reclamation plans to be approved by the Seattle Engineering Department shall be prepared and submitted for approval as hereinafter specified.

Under no circumstance will the Contractor be allowed to waste material within a wetland as defined in Section 2-03.3(7).

3-03.2(2)B OUT OF STATE SITES

All Out-of-State borrow, quarry or pit, stockpile, and waste sites which are furnished by the Contractor exclusively for use on this Contract shall be reclaimed in accordance with an approved reclamation plan that is in compliance with local area restrictions.

3-03.2(3) RECLAMATION PLANS

3-03.2(3)A VACANT

3-03.2(3)B CONTRACTOR-PROVIDED SITES

A plan will not be required except on specific request for those sources of material for which the Contractor has obtained a valid surface mining operating permit issued by the Department of Natural Resources and has paid all required fees.

If the Contractor elects to apply for an approved reclamation plan from the Seattle Engineering Department the following requirements shall apply:

(a) The Contractor shall prepare his own plan but may use the Standard Plans as a guide.

(b) Reclamation Plans shall be approved in advance of any work within the site.

(c) The Standard Plans include a list of minimum design requirements which must be considered in preparing reclamation plans. The Contractor shall meet or exceed these minimum requirements for the various types of sites described in the Standard Plans. The Owner reserves the right to accept or reject reclamation plans.

(d) All plans shall be drawn on reproducible sheets each 24 inches wide by 36 inches long in overall dimensions.

(e) The Contractor shall furnish to the Engineer for approval 6 copies of the reclamation plan which shall include but not be limited to the following details:

(1) Site boundaries and pertinent topographic features.
(2) Location of the site. The plan shall provide sufficient information to permit the site to be located on quadrangle or county maps.
(3) Proposed finished ground contours or cross-sections and all final slopes.
(4) Site drainage; restoration of stream beds.
(5) Methods by which contaminants are controlled.
(6) Planned lakes, ponds or other bodies of water which would be beneficial for residential, recreational, game or wildlife purposes.
(7) Local zoning and planning, if any.
(8) Type of vegetative cover.
(9) Proposed stockpiles or buildings.
(10) Any proposed development of the site which will be affected within 2 years after depletion or abandonment of the site.
(11) A statement of the proposed subsequent use of the land after reclamation and satisfactory evidence that all owners of a possessory interest in the land concur with this proposed use.
(12) Any other feature which contributes to the final appearance of the land subsequent to restoration measures.

(f) The Contractor shall furnish, together with the 6 copies of the reclamation plan, completed forms No. SM-2 and SM-6 issued by the Department of Natural Resources.

(g) The Contractor shall submit the original tracing of the plan or a reproducible of the plan for all borrow, quarry and pit sites. These approved plans shall be submitted to the Engineer within 10 days after receiving approval of the plan. If the plan is "Approved as noted", it shall be modified by the Contractor before submission of the plan to the Engineer.

(h) When the reclamation plan for sites involving more than 2 acres or over 10,000 tons of production is approved by the Engineer, the Contractor will be allowed to operate under the Seattle Engineering Department's combined operating permit subject to continuing approval and inspection by the Engineer and the Department of Natural Resources.

(i) Form No. SM-3 shall be completed by the Contractor and forwarded to the Department of Natural Resources through the Seattle Engineering Department upon completion of all seeding and planting.

Form No. SM-7 shall be completed by the Contractor and forwarded to the Department of Natural Resources through the Seattle Engineering Department immediately upon completion of mining operations and site reclamation.

Forms No. SM-3 and SM-7 are not required on sites of 2 acres or less involving less than 10,000 tons of production.

(j) The Engineer will notify the Contractor if environmental requirements must be satisfied. To meet the requirements, the Contractor shall furnish a completed environmental checklist in the SEPA guidelines format. The SEPA checklist will then be reviewed under existing Seattle Engineering Department procedures. Any landfill or excavation of 500 cubic yards or less is exempt from SEPA requirements.

3-03.3 CONSTRUCTION REQUIREMENTS

3-03.3(1) EROSION CONTROL

All sites owned or furnished by the Contractor shall, if specified on a reclamation plan approved by the Engineer, require erosion control in accordance with Section 8-01 or plant materials in accordance with Section 8-02.

3-03.3(2) DEVIATIONS FROM APPROVED RECLAMATION PLANS

Reclamation of any site which deviates from the approved reclamation plan will not be permitted without first revising the approved reclamation plan and obtaining the approval of the Engineer.

3-03.4 VACANT

3-03.5 PAYMENT

For Contractor-provided sites, all costs involved in complying with the requirements of an operating permit acquired from the Department of Natural Resources, complying with the requirements of a reclamation plan approved by the Engineer, or with reclaiming sites to the full extent required by the Contract shall be included in the costs of other items of work involved in the project.

DIVISION 4
BASES

SECTION 4-01 MINERAL AGGREGATES

4-01.1 DESCRIPTION

This section serves to unite the measurement and payment for all mineral aggregates.

4-01.2 MATERIALS

Grading of all mineral aggregates shall meet the requirements of the Mineral Aggregate Table in Section 9-03.16.

4-01.3 VACANT

4-01.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Mineral aggregates of the types specified will be measured by the ton or by the cubic yard as specified on the Bid Form.

Measurement for payment of mineral aggregates shall be in accordance with Section 1-09.1.

4-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 4-01 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Mineral Aggregate, (Type)," per ton.
(2) "Mineral Aggregate, (Type)," per cubic yard.

The unit contract price for "Mineral Aggregate, (Type)" shall include all costs of furnishing, hauling, stockpiling, placing, grading, and compacting the mineral aggregate.

Payment for roadway ballast will include all costs for removal and disposal of unsuitable material.

Payment for backfill for walls will be by the cubic yard in place as determined by the neat lines shown on the Drawings, or as ordered by the Engineer, except for the volume of pipes and gravel backfill for drains. Volumes of pipes 6 inches in diameter or less, drainage gravel placed around weep holes, and minor structural features will not be deducted.

Payment for backfill for foundations and for drains will be by the cubic yard in place as determined by the neat lines shown on the Drawings, or as ordered by the Engineer. Backfill for drains surrounding weep holes will be included in the unit contract price for concrete in place per Section 6-02.5, and therefore will not be measured.

SECTION 4-02 GRAVEL BASE

4-02.1 DESCRIPTION

This work shall consist of constructing one or more layers of gravel base upon a prepared subgrade in accordance with these Specifications and in conformity with the lines, grades, depth, and typical cross-section shown in the Drawings or as established by the Engineer.

4-02.2 MATERIALS

Materials shall meet the requirements in the following Sections:

GRAVEL BASE	
Mineral Aggregate Type 17	9-03
Grading	9-03

4-02.3 CONSTRUCTION REQUIREMENTS

Gravel base shall be uniformly spread upon the prepared subgrade to the depth, width, and cross-section shown in the Drawings. Construction methods used shall meet the applicable requirements of Sections 4-04.3.

4-02.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

"Mineral Aggregate, (Type)" for gravel base will be measured by the ton in accordance with Section 1-09.1.

4-02.5 PAYMENT

Payment will be in accordance with Section 4-01.5.

SECTION 4-03 VACANT

SECTION 4-04 BALLASTING AND CRUSHED SURFACING

4-04.1 DESCRIPTION

This work shall consist of constructing one or more courses of crushed aggregate material upon an existing roadway surface, or upon a subgrade properly prepared in accordance with the provisions of Section 2-06. The courses shall be constructed by spreading and shaping the aggregate material in such a manner that, with incorporation of a minimum amount of filler or keystone material, the courses will compact into a dense and unyielding mass to form a paving base in reasonably close conformity with the lines, grades, depth and cross sections indicated on the Drawings or established by the Engineer.

4-04.2 MATERIALS

Materials shall meet the requirements in the following Sections:

ROADWAY BALLAST	
Mineral Aggregate Type 2	9-03
Mineral Aggregate Type 14	9-03
SHOULDER BALLAST	
Mineral Aggregate Type 13	9-03
BASE COURSE[1]	
Mineral Aggregate Type 2	9-03
TOP COURSE AND KEYSTONE	
Mineral Aggregate Type 1	9-03
MAINTENANCE ROCK	
Mineral Aggregate Type 3	9-03
SAND FILLER	
Mineral Aggregate Type 11	9-03
DUST PALLIATIVE SAND	
Mineral Aggregate Type 6	9-03
DUST PALLIATIVE OIL	
CMS-2	9-02

4-04.3 CONSTRUCTION REQUIREMENTS

4-04.3(1) EQUIPMENT

All equipment necessary for the satisfactory performance of this construction shall be on the project and approved by the Engineer prior to beginning work. If central mix plant methods are used, the central mixing plant shall comply with the following requirements:

(a) The cold aggregate feeder shall be mechanically operated and adjustable to the extent necessary to provide a uniform and continuous flow of materials. These materials shall be deposited in an approved mixer with a sufficient amount of water being added to obtain the required density when spread and compacted. The water shall be weighed or metered, and dispensed through a device providing uniform dispersion across the mixer.
(b) The mixing plant shall be provided with weighing or calibrating devices, feeders, provisions for sampling, and other devices and equipment so designed, coordinated, and operated to produce a uniform mixture, and to permit the sampling of the materials before and after mixing. The mixer shall be kept in good condition, and mixing blades or paddles shall be of proper size, adjustment, and clearance to provide positive and uniform mixing of the mixture at all times.
(c) The capacity of the plant and equipment furnished on the work shall be adequate at all times to provide for efficient and continuous operations insofar as practical.

The minimum amount and type of heavy equipment considered necessary for the proper execution of the work described herein shall be as follows:

(a) One heavy duty self-propelled grader, of an approved type, equipped with scarifier, broom, and not less than an 8-foot blade.
(b) One 10-ton self-propelled three-wheel roller, one vibratory roller, or one pneumatic-tired roller. Roller wheels may be weighted if necessary to secure specified weight per linear inch of tire width. Vibratory rollers shall meet the requirements of Section 5-04.

Other combinations and types of equipment may be substituted for the above if approved by the Engineer. Additional equipment shall be supplied if required by the Engineer. Such equipment includes, but is not limited to, bottom-dump hauling equipment with transfer spreading facilities; self-propelled spreading and leveling machines; and spreader boxes equipped with wheels or so constructed as to preclude any damage to the subgrade or underlying courses.

The equipment used for the work shall be subject to the Engineer's approval. Equipment shall be kept in good repair.

4-04.3(2) SUBGRADE

The subgrade shall be prepared as specified in Section 2-06 and shall be approved by the Engineer before placing ballast or surfacing materials.

4-04.3(3) MIXING

Unless otherwise specified, the Contractor may use either, or both, of the following described methods:

(a) Central Plant Mix Method. The surfacing material and water shall be mixed in an approved mixing plant as described in Section 4-04.3(1). The completed mixture shall be a thoroughly mixed combination of proportioned materials and water, uniform in distribution of particle sizes and moisture content. A mixture containing water in excess of the proportion established by the Engineer will not be accepted.
(b) Road Mix Method. After material for each layer of surfacing has been placed, the material shall be mixed until uniform throughout by motor graders or other equipment approved by the Engineer. Water to facilitate mixing and compacting shall be added in amounts approved by the Engineer.

4-04.3(4) PLACING AND SPREADING

Unless indicated otherwise on the Drawings, in street areas to be paved with asphalt concrete pavement, crushed surfacing shall be placed to a compacted depth of 6 inches consisting of a 2 inch top course of Mineral Aggregate Type 1 placed on a 4 inch base course of Mineral Aggregate Type 2.

Spreading of the first course of surfacing or ballasting shall begin at points nearest to the point of loading and successive course shall begin at points farthest from the point of loading. Each course shall be constructed continuously from the beginning point of the course unless otherwise directed by the Engineer. The first course of surfacing or ballasting material shall be placed on all available subgrade before placing the succeeding course. If the Engineer deems it necessary, a succeeding course shall be placed over a section of a previously placed course before the final completion of that course.

Crushed surfacing, base course and top course shall be constructed in layers not to exceed 4 inches in depth. Ballast shall be constructed in layers not to exceed 6 inches in depth.

Each layer of surfacing and ballasting material shall be placed and spread by equipment approved for use by the Engineer. The surfacing and ballasting shall be spread by any method that will result in an even distribution of the material upon the roadway without perceptible separation in gradation. The material shall be spread and screeded to a depth and surface uniformity which will permit compaction to a reasonably true line, grade, depth, course, and cross section without further shaping.

Should there occur during any stage of the placing and spreading operation a separation of the coarser from finer materials causing, in the opinion of the Engineer, serious lack of uniformity in the grading, the Contractor shall immediately, upon request of the Engineer, make such changes in the method of handling the material as will prevent separation.

Unless otherwise approved by the Engineer, there shall be a distance of not less than 1 block nor more than 1/2 mile between the construction of any two courses of surfacing or ballast. Uniform gradations of mineral aggregates shall be used for surfacing on roadways.

Before placing any course, the preceeding layer shall be properly bound up, and all floating or loose stone shall be removed from the surface.

For weather limitations, see Section 4-04.3(8).

4-04.3(5) SHAPING AND COMPACTION

Immediately following spreading and final shaping, each layer of the surfacing shall be compacted to at least 95 percent of the maximum density determined by the Engineer in accordance with Section 2-03.3(14)E before the next succeeding layer of surfacing or pavement is placed.

Vibratory compactors and rollers shall obtain the specified density for each layer. A mist spray of water shall be applied as needed to replace moisture lost by evaporation. The completed layer shall have a smooth, tight, uniform surface true to the line, grade, and cross-section shown in the Drawings, or as staked by the Engineer.

When the thickness of a layer is less than 2 inches, density testing will not be required and the Engineer will determine the number of coverages required for the particular compaction equipment available. Each course of surfacing shall be compacted until the material does not creep under the

compaction equipment before a succeeding course of surfacing material is applied. All compaction shall begin at the outer edges of the surfacing and continue towards the center.

4-04.3(6) KEYSTONE

When necessary, as determined by the Engineer, crushed surfacing top course shall be used for keystone to key the top surface of ballast, gravel base, crushed surfacing base course, or any other surfacing course which requires keying. The keystone shall be spread evenly on top of the surfacing course by means of approved spreading equipment. The surface shall be watered and, if necessary, bladed lightly until the keystone is worked into the interstices of the surfacing course without excessive displacement and shall be compacted. The operations of adding keystone, wetting, blading, and compacting shall be continued until the course has become thoroughly keyed and compacted.

When keystone is required, it shall be placed before terminating each day's operation.

4-04.3(7) MISCELLANEOUS REQUIREMENTS

The surface of each layer of surfacing material shall be maintained true to line, grade, and cross-section by blading, watering, and rolling until placing the next succeeding course or the final paving surface. The first course of surfacing material shall be placed on all available subgrade before placing the succeeding course unless otherwise authorized by the Engineer. Unless otherwise approved, there shall be a distance of not less than one station between the construction of any two courses of surfacing or ballast.

Should irregularities develop in any surface during or after compaction, they shall be remedied by loosening the surface and correcting the defects after which the entire area including the surrounding surface shall be thoroughly recompacted. The finished surface shall be true to the proper grade and crown before proceeding with the surfacing or final paving.

4-04.3(8) WEATHER LIMITATIONS

When, in the opinion of the Engineer, the weather is such that satisfactory results cannot be obtained, the Contractor shall suspend operations until the weather is favorable. No surfacing materials shall be placed in snow or on a soft, muddy, or frozen subgrade.

The Owner shall not be liable for damages or claims of any kind or description by reason of suspending operations due to weather under directions of the Engineer.

4-04.3(9) HAULING

Hauling equipment shall be routed over the roadway in a manner to be most effective in the compacting of the surfacing. Hauling over any of the surfacing in the process of construction will not be permitted when, in the opinion of the Engineer, the effect will be detrimental. All loads shall be of uniform capacity unless deviation is expressly authorized by the Engineer.

4-04.3(10) HOURS OF WORK

The Contractor shall arrange his surfacing operations so that the placing of materials will be accomplished during daylight hours. However, when necessary to complete the project within the time specified, or to avoid peak periods of public traffic, work may be undertaken during the hours of darkness, provided the Contractor furnishes and operates adequate lighting. Inability to demonstrate reliable and satisfactory results will be reason to order termination of night operations, and the Contractor shall procure additional equipment and personnel necessary to satisfactorily complete the work as specified while operating during daylight hours only.

See Section 1-08 for specific requirements for working overtime.

4-04.3(11) SHOULDER BALLAST

Shoulder ballast shall not be placed until the abutting pavement has been completed, unless otherwise designated by the Engineer. Shoulder ballast shall be placed through a spreader box in one lift. Processing of the shoulder ballast course on the roadway will not be permitted. Compaction shall be accomplished by making a minimum of three passes over the aggregate with a vibratory compactor of a type acceptable to the Engineer. The density requirements of Section 4-04.3(5) shall not apply.

4-04.3(12) APPLICATION OF DUST PALLIATIVE

When required by the Drawings, in the Project Manual, or when directed by the Engineer, completed crushed rock surfacing courses or roadways shall be given two or more applications of dust palliative oil to the limits specified. Dust palliative shall be CMS-2 and shall be uniformly applied by an approved pressure-type distributor at the rate of 0.3 gallons of emulsion per square yard of surface to be treated. Before succeeding applications of dust palliative are applied, the preceding application shall have thoroughly dried, as approved by the Engineer.,

Dust palliative shall not be applied upon a wet surface nor when the temperature is below 60 degrees F.

When directed by the Engineer, the Contractor shall furnish and place Type No. 6 sand on newly oiled streets to such limits as designated by the Engineer to prevent tracking of oil onto adjacent existing concrete pavement. Sand shall also be used where, in the opinion of the Engineer, the oil penetration is unsatisfactory.

4-04.3(13) RESURFACING OF OIL MAT AND GRAVEL STREETS

The surface of existing oil mat and graveled streets shall be scarified and bladed to a minimum width of 21 feet until it has a uniform grade and cross section with a 3-inch to 5-inch crown at the center line. No attempt shall be made to apply oil to the street surface disturbed by construction operations without first scarifying and blading the entire roadway. Preparation work on the street surface shall produce a smooth, crowned surface, without residual ripples and ridges. All stones, lumps, broken concrete or asphalt, bricks, or other mineral matter which will not pass a 3-inch mesh shall be removed. Any and all wood, peat, or other organic matter shall also be removed, if required by the Engineer, prior to the application of the crushed surfacing. In shaping the existing surfacing, all material that may have been displaced by traffic or otherwise shall be bladed into the newly formed surfacing section.

Crushed Surfacing, "Mineral Aggregate, Type 1," shall be applied only after the newly formed street surface has been approved by the Engineer. Upon approval of the preparatory work, crushed surfacing shall be spread to a minimum depth of 2 inches by any method that will result in an even distribution of the material upon the roadway without perceptible separation in gradation. Where separation does occur, correction shall be made according to Section 4-04.3(4). During or after spreading operations, the newly spread crushed surfacing shall be shaped by blading to conform to the 2 inch depth and the required grade and cross section. Water for laying dust caused by grading operations, public travel, or for otherwise shall be applied in the amounts and places designated by the Engineer.

After final grading has been completed and approved by the Engineer, dust palliative oil shall be applied as specified in Section 4-04.3(12). Prior to opening the newly oiled streets to traffic, warning signs shall be placed at all routes leading to the

freshly oiled roadways. These signs shall say "Fresh Oil," and shall be of a type approved by the Engineer and shall remain as long as may be required by the Engineer.

4-04.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Crushed rock surfacing, top course and base course, ballast, and gravel base will be measured by the ton in accordance with Section 1-09.1.

4-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 4-04 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Dust Palliative," per gallon.

The unit contract price for "Dust Palliative" shall include all costs for the work required to furnish and place dust palliative as specified.

Payment for mineral aggregate of the type specified shall be in accordance with Section 4-01.5.

If the Engineer orders the Contractor to change the type of mineral aggregate from that specified, then any additional compensation resulting from the substitution will be limited to the actual additional cost of the subtituted mineral aggregate based upon invoices from the supplier. If the Contractor requested such change and is approved by the Engineer, no additional cost resulting from the substitution will be made. However, in either case, if the cost of the substituted mineral aggregate is lower than that of the mineral aggregate originally specified, then the difference in cost based upon invoices from the supplier will be conducted from the monies due the Contractor.

SECTION 4-05 VACANT

SECTION 4-06 ASPHALT TREATED BASE

4-06.1 DESCRIPTION

Asphalt treated base consists of a compacted course of base material which has been weatherproofed and stabilized by treatment with an asphalt binder.

The work shall consist of one or more courses of asphalt treated base placed on the subgrade in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Drawings or staked by the Engineer.

4-06.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Asphalt	9-02
Anti-Stripping Additive	9-02
Aggregates	9-03

The grade of paving asphalt shall be AR-4000W meeting the requirements of Section 9-02.1(4).

4-06.3 CONSTRUCTION REQUIREMENTS

4-06.3(1) ASPHALT MIXING PLANT

Asphalt mixing plants for asphalt treated base shall meet the following requirements:

(a) Heating: The plant shall be capable of heating the aggregates to the required temperature.

(b) Proportioning: The mixing plant shall be capable of proportioning the aggregates to meet the Specification, and the asphalt at the rate specified by the Engineer. If the aggregates are supplied in two or more sizes, means shall be provided for proportioning or blending the different sizes of aggregates to produce material meeting the specification requirements.

(c) Mixing: The mixer shall be capable of producing a uniform mixture of uniformly coated aggregates meeting the requirements of these Specifications.

4-06.3(2) PREPARATION OF AGGREGATES

Aggregates for ATB shall be heated to a temperature between the limits of 350 degrees F. and 375 degrees F., or as designated by the Engineer.

4-06.3(3) HEATING OF ASPHALT MATERIAL

Heating of the asphalt material shall conform to the requirements of Section 5-04.3(6).

4-06.3(4) MIXING

The asphalt treated base shall be mixed in accordance with the requirements of Section 5-04.3(6).

4-06.3(5) HAULING EQUIPMENT

Hauling equipment for asphalt treated base shall conform to the requirements of Section 5-04.3(2).

4-06.3(6) SPREADING AND FINISHING

4-06.3(6)A GENERAL

Asphalt treated base shall be spread with a spreading machine equipped with a stationary, vibratory, or oscillating screed or cut-off device, subject to the approval of the Engineer. Approval of the equipment shall be based on a job demonstration that the finished product will meet all requirements of the Specifications. Automatic controls will not be required.

The temperature of the mixture at the time compaction is achieved shall be a minimum of 185 degrees F.

When the total depth of ATB exceeds 3 inches, the ATB material shall be placed in two or more equal courses with each not to exceed 3 inches in thickness.

4-06.3(6)B SUBGRADE PROTECTION COURSE

Unless otherwise ordered by the Engineer, the Contractor shall place the first course of ATB as a protection for the prepared subgrade as soon as possible after the subgrade has been completed.

The surface of the subgrade protection layer when constructed on a grading project shall conform to grade and smoothness requirements that apply to the subgrade upon which it is placed.

4-06.3(6)C FINISH COURSE

The final surface course of the asphalt treated base section, excluding shoulders, whether constructed in one or more courses or over a protective layer, shall not deviate at any point more than 3/8 inch from the bottom of a 10-foot straightedge laid in any direction on the surface on either side of the roadway crown. Failure to meet this requirement will necessitate sufficient surface correction to satisfy the requirements at the Contractor's cost.

4-06.3(7) DENSITY

The asphalt treated base shall be compacted to a density of not less than 80 percent of the maximum theoretical density established for the mix by WSDOT Test Method 705. The density of the base shall be determined by means of tests on cores taken from the roadway or with the nuclear gauge in accordance with Section 5-04.3(10)B. The frequency of these tests shall be at the discretion of the Engineer, but in no case shall it be less than one control lot for each normal day's production. The use of equipment which results in damage to the materials or produces substandard workmanship will not be permitted.

4-06.3(8) ANTI-STRIPPING ADDITIVE

An anti-stripping additive shall be added to the asphalt material in accordance with Section 9-02.4, when directed by the Engineer.

4-06.3(9) COMPACTION

The method of compaction shall be as specified in Section 5-04.3(10).

4-06.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Asphalt treated base will be measured by the ton in accordance with Section 5-04.4.

4-06.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 4-06 will be made at the unit contract price bid only for the pay item listed or referenced below:

(1) "Pavement Base, Asphalt Treated (ATB)," per ton.

The unit contract price for "Pavement Base, Asphalt Treated (ATB)" shall include the cost for all work described in Section 4-06 and not otherwise provided for separately and necessary to construct the asphalt treated base on a prepared subgrade to the lines, grades, and cross sections required.

Payment for roadway excavation and subgrade preparation including excavation and disposal of unsuitable material shall be in accordance with applicable Sections.

DIVISION 5
SURFACE TREATMENTS AND PAVEMENTS

SECTION 5-01 SUBSEALING

5-01.1 DESCRIPTION

This work shall consist of filling voids under existing cement concrete pavement by pumping a mixture of portland cement, pozzolan, and water under the slabs in accordance with these Specifications.

5-01.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement	9-01
Pozzolan	9-23
Water	9-25

5-01.3 CONSTRUCTION REQUIREMENTS

5-01.3(1) PROPORTIONING MATERIALS

The standard mix design for subsealing is as follows:

1 part (by volume) portland cement Type I or II
3 parts (by volume) pozzolan (natural or artificial)
2.25 parts (by volume) water

Any deviation from the dry mix portion (portland cement and pozzolan) shall be approved by the Engineer. The water content may be varied by the Contractor as required for local conditions.

The Contractor shall add powdered aluminum or approved equal as an expanding agent to offset shrinkage. The proportions shall be approved by the Engineer.

The Contractor shall add a liquifier and water reducing agent approved by the Engineer. The proportions shall be approved by the Engineer.

5-01.3(2) EQUIPMENT

All equipment used in performance of the work shall be subject to the approval of the Engineer and shall be maintained in satisfactory working condition at all times.

Air compressors to be used for operating air hammers, and for blowing air into the cavities beneath the pavement, shall be of sufficient size and capacity to perform the work to the satisfaction of the Engineer.

Drills shall be equipped with tips that are capable of cutting 1-1/2 inch diameter holes through the pavement. The equipment shall be in good condition and operated in such a manner that out-of-round holes shall not be produced.

The grout plant shall consist of a cement injection pump and a high speed colloidal mixing machine. The colloidal mixing machine shall operate at a minimum speed of 1,200 rpm and shall consist of a rotor operating in close proximity to a stator, creating a high shearing action and subsequent pressure release to make a homogeneous mixture.

The dry material shall be accurately measured, and the water shall be batched through a meter or scale with a totalizer for the day's consumption.

Wooden cylindrical plugs or other devices approved by the Engineer shall be provided to temporarily plug the application holes until the material has set. The plugs shall be slightly tapered on one end for ease in driving.

5-01.3(3) CONSTRUCTION

Subsealing shall not be done when the pavement is wet, or when water is present under the pavement. Application holes shall be drilled through the cement concrete pavement in the approximate pattern as shown in the Drawings.

Application holes shall be approximately 1-1/2 inches in diameter and shall be perpendicular to the pavement surface. Without specific approval of the Engineer, no more application holes shall be drilled during a day's operation than can be filled or temporarily plugged during the same day. To prepare the cavity for injection of the subsealing mix materials, compressed air shall be blown through the application holes for not less than 15 seconds nor more than 60 seconds, as determined by the Engineer. After the application holes are blown out and the nozzle is firmly wedged into the hole, the subsealing mix shall be pumped into the application hole until all cavities are filled, or until any one of the following occurs:

(a) A pavement slab or portion of a slab starts to rise.
(b) Subsealing mix extrudes from adjacent application holes, or along or outside the longitudinal edges of the pavement.
(c) The Engineer orders application of subsealing mix stopped. After pumping is completed, the nozzle shall not be removed until a worker with a wooden plug is standing by. Immediately upon removal of the nozzle, the plug shall be inserted and firmly driven into the application holes.

Following the application and after it has set, the wooden plugs shall be removed and the application holes immediately filled with subsealing mix.

Subsealing shall be continued progressively through the entire project.

Traffic shall not be allowed to use any subsealed area until the subseal has hardened.

In the event the Engineer determines that continued injection at any specific location is no longer economically feasible, the Contractor shall cease operations and move to a new location.

5-01.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pavement Subseal" will be by the cubic foot (bulk) of dry materials (portland cement and pozzolan) in bags before the addition of water or other additives.

Measurement for "Drill Hole for Subsealing" will be by each hole drilled completely through the cement concrete pavement, including that portion of asphalt concrete if such overlay exists at the drilling locations.

5-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-01 will be made at the unit contract prices bid only for the payment items listed or referenced below:

(1) "Drill Hole for Subsealing," per each.
(2) "Pavement Subseal," per cubic foot.

The unit contract price for "Drill Hole for Subsealing" shall include all costs for the work required to drill the holes as specified.

The unit contract price for "Pavement Subseal" shall include all costs for the work required to complete the subsealing operation as specified.

SECTION 5-02 BITUMINOUS SURFACE TREATMENT

5-02.1 DESCRIPTION

5-02.1(1) GENERAL

This work shall consist of constructing a single or multiple course, bituminous surface by treating existing crushed rock, screened gravel or bituminous roadway surfaces with asphalt and covering with a mineral aggregate thoroughly cemented to the roadway to obtain a wearing surface with good riding and nonskid qualities. The bituminous surface treatment shall be constructed in reasonably close conformity with the lines and cross sections shown in the Drawings or established by the Engineer.

Roadway surfaces shall be classified as treated or untreated roadway surfaces. A treated surface is defined as a paved surface consisting of asphalt concrete, cement concrete, brick, or seal coat. An untreated surface is defined as an unpaved surface which may consist of gravel, crushed rock or oil mat surfaces. Surfaces may be existing or new construction.

The method of treatment to be used on any particular project shall be bituminous surface treatment, Class B, unless otherwise specified.

5-02.1(2) BITUMINOUS SURFACE TREATMENT CLASS A

This method of treatment requires two applications of asphalt and three applications of aggregate as specified. The second application (tack coat) shall be applied not less than ten days after the first application (prime coat) for cutback asphalts and as approved by the Engineer for emulsified asphalts.

5-02.1(3) BITUMINOUS SURFACE TREATMENT CLASSES B, C, AND D

These methods require the placing of one application of asphalt and one or more sizes of aggregate as specified to an existing asphalt roadway to seal and rejuvenate the surface and to produce a uniform roadway surface with good nonskid characteristics.

5-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Asphalt (grade specified)	9-02
Anti-Stripping Additive	9-02
Aggregates	9-03

The grade of asphalt shall be Cationic Emulsified Asphalt (CRS-2) meeting the requirements of Section 9-02.1(6).

Mineral aggregate for Bituminous Surface Treatment Class A or B shall be Mineral Aggregate Type 24, Chip Rock, meeting the requirements set forth in Section 9-03.

When cutback asphalts are specified or ordered by the Engineer for BST Class A, or for BST Class C used in conjunction with BST Class A, construction shall not begin until the need for anti-stripping additive has been determined. The Contractor shall allow a minimum of seven working days after the necessary aggregate, asphalt, and additive samples have been received in the Materials Laboratory for the necessary tests. Additional time will be required if the Contractor has requested more than one source of asphalt or additive be approved.

5-02.3 CONSTRUCTION REQUIREMENTS

5-02.3(1) EQUIPMENT

The equipment used by the Contractor shall include scarifying, mixing, spreading, finishing and compacting equipment, an asphalt distributor, and equipment for heating asphalt material and shall be subject to approval by the Engineer before its use on the work.

The distributor shall have a capacity of not less than 1,000 gallons, and shall be so designed, equipped, maintained, and operated that asphalt material of an even heat shall be uniformly applied at the required rate. It shall be equipped with a 10-foot spray bar with extensions, pressure pump and gauge, volume gauge so located as to be observed easily by the Engineer from the ground, a tachometer to control accurately the speed and spread of asphalt, and two thermometers, one installed permanently in the tank to indicate temperatures of the asphalt at all times. The power for operating the pressure pump shall be supplied by a power unit which will provide a uniform spray from each of the nozzles across the spray bar and extensions.

Rollers shall be self-propelled pneumatic-tired or smooth-wheeled rollers, each weighing not less than 10 tons.

Spreading equipment shall be self-propelled, supported on at least four pneumatic tires, with an approved device for accurately metering and distributing the aggregate uniformly over the roadway surface.

Brooms shall be motorized with a positive means of controlling vertical pressure.

Other equipment necessary to satisfactorily perform the work as specified herein or as designated by the Engineer, shall be subject to approval by the Engineer before its use on the work.

Additional units shall be placed on the work when, in the opinion of the Engineer, it is considered necessary in order to fulfill the requirements of these Specifications, or to complete the work within the time specified.

All equipment shall be maintained in good working order to ensure progress and quality of work.

The right is reserved for the Engineer to disapprove any equipment that, in the opinion of the Engineer, will not or does not accomplish the work satisfactorily.

Both the asphalt distributor and the self-propelled chip spreader shall be calibrated prior to their use to insure applications within the coverage limits specified. Adjustment of the asphalt distributor spray bar height shall be such as to obtain a triple lap of spray fans from bars with a 4-inch nozzle spacing and a double lap from bars having a 6-inch nozzle spacing.

The Contractor shall frequently check and adjust, if necessary, the height of the spray bar during asphalt application to insure the height above the pavement surface does not vary more than 1 inch as the truck load lightens.

5-02.3(2) PREPARATION OF ROADWAY SURFACE

5-02.3(2)A UNTREATED SURFACES

Refer to Section 5-04.3(5)C.

No traffic will be allowed on the repaired surface until the prime coat of asphalt and aggregate is applied.

5-02.3(2)B TREATED SURFACES

Refer to Section 5-04.3(5)B.

5-02.3(2)C SOIL RESIDUAL HERBICIDE

Where shown in the Drawings, soil residual herbicide shall be applied in accordance with Section 5-04.3(5)E. All other provisions of Section 5-04 pertaining to soil residual herbicide shall apply.

5-02.3(3) APPLICATION OF ASPHALT

Upon the properly prepared roadway surface, Cationic Emulsified Asphalt (CRS-2) shall be applied at the rate of 0.35 to 0.40 gallons per square yard (0.38 to 0.45 gallon per square yard in shaded areas) at a distributor spraying temperature between 140xF and 185xF. The Engineer may vary the amount of asphalt to be applied that in his judgment will give the best results.

At any time during the progress of the work, the Engineer may order the use of other grades of asphalt materials in lieu of CRS-2 if, in the Engineer's judgment, the results contemplated by the Specifications will thereby be better attained.

To ensure uniform distribution of apshalt prior to beginning work, the distributor bar shall be operated over a pit or vat. To avoid laps and ridges at transverse junctions of separate applications of asphalt, the Contractor shall spread sufficient building paper over the treated surface to make sure that the spray jets will be functioning normally when the untreated surface is reached.

The pattern of application of shots, and width and length of application of shots of asphalt material shall be such as to provide proper coverage of crushed material within the times specified, provide proper widths to such dimensions as to facilitate the most satisfactory coverage with crushed cover stone, and provide lapping of subsequent adjacent applications.

Asphalt shall be applied to spandrels of intersections and driveways immediately ahead of, or immediately behind the adjacent longitudinal street application.

Omissions (skips) by the distributor shall be immediately covered by hand application with the same grade of hot asphalt.

Any one spread of asphalt shall cover no more area than can be covered with mineral aggregate within 3 minutes from the time of application, upon any part of the spread.

Unless otherwise directed by the Engineer, asphalt shall be spread toward the source of mineral aggregate to avoid injury to the freshly treated surface. No asphalt shall be spread until adequate supplies of mineral aggregate are on hand on the site.

Where earth curbs or no curbs exist, the application of asphalt shall extend 4 inches beyond the gutter line. Where concrete curb and gutter exist, the application shall lap onto the gutter section, but shall not exceed 2 inches. Where concrete curb exists, the application shall be placed as closely as possible to the vertical surface without excessive splash onto the curb. Where concrete curb or curb and gutter exist, the distributor shall be equipped with a splash board designed to prevent spraying thereon.

All castings shall be covered with heavy building paper and weighed down with sand or crushed material.

Hand sprayers shall be used to apply asphalt around castings and wherever cover is insufficient.

5-02.3(4) CHANGE IN GRADES OF ASPHALT

At any time during the progress of the work, the Engineer may order the use of other grades of asphalt materials in substitution of the grades specified in the Project Manual if the intent of the Specifications will be better attained.

5-02.3(5) APPLICATION METHOD OF AGGREGATES

Mineral aggregates shall be furnished and placed by the Contractor. Any method of handling the mineral aggregate which causes segregation of the various sizes of aggregate particles shall be corrected by the Contractor upon the request of the Engineer so that a uniform product will be incorporated in the work.

After applying the asphalt and at such time as the Engineer may direct, mineral aggregate shall be evenly applied to the roadway surface at a rate of 25 to 33 pounds per square yard. The quantity of aggregate to be applied shall be such that the asphalt will be uniformly covered and will not pick up under traffic. The aggregate shall be applied over the freshly spread asphalt by trailer-type or self-propelled spreader boxes of an approved design. The aggregate shall be applied so that trucks and spreader boxes will not travel on the fresh asphalt and it shall be spread in one operation for each application of asphalt. Spandrels of intersections, driveways, and bare spots shall be covered by hand spreading from trucks immediately behind the box application. Aggregate shall be spread in such a manner as to provide an 8-inch strip of asphalt exposed to provide a lap with the next application of asphalt.

The aggregate shall be damp when applied to the roadway. If the aggregate is dry and dusty, the Contractor shall dampen the aggregate by spraying with water.

As soon as the aggregate has been applied to the surface, the aggregate shall be well rolled with a pneumatic-tired roller. Places inaccessible to the pneu matic-tired roller, such as spandrels of intersections and private driveways, shall be rolled with a self-propelled smooth-wheel roller.

Where excess aggregate has been applied, it shall either be removed or be drifted uniformly over the adjacent roadway by using a motor patrol grader equipped with a wire broom mold board, subject to approval of the Engineer. This type of brooming shall be held to a minimum, and where necessary it shall be very carefully performed so as not to disturb the mat in any way. Thin or bare spots in the spread of aggregate shall be corrected by hand spreading or by use of a grader as described above.

Rolling and brooming shall continue until the roadway is evenly covered and the aggregate is well compacted and "set" into the asphalt. This operation shall continue, as directed, until the asphalt has cured to the extent that it will not "pick up" under traffic. Primarily, all rolling will be performed with pneumatic rollers, except as otherwise described above, and the final rolling shall be performed with a self-propelled smooth-wheel roller.

During the maintenance period following the application of the Bituminous Surface Treatment, the Contractor shall perform brooming, spotting, and rolling as may be necessary to prevent "pick up" or other damage to the surface.

At any time during the progress of the work, the Engineer may order the use of a different aggregate grading in lieu of the mineral aggregate specified if in the Engineer's judgment the results contemplated by the Specifications will thereby be better attained.

5-02.3(6) ADDITIONAL ASPHALT AND AGGREGATE

If the application of asphalt or aggregate, or both, is insufficient or excessive for the required results, the Engineer may require the Contractor to make an additional application of one or both materials in accordance with these Specifications, or at the direction of the Engineer.

5-02.3(7) PATCHING AND CORRECTION OF DEFECTS

Omissions by the distributor or damage to the treated surface of any coat shall be immediately covered by hand application with asphalt in adequate quantities. Holes which develop in the surface shall be patched in the same manner as specified in Section 5-04.3(5)C.

Defects such as raveling, lack of uniformity, or other imperfections caused by faulty workmanship shall be corrected and new work shall not be started until such defects have been remedied.

All improper workmanship and defective materials resulting from overheating, improper handling or application, shall be removed from the roadway by the Contractor and be replaced with approved materials and workmanship.

If the Engineer determines a fog seal is necessary at any time during the life of the contract, the Contractor shall apply a fog seal of CSS-1 at the rate of 0.07 to 0.18 (0.02 to 0.05 residual) gallons per square yard. The emulsified asphalt shall be diluted with water at a rate of one part water to one part emulsified asphalt unless otherwise directed by the Engineer.

5-02.3(8) PROGRESS OF WORK

The Contractor shall organize the work such that the entire operation will progress in an orderly and expeditious manner or make progress satisfactory to the Engineer.

The sequence of operation for placing Bituminous Surface Treatments shall be as follows:

(a) Apply asphalt emulsion on a properly prepared roadway surface.
(b) Apply mineral aggregate by spreader boxes.
(c) Roll with pneumatic-tired and/or self-propelled smooth-wheeled roller.
(d) Allow a minimum of 48 hours set time.
(e) Sweep with an approved road broom to pick up and remove excess aggregate. This work shall be accomplished in the early morning hours before the heat from the sun has warmed the pavement.
(f) Maintain roadway surface for 5 calendar days by sweeping and patching as necessary on a daily basis, maintaining traffic signing, etc.

Ten (10) calendar days after the final application, the Contractor shall make a final sweep with a mechanical broom, using the pick up broom only, to clear off any remaining loose aggregates. Gutter brooms shall not be used. The Contractor shall dispose of the excess aggregates.

5-02.3(9) PROTECTION OF STRUCTURES

All bridge handrails, guardrails, curbs, road signs, or other facilities shall be protected from splashing of the asphalt.

5-02.3(10) UNFAVORABLE WEATHER

Asphalt shall not be applied to wet material. Subject to the determination of the Engineer, asphalt shall not be applied during rainfall, sand or dust storms, or before any imminent storms that might damage the construction. The Engineer will have the discretion as to whether the surface and materials are dry enough to proceed with construction.

The application of any asphalt to the roadway shall be restricted to the following conditions:

(a) The roadway surface temperature shall be at least 60 degrees F and the air temperature at least 60 degrees F and rising, or
(b) The air temperature shall be not less than 70 degrees F when falling and the wind shall be less than 10 miles per hour as estimated by the Engineer.

No asphalt shall be applied which cannot be covered one hour before darkness. The Engineer may require the Contractor to delay application of asphalt until the atmospheric and roadway conditions are satisfactory.

Construction of bituminous surface treatments on any travelled way shall not be carried out before May 15 or after September 1 of any year except upon written order of the Engineer.

5-02.3(11) ANTI-STRIPPING ADDITIVE

Refer to Section 4-06.3(8).

5-02.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Asphalt (Grade)" will be made by the gallon or ton before dilution in accordance with Section 1-09.1.

The measurement of aggregates will be by the ton that is being placed in each truck, in accordance with Section 4-01.4.

5-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-02 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(a) "Asphalt, (Grade)," per gallon or ton.

The unit contract price for "Asphalt, (Grade)" shall include all costs for the work required to construct a single or multiple course bituminous surface treatment as specified.

Payment for mineral aggregate will be made in accordance with Section 4-01.5

In accordance with Section 5-02.3(4), the Engineer may order the use of other grades of asphalt materials in substitution of the grades specified in the Project Manual. If the market price of the grade substituted is higher than that of the grade specified, the difference will be added to the unit contract price for asphalt, or if lower, it will be deducted from the unit contract price.

All costs for the work required to coat omissions or patch defects as specified in Section 5-02.3(7) shall be at the Contractor's expense.

All costs for providing protection from splashing of asphalt in accordance with Section 5-02.3(9) shall be included in the unit contract price for "Asphalt, (Grade)".

"Anti-Stripping Additive" will be paid for as extra work in accordance with Section 1-09.4.

All costs for roadway preparation shall be paid in accordance with Section 5-04.5.

SECTION 5-03 COAL TAR PITCH EMULSION SEAL COAT

5-03.1 DESCRIPTION

This work shall consist of constructing two applications of coal tar pitch emulsion sand slurry in accordance with these Specifications.

5-03.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Coal Tar Pitch Emulsion	9-02
Aggregates	9-03

Water used for mixing and for surface dampening shall be clear, fresh, and potable.

5-03.3 CONSTRUCTION REQUIREMENTS

5-03.3(1) EQUIPMENT

All equipment used in the performance of the work shall be subject to the approval of the Engineer and shall be maintained in satisfactory working condition at all times.

Equipment for surface cleaning shall be capable of effectively removing oil, grease, dust, dirt, or other objectionable materials from the pavement surface prior to application of the seal coat.

The mixer for combining the coal tar pitch emulsion and sand shall be of the blade or paddle type (plaster mixer or pug-mill). For larger operations, a concrete transit mixer or a conventional slurry machine may be used with the approval of the Engineer. The mixer shall be of sufficient size and power to obtain thorough and uniform mixing at the rated capacity.

Application equipment shall consist of suitable brooms, squeegees, slurry seal spreader box, and distributor as required. The selection of the application equipment is dependent upon project size and job conditions. The equipment shall be approved by the Engineer.

The distributor shall include a mixing tank with agitator, water tank, pressure pumps and regulators, and hydraulic or pneumatic controls capable of applying the emulsion at a uniform rate. It shall also have suitable metering devices for gauging the rate of application. The distributor equipment may be provided with a separate water spray-bar located ahead of the product spray-bar, or a separate water truck may be used in place of the extra spray-bar. Hand equipment shall be available for application where mechanical equipment cannot be used.

Where a slurry box spreader is used, it shall be attached to the mixer. It shall be of a mechanical type squeegee box equipped with flexible material in contact with the surface to prevent loss of slurry from the box. It shall have adjustments to ensure uniform spread. The box shall be kept clean, and build up of bitumen and aggregate on the box shall not be permitted.

5-03.3(2) SURFACE PREPARATION

All pavement surfaces shall be thoroughly cleaned before application of the seal coat.

On newly constructed asphalt concrete, the surface shall be allowed to age for at least two weeks. The surface shall then be washed with a strong detergent such as trisodium phosphate, and thoroughly rinsed with water. The cleaned pavement shall be allowed to dry completely before application of the coal tar pitch emulsion seal coat.

Old pavement surfaces shall be free of oil and grease spots, paint, clay, dust, and other objectionable materials which might adversely affect bonding of the emulsion. Cleaning equipment shall be capable of effectively removing oil, grease, paint, clay, dust, and other objectionable materials. Solvents shall not be used for cleaning.

When specified in the Project Manual, or determined by the Engineer, pavement surfaces that have been softened and cut back by petroleum derivatives, or have failed from other causes, shall be removed and replaced by a hot plant mix asphalt concrete and compacted to match existing pavement in order to provide a surface texture comparable to that of the surrounding area. These replacement areas shall be prepared as new pavement surfaces before application of the coal tar pitch emulsion seal coat.

5-03.3(3) PREPARATION OF EMULSION

The coal tar pitch emulsion shall be thoroughly stirred in its container as received, preferably by power mixer, so that a creamy homogeneous consistency of all material in the container is ensured for ready application.

5-03.3(4) PROPORTIONING SAND SLURRY

Aggregate shall be mixed with the emulsion at the rate listed below based on the oven-dry weight of the aggregate.

Water blended into the mix for workability shall include the surface moisture content of the aggregate and shall not exceed 30 percent, by volume, of emulsion used. The amount of water to be added to the emulsion shall be the minimum necessary to secure a workable mixture as determined by the Engineer.

5-03.3(5) MIXING SAND SLURRY

Emulsion shall be charged into the mixer first, and if necessary, water shall be added in minimal amounts as the mixer operates, allowing not less than five minutes for thorough blending of the liquids. Dampened aggregate shall be introduced slowly during mixing to prevent segregation or lumping of the materials, and mixing shall be continued for a minimum of five minutes after all aggregate has been added. The mixture shall be uniform and homogeneous and no slurry shall be accepted in which the emulsion has broken prior to spreading operations.

5-03.3(6) APPLICATION

After completion of surface preparation and immediately prior to application of the emulsion, the pavement surface shall be dampened with a fog spray of water. A distributor truck or other method approved by the Engineer shall be used to apply the water.

Emulsion sand slurry shall be applied by the combined or individual use of a distributor, spreader box, brushes, nylon or plastic bristled brooms, squeegees, and related hand tools.

The first application of coal tar pitch emulsion sand slurry shall contain 5 to 7 pounds of aggregate per gallon of undiluted emulsion, spread at a rate of 0.10 to 0.15 gallon per square yard.

The second application of slurry shall contain 0 to 5 pounds of aggregate per gallon of undiluted emulsion, spread at a rate of 0.10 to 0.15 gallon per square yard.

If required by the Engineer, the surface shall be dampened with water prior to application of each coat. Each application shall be cured sufficiently so that the material will not adhere to and be picked up by the tires of vehicles before the next coat is applied. The curing period between applications will be designated by the Engineer, but in no case shall it be less than four hours.

Each coat shall be applied so that coverage is uniform, and any pinholes or unsealed areas shall be repaired prior to each subsequent operation.

Upon completion of the slurry seal construction, all traffic shall be excluded from the area for not less than 24 hours, or longer, if determined by the Engineer.

5-03.3(7) WEATHER LIMITATIONS

Coal tar pitch emulsion seal coats shall be constructed in dry weather and only when the ambient temperature is 60 degrees F or above.

5-03.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Preparation of Surface" will be made by the square yard of surface prepared.

Measurement for "Coal Tar Pitch Emulsion Seal Coat" will be made by the square yard of seal completed in place and accepted by the Engineer.

5-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-03 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Preparation of Surface," per square yard.
(2) "Coal Tar Pitch Emulsion Seal Coat," per square yard.

The unit contract price for "Preparation Of Surface" shall include all cost for the work required to prepare the pavement surfaces as specified in Section 5-03.3(2).

The unit contract price for "Coal Tar Pitch Emulsion Seal Coat" shall include all costs for the work required to make a complete construction of the coal tar pitch emulsion seal coat as specified.

SECTION 5-04 ASPHALT CONCRETE PAVEMENT

5-04.1 DESCRIPTION

This work shall consist of one or more courses of plant mixed asphalt concrete placed on a prepared foundation or base in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Drawings or established by the Engineer.

Asphalt concrete shall be composed of asphalt and aggregate which, with or without the addition of mineral filler and blending sand as may be required, shall be mixed in the proportions specified to provide a homogeneous, stable and workable mixture.

Asphalt concrete Class B, Class D, Class F and Class G are designated as leveling or wearing courses. Asphalt concrete Class E is designated as a pavement base course. With the exception of asphalt concrete Class D, all mixtures are considered dense graded asphalt concrete.

5-04.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Asphalt	9-02
Anti-Stripping Additive	9-02
Aggregates	9-03
Blending Sand	9-03
Mineral Filler	9-03
Rejuvenating (Recycling) Agent	9-02

The various mineral materials may be furnished in whole or in part by the Owner for the manufacture of asphalt concrete, or the Contractor may be required to furnish them. If any of these mineral materials are not provided by the Owner, it shall be understood that the Contractor shall furnish such materials in the amounts required for the designated mix. Mineral materials include coarse and fine aggregates, blending sand, and mineral filler.

When aggregates or a source for the production of aggregates is provided by the Owner, the approximate percentage of asphalt required in the mixture for the particular class of pavement will be set forth in the Project Manual. The percentage is based upon a midline gradation mix design for the source provided.

The grade of paving asphalt shall be AR-4000W.

The grade of asphalt for tack coats shall be Cationic Emulsified Asphalt CRS-2 or STE-1 meeting the requirements of Section 9-02.

The grade of asphalt for sealing joints and other meet lines shall be STE-1 except when the paving to be sealed is outside the Seattle City Limits and under the jurisdiction of King County. In such case the asphalt for sealing meet lines and joints shall be AR 4000W. Asphalt for crack sealing shall be as specified in Section 5-04.3(5)D.

Production of aggregates shall comply with the requirements of Section 3-01.

Preparation of stockpile site, the stockpiling of aggregates, and the removal of aggregates from stockpiles shall comply with the requirements of Section 3-01.

5-04.3 CONSTRUCTION REQUIREMENTS

5-04.3(1) ASPHALT MIXING PLANT

5-04.3(1)A GENERAL

Sufficient storage space shall be provided for each size of aggregate. The different aggregate sizes shall be kept separated until they have been delivered to the cold elevator feeding the plant except that aggregates produced meeting the requirements of Section 9-03.8(3)B need not be separated. The storage yard shall be maintained neat and orderly and the separate stockpiles shall be readily accessible for sampling.

Plants used for the preparation of asphalt concrete shall conform to all requirements of Section 5-04.3(1)B except that scale requirements shall apply only where weight proportioning is used. In addition, batch plants shall conform to the requirements of Section 5-04.3(1)C; continuous mix plants shall conform to the requirements of Section 5-04.3(1)D; and rotary drum plants shall conform to the requirements of Section 5-04.3(1)E.

5-04.3(1)B REQUIREMENTS FOR ALL PLANTS

Except as noted in Section 5-04.3(1)F, all plants shall meet the following requirements:

(a) The asphalt plant shall have a minimum capacity rating by the manufacturer as follows:

For projects involving 5,000 tons or more:

Batch plants–2,000 lbs. per batch.
Continuous mix and rotary drum plants–100 tons per hour.

For projects involving less than 5,000 tons:

Batch plants–1,000 lbs. per batch.
Continuous mix and rotary drum plants–45 tons per hour.

(b) **Smoke and dust control:** When the asphalt plant is erected at a site for the primary purpose of producing mixtures for a specific project, dust and smoke from the asphalt plant shall be eliminated to the extent that they will cause no inconvenience to property owners in the area or damage to their property. The Contractor shall be required to install supplemental equipment, when necessary, to control the dust and smoke to meet the requirements of Section 1-07.1.

(c) **Scales:** Plant and truck scales shall meet the requirements of Section 1-09.2.

(d) **Equipment for preparation of asphalt material:** Tanks for the storage of asphalt material shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the tank. The circulating system for the asphalt material shall be designed to ensure proper and continuous circulation during the operating period. Provision shall be made for measuring the asphalt in the storage tank and a valve shall be placed in the supply line to the mixer for sampling the material.

(e) **Feeder for drier or drum mixer:** The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and uniform temperature will be obtained. The feeder for blending sand, when required, shall be capable of providing a consistent, uniform flow in the amount designated by the Engineer.

(f) **Screens:** Plant screens, capable of screening all aggregates to the specified sizes and proportions and having normal capacities in excess of the full capacity of the mixer, shall be provided.

(g) **Bins:** The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the aggregates. Separate dry storage shall be provided for mineral filler when used and the plant shall be equipped to feed such material into the mixer. Each bin shall be provided with overflow pipes, sized and located to prevent material backing up into other compartments or bins. Each compartment shall be provided with an outlet gate, constructed so there shall be no leakage when closed. The gates shall close quickly and completely. Bins shall be constructed so samples can be readily obtained. Bins shall be equipped with adequate tell-tale devices to indicate the level of the aggregates in the bins at the lower quarter points.

(h) **Asphalt control unit:** Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of asphalt material in the mix. Means shall be provided for checking the quantity or rate of flow of asphalt material into the mixer.

The asphalt may also be proportioned by a device which sprays the asphalt into the mixer through six or more nozzles, and which weighs or proportions the material for each batch by a positive rotating meter which is calibrated in pounds. The metering device shall have an established background of service and shall be approved by the Engineer.

(i) **Thermometric equipment:** An armored thermometer of dequate range in temperature reading shall be fixed in the asphalt feed line at a suitable location near the charging valve at the mixer unit.

The plant shall also be equipped with either an approved dial-scale, a mercury actuated thermometer, an electric pyrometer, or other approved thermometric instrument placed at the discharge chute of the drier to automatically register or indicate the temperature of the heated aggregates. This device shall be in full view of the plant operator. The Engineer may require replacement of any thermometer with an approved temperature-recording apparatus for better regulation of the temperature of aggregates.

(j) **Dust collector:** The plant shall be equipped with a dust collector constructed to waste or return uniformly to the hot elevator all or any part of the material collected.

When a baghouse is used for dust control, the Contractor shall be able to introduce the material returned from the baghouse into the mixture at a uniform and continuous rate. Accurate mechanical means shall be provided for uniformly feeding the fines into the aggregate stream. To accomplish this, the Contractor shall provide a surge hopper with a holding capacity sufficient to accumulate the baghouse fines or shall have a variable speed mechanical feed interlocked to the plant which will prevent any variance in feed into the aggregate stream. Either method shall provide uniform and continuous return of the well-graded fine materials and be provided with a method of withdrawing the surplus fines independently for disposal.

5-04.3(1)C REQUIREMENTS FOR BATCH PLANTS

In addition to the requirements listed under Section 5-04.3(1)B, batch plants shall meet the following requirements:

(a) The plant shall include a drier or driers which continuously agitate the aggregate during the heating and drying process, and be capable of preparing aggregates to specification requirements.

(b) **Weigh box or hopper:** The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the mixer while a batch is being weighed.

(c) **Asphalt control:** The equipment used to measure the asphalt material shall be accurate to plus or minus 0.5 percent. The asphalt bucket shall be a nontilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be not less than 3/4 the length of the mixer and it shall discharge directly into the mixer. The asphalt bucket, its discharge valve or valves and spray bar shall be adequately heated. Steam jackets, if used, shall be efficiently drained and all connections shall be constructed so they will not interfere with the efficient operation of the asphalt scales. The capacity of the asphalt bucket shall be at least 15 percent in excess of the weight of asphalt material required in any batch. The plant shall have an adequately heated quick-acting, nondrip, charging valve located directly over the asphalt material bucket.

The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of asphalt material used in a batch. The controls shall be constructed so they may be locked at any dial setting and will automatically reset to that reading after the addition of asphalt material to each batch. The dial shall be in full view of the mixer operator. The flow of asphalt material shall be automatically controlled so it will begin when the dry mixing period is over. All of the asphalt material required for one batch shall be discharged in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt material the full length of the mixer. The section of the asphalt line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for an asphalt material bucket.

(d) **Mixer:** The batch mixer shall be an approved type capable of producing a uniform mixture meeting the requirements of these Specifications. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

Clearance of the blades from all fixed and moving parts shall not exceed 1 inch unless the maximum diameter of the aggregate in the mix exceeds 1-1/4 inches, in which case the clearance shall not exceed 1-1/2 inches.

(e) **Mixing Time:** The plant shall be capable of regulation of the mixing time as specified in Section 5-04.3(8) in 5 second increments.

(f) **Automatic controls:** All projects using a batch mixer involving 5,000 tons or more of asphalt concrete, except Class F, shall conform to the following provisions. Automatic control of batch mixing operations may be used providing the requirements of this section are met.

The proportioning and timing devices shall be automatic to the extent that the only manual operation required for the proportioning and mixing of materials for one batch shall be a single operation of a switch or starter.

The mixing plant shall be equipped with automatic weight proportioning devices to monitor and control the weights of the several components of aggregates and of the asphalt, plus timing lock devices to monitor and control the position of the aggregate weigh hopper dump gate, the asphalt bucket discharge valve, and the mixer discharge gate.

Withdrawal from the aggregate bins and the discharge of the weigh hopper shall be so interlocked that the weigh hopper cannot discharge until the required quantity of aggregate from each bin has been deposited therein. The weigh hopper may be a single compartment, individual weight control type, or of the divided compartment, preset volume type. When the single compartment, individual weight control type is used, the automatic scale weight system shall discharge and weigh material from one bin at a time. When the preset volume weigh hopper is used, the automatic control system shall check the total weight of each aggregate batch and provision shall be made to allow the Engineer to check easily and quickly the individual aggregate weights at any time.

The timing lock devices shall be actuated by the opening of the aggregate weigh hopper dump gate. They shall lock the asphalt bucket discharge valve until preset dry mixing time is expired and shall lock the mixer discharge gate throughout the preset dry and wet mixing periods. The control of the timing shall be flexible and capable of being set at intervals of not more than 5 seconds throughout cycles up to 60 seconds.

The dials of the timing locks and automatic weighing controls shall be so arranged that the time interval and weight proportion controls may be locked by the Engineer.

5-04.3(1)D REQUIREMENTS FOR CONTINUOUS MIX PLANTS

In addition to the requirements listed under Section 5-04.3(1)B, continuous mix plants shall meet the following requirements:

(a) **Aggregate proportioning:** The plant shall include a means for accurately proportioning each size of aggregate.

The plant shall have a feeder mounted under each compartment bin. Each compartment bin shall have an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from each compartment. The feeding orifice shall be rectangular with one dimension adjustable by positive mechanical means provided with a lock.

Indicators shall be provided for each gate to show the respective gate opening in inches.

The feeder belt or drive system shall be adjustable to various speeds and calibrated with various gate openings for the material to be used.

(b) **Weight calibration of aggregate feed:** The plant shall include a means for calibration of gate openings by weighing test samples. Provision shall be made so that materials fed out of individual orifices may be bypassed to individual test boxes. The plant shall be equipped to conveniently handle individual test samples weighing not less than 200 pounds.

(c) **Synchronization of aggregate feed and asphalt material feed:** Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of asphalt material from the meter or other proportioning device. This control shall be accomplished by interlocking mechanical means or by any other positive method satisfactory to the Engineer.

A warning device shall be provided to alert the plant operator any time the level of material in any one bin is so low that uniform feed is discontinued.

(d) **Mixer:** The plant shall include a continuous mixer of an approved type, adequately heated and capable of producing a uniform mixture meeting the requirements of these Specifications. It shall be equipped with a discharge hopper with dump gates which will permit rapid and complete discharge of the mixture. The paddles shall be adjustable for angular position on the shafts and reversible to retard the flow of the mix. The mixer shall have a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge. Charts shall be provided showing the rate of feed of aggregate per minute for the aggregate being used.

5-04.3(1)E REQUIREMENTS FOR ROTARY DRUM PLANTS

In addition to the requirements listed under Section 5-04.3(1)B, rotary drum plants shall meet the following requirements:

(a) The plant shall have a feeder capable of uniformly introducing the aggregate into the drum. The aggregate feeder shall be synchronized with the asphalt material feed. Satisfactory means shall be provided to afford positive interlocking control between each aggregate cold feed bin, aggregate feed, and the asphalt feed so the plant will automatically activate a warning device if the feed of either aggregate or asphalt is interrupted.

(b) The plant shall have the mixing capability to provide a uniform mixture meeting the requirements of these Specifications.

(c) The asphalt material feed shall have positive recording capabilities so the amount of asphalt incorporated into the mix during any given period of time may be read directly.

5-04.3(1)F SCREENLESS PLANTS

If the Contractor elects to produce aggregate in accordance with Section 9-03.8(3)B, Item 6 - Screens and Item 7 - Bins of Section 5-04.3(1)B will not be required provided the completed mixture meets the specifications as listed in Section 9-03.8(6) for the class of mix being produced.

5-04.3(2) HAULING EQUIPMENT

Trucks used for hauling asphalt concrete mixtures shall have tight, clean, smooth metal beds which have been thinly coated with a minimum amount of paraffin oil, or other approved material to prevent the mixture from adhering to the beds. Each truck shall have a cover of canvas or other suitable material of sufficient size to protect the mixture from the weather.

When dump truck beds are sprayed with oil, the excess oil shall be drained prior to filling with the asphalt mixture. For hopper trucks, the conveyer shall be in operation during the process of oiling the bed.

The asphalt concrete mixture shall leave the mixing plant at a temperature between 260°F. and 350°F. and when deposited on the road it shall have a temperature not less than 250°F.

The exact temperature range within the above limits shall be as directed by the Engineer.

5-04.3(3) VACANT

5-04.3(4) ASPHALT EQUIPMENT

5-04.3(4)A ASPHALT PAVERS

Asphalt pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of asphalt plant mix material in lane widths applicable to the specified typical section and thicknesses shown in the Drawings.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. Any bolt-on extensions over 1 foot in length on either side of the paver shall have the same equipment as the rest of the paver. Hydraulic extenders without screeds, augers, and vibration shall not be used in the traveled way.

When laying mixtures, the paver shall be operated at a uniform forward speed consistent with the plant production rate and roller train capacity to result in a continuous operation. The auger speed and flight gate opening shall be adjusted to coordinate with the operation.

The paver shall be equipped with automatic screed controls with sensors for either or both sides of the paver. The controls shall be capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing automatic signals which operate the screed to maintain the desired grade and transverse slope. The sensor shall be constructed so it will operate from a reference line or a multi-footed ski-like arrangement.

The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

Manual operation will be permitted in the construction of irregularly shaped and minor areas.

When specified in the contract, reference lines will be required for both outer edges of the traveled way for each main line roadway for vertical control. Horizontal control utilizing the reference line will be permitted. The grade and slope for intermediate lanes shall be controlled automatically from reference lines or by means of a multi-footed ski and a slope control device. When the finish of the grade prepared for paving is superior to the established tolerances, and, when in the opinion of the Engineer, further improvement to the line, grade, cross-section, and smoothness can best be achieved without the use of the reference line, a multi-footed ski-like arrangement may be substituted subject to the continued approval of the Engineer. After paving the first lane, a joint matcher may be used subject to the approval of the Engineer. The use of the reference line shall be reinstituted immediately whenever the Contractor fails to maintain a superior pavement, or rhythmic undulations occur, or the surface smoothness of the course being paved fails to meet the requirements for wearing course. The reference line may be removed after the completion of the first course of asphalt concrete when approved by the Engineer and subject to reinstallation as specified herein.

The Contractor shall furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment. The Contractor shall submit samples of the above items along with the methods and procedures to the Engineer for approval prior to installation.

5-04.3(4)B ROLLERS

Rollers shall be of the steel wheel, vibratory, or pneumatic tire type, in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the mixture. The number and weight of rollers shall be sufficient to compact the mixture as required in Section 5-04.3(10). The use of equipment which results in excessive crushing of the aggregate will not be permitted. Rollers producing pickup, washboard, uneven compaction of the surface or other undesirable results will be rejected by the Engineer.

The following specifications shall apply to the various types of rollers:

(a) Vibratory Rollers:

(1) A variable amplitude will be required, with at least 2 settings.
(2) A variable frequency with a 2,000 VPM minimum.
(3) The maximum rate of travel under vibration shall be limited to 3 mph.
(4) Pneumatic propulsion on surface courses shall be limited to smooth tires that will not leave visible tracks.

(b) Pneumatic Tired Rollers:

(1) The maximum rate of travel shall be limited to 5 mph.
(2) Skirts shall be firmly affixed to the perimeter of the roller and shall uniformly extend to within 1 inch of the pavement surface.

(c) Steel Wheel Rollers:

(1) The maximum rate of travel shall be limited to 4 mph.
(2) The minimum weight shall be 10 tons except for rollers used to compact areas inaccessible to a 10 ton roller (i.e., driveways, walkways, around castings, etc.).

5-04.3(4)C PLANERS

Planing shall be by the cold planing method only. Equipment shall be of a type that has operated successfully on work comparable to that in the contract and shall be subject to the Engineer's approval prior to use. Equipment shall be maintained in good working condition while in use. The storage of equipment and volatile material shall be off-street and in compliance with Seattle Fire Department regulations.

Cold planers shall be milling type equipment capable of cutting at least a 5 foot chord to a depth of 4 inches in one pass. Smaller planers may be used for cutting around utility castings and making taper cuts for butt joints.

For mainline cold planing operations, the equipment shall have automatic controls with sensor for either or both sides of the equipment capable of sensing the proper grade from an outside reference line. The automatic controls shall also be capable of maintaining the desired transverse slope. The sensor shall be so constructed that it will operate from a reference line or multi-footed ski-like arrangement. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

5-04.3(4)D DISTRIBUTORS

Distributors shall meet the requirements of Section 5-02.3(1).

5-04.3(4)E HEATER SCARIFIERS

Equipment used to heater-scarify pavement shall be capable of heater-scarifying between 1,000 square yards and 1,500 square yards of pavement per hour. The heating unit shall have a minimum rating of 10,000 BTU's per hour. The heater-scarifier shall also be equipped with a leveling device to

provide for an even distribution of loose material. The scarifier shall maintain continuous and undiminished pavement contact without damaging utility castings.

5-04.3(5) PREPARATION OF STREET SURFACES

5-04.3.(5)A GENERAL

Street surfaces shall be classified as treated and untreated surfaces. Treated surfaces shall be cement concrete, asphalt concrete, brick, seal coat or other bituminous surface treatments. Untreated surfaces shall be crushed rock, gravel, or oil mat surfaces.

The work of preparing existing street surfaces prior to the addition of one or more courses of asphalt concrete or other bituminous material shall be classified as "surface preparation" for treated street surfaces, and "roadway preparation" for untreated street surfaces.

5-04.3(5)B SURFACE PREPARATION - TREATED SURFACES

5-04.3(5)B1 GENERAL

When an existing treated surface is to be used as a base for one or more courses of new asphalt concrete or other surfacing, the treated surface shall first be swept, cleaned, and patched as follows:

(a) Treated surfaces shall be swept with a power broom until free from dirt and other foreign matter. Hand brooms shall be used to clean omissions of the power broom. Fatty asphalt patches, grease drippings and other objectionable material shall be removed from the existing pavement.

(b) Excess asphalt joint filler shall be completely removed and premolded joint filler shall be removed to at least 1/2-inch below the surface of the existing pavement.

(c) In order to obtain a base having uniform grade and cross section, all surface irregularities in the existing treated surface shall be corrected prior to placement of the new asphalt concrete or other bituminous surface treatment. Correction shall be by patching and if necessary, preleveling unless planing or heater-scarifying is specified. Although patching and preleveling may be necessary after planing, such work, after planing, shall be performed only when specified in the Contract Documents or designated by the Engineer.

5-04.3(5)B2 PRELEVELING

When a surface of the existing pavement or old base is irregular, it shall be brought to a uniform grade and cross section by preleveling, unless some other method of correction has been specified in the Contract Documents.

As soon as the existing surface has been thoroughly cleaned, holes and discontinuities in the surface and edges and edge breaks shall be patched. Asphalt used for patching shall be Class B Asphalt concrete mix, heated to the temperature specified in Section 5-04.3(6). Before placing the premixed patch material in the hole, the bottom and edges of the hole shall be tack coated. The patch material shall be thoroughly tamped or rolled.

Patching shall be accomplished prior to preleveling or installation of the first asphalt course, whichever is applicable. Preleveling of uneven or broken surfaces shall be accomplished by placing asphalt concrete of the class specified with a motor patrol grader, by hand-raking, by Miller box, or by such other method as may be approved by the Engineer. After placement, the asphalt concrete shall be compacted thoroughly.

In some cases spot planing to remove high areas caused by rutting, etc., shall be performed prior to preleveling. Locations to be planed prior to preleveling will be noted in the Contract Documents.

Preleveling materials shall be the same class of asphalt concrete as the wearing course except that when asphalt concrete Class G is being used to construct the wearing course overlay, asphalt concrete Class B may, upon approval of the Engineer, be used as an alternate for preleveling provided there is no increase in cost to the Owner for substituting the alternate mix.

5-04.3(5)B3 PLANING BITUMINOUS PAVEMENTS

When planing is specified, the surface of designated pavement or the top surface of subsurface courses shall be removed or reshaped by planing to remove irregularities and produce a prepared subgrade acceptable for receiving an asphalt concrete overlay. Planing shall be by the cold milling method unless heater planing is specifically designated. The planer shall not be used on the final wearing course of new asphalt concrete construction.

Planing operations shall be conducted in such a manner as will not tear, break, burn or otherwise damage the surface which is to remain. The finished planed surface shall be slightly grooved or roughened and shall be free from gouges, deep grooves, ridges, or other imperfections.

A tapered wedge cut shall be made longitudinally along curb lines sufficient to provide a minimum of 4 inches of curb reveal after placement and compaction of the final wearing course. A tapered wedge cut shall also be made at transitions to adjoining pavement surfaces (meet lines) where butt joints are indicated on the Drawings. Butt joints shall be cut in a straight line with vertical faces 2 inches or more in height and shall produce a smooth transition to the existing adjoining pavement.

After planing is complete or when designated by the Engineer, the planed surfaces shall be swept, cleaned, and if required by the Contract Documents or Engineer, patched and preleveled.

When the planed street surface is opened to traffic prior to asphalt concrete paving operations, the Contractor shall install, maintain and subsequently remove temporary pavement markings as specified in Section 5-04.3(17) and as directed by the Engineer.

Temporary asphalt shims (MC 250) shall be placed around each utility casting protruding above the surface in the traveled roadway, or any other area which can be a safety hazard to vehicular traffic. These temporary shims shall be removed prior to laying the asphalt overlay.

5-04.3(5)B4 HEATER-SCARIFYING

When heater scarifying is specified, the surface of designated pavements shall be sufficiently softened by heating to permit scarifying to a minimum depth of 3/4 inch without damaging the remaining pavement. The scarified material shall, in one continuous operation, be thoroughly mixed by tumbling, uniformly redistributed and leveled by an oscillating or vibratory device followed by roller compaction while the material is still hot.

Scarification to a depth of 3/4 inch shall provide 9 pounds of scarified material per square foot of scarified roadway.

After compaction, the material shall be rejuvenated by the application of a rejuvenating agent in the amount and at the rate designated by the Engineer. Subject to climatic conditions and directions from the Engineer the rejuvenating agent shall be applied within 30 minutes of rolling.

Heater scarifying shall produce a completed surface with a uniform grade and cross-slope varying not more than 1/4 inch from the lower edge of a 10-foot straightedge placed on the

completed surface in any direction. Variances due to roadway crowns, designed grade changes, tapered cuts at butt joints and along curbs or gutter will be taken into consideration by the Engineer.

Excess material from heater scarifying shall be removed and disposed of by the Contractor.

The recycled pavement may be opened to traffic after application of the rejuvenating agent. However, if the processed surface is, in the opinion of the Engineer, contaminated or degraded by traffic, a tack coat of asphalt shall be applied at the ratio of 0.12 to 0.20 gallons per square yard (0.08 to 0.12 residual).

5-04.3(5)B5 TACK COAT

A tack coat of asphalt, applied at the rate of 0.02 to 0.08 gallons per square yard of retained asphalt, shall be applied by a mechanical distributor, approved by the Engineer and meeting the requirements of Section 5-02.3(1), to all surfaces on which any course of asphalt concrete is to be placed or abutted including prior to preleveling. The distributor equipment shall be capable of distributing asphalt uniformly over an area in controlled amounts and shall be equipped with hand operated spray equipment for use only on inaccessible and irregularly shaped areas. When asphalt concrete pavement Class D is being constructed, the tack coat shall be applied to the existing surface at a rate of 0.12 to 0.20 (0.08 to 0.12 residual) gallons per square yard.

Where the new asphalt concrete abuts a curb or gutter, cold pavement joint, trimmed meet line, or any metal surface, a thin tack coat of asphalt shall be applied on the vertical face of the abutting surface by hand painting prior to paving. The application on the contact surfaces shall be thin and uniform in order to avoid an accumulation of excess asphalt in puddles. The Contractor shall not apply the tack coat on vertical contact surfaces above the finished height of the asphalt concrete being placed.

Where it is necessary to remove sections of existing pavements, the removal shall be performed in accordance with Section 2-02.

5-04.3(5)C PREPARATION OF UNTREATED ROADWAY

5-04.3(5)C1 GENERAL

Untreated roadway surfaces, including intersections and side street approaches which are to receive asphalt concrete pavement or other surfacing shall be shaped to a uniform grade and cross-section, conforming as nearly as possible to that which exists except:

(a) When new lines and grades are indicated in the contract documents or staked by the Engineer; or

(b) Where the height of the centerline crown relative to the gutterline or edge of roadway exceeds 2 percent X 1/2 of the roadway width; in which case the crown shall be corrected by excavation or scarifying and blading to a cross section having a crown of 2 percent X 1/2 width or such other crown as may be designated by the Engineer.

Lines and grades will not be set by the Engineer in Case (b) above. The basis for establishing final line and grade in such case shall be curbs, curbs and gutters, existing pavement, or pavement edges or other existing street improvements. Existing driveways shall be graded as necessary to provide a smooth transition to the final grade of the new pavement surface including such grading as may be necessary to permit driveway adjustment with Class B Asphalt.

Where curbs or curb and gutters are not required or existing, subgrade preparation shall be 2 feet greater than the final asphalt paving width indicated on the Drawings for that street (1 foot on each side) or to such other width des ignated by the Engineer. The radius at the edge of roadway or at intersections shall be a minimum of 20 feet.

The grade shall be shaped so that all frame castings for manholes, monument boxes, gate valve boxes, catch basins, etc. within the roadway section to be treated will extend above the prepared surface, such that the casting will be flush with the final surface.

Preparation work shall produce a subgrade with a smooth, crowned surface without ripples or ridges. All stones, lumps, broken concrete, asphalt, bricks or other mineral matter which will not pass a 2 inch mesh shall be removed and disposed of by the Contractor. Wood, peat, or other organic matter shall also be removed and disposed of by the Contractor.

Where existing asphalt or cement concrete pavement is being met with new asphalt surfacing, sufficient native material shall be removed to permit the forming of a butt joint.

Those areas and surfaces which are to be prepared for the placement of asphalt concrete pavement or other surfacing shall be considered subgrade for the new construction. The existing roadway shall be scarified, excavated, bladed, shaped, and compacted to remove irregularities and secure a uniform surface conforming to the existing street profile and to the desired cross section. Excavated native material deemed unsuitable by the Engineer shall be removed and disposed of by the Contractor. Excess native material deemed suitable by the Engineer shall be stockpiled by the Contractor or bladed to the roadway edge and used as needed for fill or shoulder restoration following completion of the pav ing. The scarified or excavated material shall be used to the fullest extent possible as sub-base material prior to the placement of new crushed rock.

During the operation of blading and rolling, water shall be applied in the amount and locations designated by the Engineer.

If there is a surplus of stockpiled material after construction is complete, the Contractor shall clean up the stockpile site and remove and dispose of the surplus material.

The Contractor shall patch with premixed materials any holes or other malformations that cannot be removed by blading. The premixed material shall be made of crushed surfacing top course or cover stone from existing stockpiles mixed on the roadway with the asphalt specified for the project, by such roadmix meth ods as designated by the Engineer. Small patches shall be thoroughly hand tamped and the larger holes or areas shall be patched and rolled with a smooth-wheeled roller or a two-axle power patching roller.

After scarifying, excavating, blading, shaping, and, if required, placing crushed surfacing, the roadway subgrade shall be compacted in accordance with the requirements of Sections 2-06 and 4-04. The subgrade shall be brought to a firm, unyielding surface by compacting the entire area to a width of 1 foot outside the edge of pavement or to the curb or curb and gutter.

Soft, spongy, or yielding spots shall be removed, refilled with suitable, stockpiled material, and thoroughly compacted.

It is assumed that sufficient existing crushed rock material will be obtained from scarifying and excavation operations to provide a minimum of 2 inches of crushed rock sub-base for the asphalt paving, or that the subgrade, after scar ifying, excavation, and shaping has been completed, will be acceptable as is, without the need for additional procured crushed rock (i.e. the depth of the existing crushed rock is at least 2 inches deep).

When, in the opinion of the Engineer, the sufficient roadway subgrade material is not available, the Contractor shall furnish, place, and compact a maximum of 2 inches of "Mineral Aggregate, Type 1" on the subgrade. The material shall not be placed unless specifically ordered in writing by the Engineer.

"Mineral Aggregate, Type 1" will not be considered a major bid item.

The Contractor shall insure that a 2 inch minimum depth of native or procured crushed rock base is provided for the asphalt paving.

The full width of the roadway shall be sprinkled with water, when ordered by the Engineer, to alleviate dust and to keep the subgrade material moist as an aid to compaction.

Immediately before the prime coat of asphalt is applied, the roadway surface shall be stable and unyielding, dry to medium damp condition, free from irregularities and material segregation, and true to line, grade, and cross section.

In the event the compacted aggregates are of such gradation as to resist penetration of the asphalt, the Contractor shall loosen no more than the upper 1/2 inch of surface and relay without compaction immediately before the prime coat application. Following the application of aggregate on the prime coat, rolling shall be performed as specified above.

5-04.3(5)C2 PRIME COAT TREATMENT

Unless otherwise specified, a prime coat treatment of asphalt in accordance with the requirements of Section 5-02.3(3) for existing gravel, crushed rock, or oil mat streets shall be required prior to being paved with asphalt concrete.

The prime coat shall be applied over the full length of the project, and asphalt concrete pavement shall not be placed until the prime coat has cured for a full 5 days.

The Contractor shall maintain the completed prime coat by blading or brooming until the asphalt concrete is placed. Should any holes, breaks, or irregularities develop in the roadway surface after the prime coat has been applied, they shall be patched or repaired in accordance with Section 5-04.3(5)C1 immediately in advance of placing the asphalt concrete pavement.

Immediately prior to tacking and placing the asphalt concrete pavement, the surface of the prime coat shall be swept clean of all dirt, dust, and other foreign matter.

In areas used as turnouts or which will receive heavy service, the Engineer may order a change in the subgrade elevation to provide a greater depth of pavement.

The Contractor shall prepare untreated shoulders and traffic islands by blading and compacting to provide a sound base for paving. The prime coat treatment shall be omitted and the asphalt concrete pavement shall be constructed on the prepared subgrade after tacking in accordance with Section 5-04.3(5)B5.

When prime coat treatment is not required, the Contractor shall prepare the untreated roadway as specified above except for the prime coat of asphalt and aggregate. The asphalt concrete pavement shall be constructed on the prepared subgrade and tacked in accordance with Section 5-04.3(5)B5.

5-04.3(5)D CRACK SEALING

When the Bid Form includes a pay item for "Crack Sealing", all cracks and joints shall be cleaned with a stiff-bristled broom and compressed air. After cleaning, all cracks less than 1/4 inch in width shall be filled with straight CSS-1 emulsified asphalt and topped with sand. All cracks and joints greater than 1/4 inch and less than 3/4 inch in width shall be filled with either a sand slurry or rubberized asphalt. Cracks larger than 3/4 inch in width shall be filled with a sand slurry. Application of the sand slurry or rubberized asphalt shall be as follows:

(a) **Sand Slurry:** The sand slurry shall consist of approximately 20 percent CSS-1 emulsified asphalt, approximately 2 percent portland cement, water (if required), and the remainder clean 1/4 inch - 0 paving sand. The mixture shall be poured into the cracks and joints until full. The following day, any cracks or joints which are not completely filled shall be topped off with the slurry. After sealing, the filler shall be broomed or squeegeed flush with the existing pavement surface and allowed to cure prior to constructing the asphalt concrete overlay.

(b) **Rubberized Asphalt:** The sealant material shall meet the requirements of Section 9-04.10 and shall be applied in accordance with the manufacturer's recommendations. These recommendations shall be furnished to the Engineer by the Contractor prior to the start of work and shall include recommended heating time and temperature, allowable storage time and temperatures after initial heating, allowable reheating criteria, and application temperature range.

The cracks shall be completely dry before being filled with the rubberized asphalt. Filling shall be controlled to confine the material within the crack or joint. If, in the opinion of the Engineer, the Contractor's method of filling results in an excessive amount of sealant on the pavement surface, filling shall be stopped and the method changed. Any overflow shall be cleaned from the pavement surface.

5-04.3(5)E SOIL RESIDUAL HERBICIDE

Prior to installing asphalt driveways or sidewalks, the driveway and sidewalk subgrade shall be treated with one application of an approved soil residual herbicide. The soil residual herbicide to be used shall not damage or have a detrimental chemical reaction to the asphalt concrete. Application of the herbicide shall be by a uniform spray in accordance with the manufacturer's recommendations. Paving shall begin within 24 hours after application of the herbicide. Areas not paved within that time limit or that have been rained on shall be retreated.

The material to be used shall be registered for use under pavement in the State of Washington by the Washington State Department of Agriculture. Before use, the Contractor shall receive from the Engineer approval of the material to be used and the proposed rate of application. The following information shall be included in the request for approval of the material: Name of the material, State registration number, manufacturer, and proposed rate of application.

Application of the herbicide shall be performed in accordance with Section 8-02.3(3).

5-04.3(6) HEATING OF ASPHALT MATERIAL

The asphalt shall be heated to a maximum of 350 degrees F. The asphalt shall be heated in a manner that will avoid local overheating and provide a continuous supply of asphalt material to the mixer at a uniform temperature plus or minus 25 degrees F from the temperature ordered by the Engineer.

The asphalt shall be heated to between 250 and 350 degrees Fahrenheit, the temperature within this range will be determined by the Engineer.

5-04.3(7) PREPARATION OF AGGREGATES

5-04.3(7)A GENERAL

The aggregates shall be stockpiled according to the requirements of Section 9-03.8(3). The aggregates shall be removed from stockpile(s) in a manner to ensure a minimum of segregation when being moved to the asphalt plant for processing into the final mixture.

5-04.3(7)B MIX DESIGN

Once the crushing operation has stabilized to the satisfaction of the Engineer, a representative sample will be obtained from the stockpiled aggregates. A sample of the stockpiled blending sand, if needed, will also be required at this time. Paving operations shall not proceed until a mix design is approved by the Engineer. The Contractor shall submit a mix design from a test laboratory approved by the Engineer based on the requirements of Section 9-03.8(2). A separate mix design shall be required for each source of asphalt cement and aggregate.

The Contractor shall obtain the Engineer's approval prior to changing the source of asphalt cement during the production of asphalt concrete. Blending of asphalt from different sources will not be permitted.

5-04.3(8) MIXING

The prepared aggregates shall be combined in the mixer in the amount of each fraction of aggregates as specified or as directed by the Engineer. The asphalt material shall be measured or gaged and introduced into the mixer in the amount determined by the Engineer.

After the required amounts of aggregate and asphalt material have been introduced into the mixer, unless otherwise specified, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the asphalt material throughout the aggregate is ensured. Wet mixing time shall be sufficient to produce 95 percent coated particles as determined by WSDOT Test Method No. 714.

When discharged, the temperature of the mix shall not exceed 325 degrees F except that the temperature for mixes designed for asphalt concrete Class D shall not exceed 260 degrees F. A maximum water content of 2 percent in the mix, at discharge, will be allowed providing the water causes no problems with handling, stripping, or flushing. In this case the moisture content shall be reduced as directed by the Engineer.

Storing or holding of the asphalt concrete mixture in approved storage facilities will be permitted during the daily operation but in no event shall the materials be held for more than 24 hours. Materials held for more than 24 hours after mixing shall be rejected and disposed of by the Contractor. The storage facility shall have a visible device located at the top of the cone or about the third point to indicate the amount of material in storage. No material shall be accepted from the storage facility when the material in storage is below the top of the cone of the storage facility, except at the end of the working day.

5-04.3(9) SPREADING AND FINISHING

5-04.3(9)A GENERAL

Crushed surfacing shall be placed under asphalt concrete pavement in accordance with 4-04.3(4).

Unless otherwise specified on the Drawings or in the Project Manual, asphalt concrete pavement in all street areas shall be Asphalt Concrete Class B to a compacted thickness of 3 inches, installed in 2 equal lifts.

The asphalt concrete pavement shall be constructed in one course or multiple courses of equal depth. Courses shall not exceed the nominal compacted depth specified below for the particular class of asphalt concrete being used:

Asphalt Concrete Class E.....0.25 foot (3 inches)
Asphalt Concrete Class B when used for Base Course .....0.25 foot (3 inches)
Asphalt Concrete Class B and F.....0.16 foot (2 inches)
Asphalt Concrete Class G .....0.10 foot (1-1/2 inches)
Asphalt Concrete Class D .....0.08 foot (1 inch)

Where the compacted depth of any asphalt concrete pavement exceeds the depth specified above for the particular class of mixture, the course shall be constructed in two or more equal layers.

When more than 1 course is necessary to meet the final paving grade, the first course shall include any widening of the existing roadway and preleveling of the existing pavement surface. The preleveling course or courses shall be constructed so that the final wearing course will have a uniform compacted depth and will conform to the finished grade and cross section elevations specified.

The final wearing course placed after a roadway surface has been planed, or planed and preleveled shall be constructed to a nominal compacted depth of 2 inches. Where heater scarifying has preceeded placement of the final lift, the nominal compacted depth of the final wearing course shall be 1 inch minimum.

Construction of 1 course upon another shall not proceed until the underlying course has completely cooled and set.

Unless otherwise directed by the Engineer, the construction of each course of asphalt concrete pavement shall commence at the point farthest away from the mixing plant and progress toward the plant so that no hauling will be done over freshly placed pavement.

Any wearing course or other pavement course to be used for the driving surface will be evaluated by the Engineer to determine whether a fog seal is required. When the results of nuclear or core density testing show that a seal is needed, or when the surface course is asphalt concrete Class D, the Contractor shall apply a fog seal of CSS-1 at the rate 0.05 to 0.10 (0.03 to 0.05 residual) gallons per square yard. Unless otherwise approved by the Engineer, fog seal shall be applied prior to opening the roadway surface to traffic.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the paving may be done with other equipment or by hand.

The placing of asphalt mixtures at night will not be permitted except by approval of the Engineer or if specified in the Project Manual.

When the asphalt mixture is being produced by more than one asphalt plant, the material produced by each plant shall be placed by separate spreading and compacting equipment.

5-04.3(9)B UTILITY ADJUSTMENTS

Utility appurtenances such as inlets, manhole covers and valve boxes shall be adjusted to finished grade prior to the construction of the final wearing course.

5-04.3(10) COMPACTION

5-04.3(10)A GENERAL

Immediately after the asphalt concrete mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, or irregularities and in conformance with the line, grade, and cross-section shown in the plans or as established by the Engineer. If necessary, the mix design may be altered to achieve desired results.

Compaction shall take place when the mixture is in the proper condition so that no undue displacement, cracking, or shoving occurs. All compaction units shall be operated at the speed, within specification limits, that will produce the required compaction. Areas inaccessible to large compaction equipment shall be compacted by mechanical or hand tampers. Any asphalt concrete that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt, or is in any way

defective, shall be removed and replaced at no additional cost with fresh hot mix which shall be immediately compacted to conform with the surrounding area.

The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided specification densities are attained. An exception shall be that the pneumatic tired roller shall be used between October 1 and April 1. Coverages with a vibratory or steel wheel roller may precede pneumatic tired rolling. When asphalt concrete pavement Class D is being constructed, the use of pneumatic rollers will not be required.

Vibratory rollers shall not be operated in the vibratory mode when the internal temperature of the mix is less than 175 degrees F or when checking or cracking of the mat occurs at a greater temperature. Vibratory rollers in the vibratory mode are also prohibited on bridge decks.

5-04.3(10)B CONTROL

For asphalt concrete Classes B, E, and F, where paving is in the traffic lanes and the specified compacted course thickness is greater than 0.10 foot, the acceptable level of compaction shall be 92 percent of the maximum density as determined by WSDOT Test Method 705. The level of compaction will be determined as the average of not less than 5 nuclear density gauge tests taken (after completion of the finish rolling) at randomly selection locations within each lot. The quantity represented by each lot will be no greater than a single day's production or approximately 400 tons, whichever is less.

Control lots not meeting the prescribed minimum density standard shall be removed and replaced with satisfactory material. At the option of the Engineer, non-complying material may be accepted at a reduced price.

Cores may be used as an alternate to the nuclear density gauge tests and shall be taken within 48 hours of the placement of the mix.

Asphalt concrete Classes B, E, F, and G constructed under conditions other than listed above shall be compacted on the basis of a test point evaluation of the compaction train. The test point evaluation shall be performed in accordance with instructions from the Engineer. The number of passes with an approved compaction train as required to meet the maximum test point density shall be used on all subsequent paving.

Asphalt concrete Class D and preleveling mix shall be compacted to the satisfaction of the Engineer. In addition to the randomly selected locations for tests of the control lot, the Engineer reserves the right to test any area which appears defective and to require the further compaction of areas that fall below acceptable density readings.

5-04.3(11) JOINTS

5-04.3(11)A LONGITUDINAL AND TRANSVERSE JOINTS

The placing of the top or wearing course shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued for such length of time as to permit the mixture to become chilled. When the work is resumed, the previously compacted mixture shall be cut back to produce a slightly beveled edge for the full thickness of the course.

Where a transverse joint is being made in the wearing course, strips of heavy wrapping paper shall be used. The wrapping paper shall be removed and the joint trimmed to a slightly beveled edge for the full thickness of the course prior to resumption of paving.

The material which is cut away shall be wasted and new mix shall be laid against the fresh cut. Rollers or tamping irons shall be used to seal the joint.

The longitudinal joint in any one layer shall be offset from the layer imme-diately below by not more than 6 inches nor less than 2 inches. All longitudinal joints constructed in the top layer shall be at a lane line or edge line of the travelled way. However, on one-lane ramps a longitudinal joint may be constructed at the center of the traffic lane, subject to approval by the Engineer, if:

(a) the ramp remain open to traffic, or,
(b) the ramp is closed to traffic and a hot lap joint is constructed.

If a hot lap joint is allowed, two paving machines shall be used; a minimum average compacted density of 92 percent of the maximum density shall be achieved throughout the traffic lane; and construction equipment shall not impact any uncompacted mix.

Immediately following the compaction of the top wearing course, meet line joints where the new asphalt concrete abuts existing asphalt concrete pavements, portland cement concrete pavements, oil mats, concrete curbs and gutter, etc., shall be sealed with STE-1 asphalt per Section 5-04.3(11)B.

5-04.3(11)B CONNECTIONS WITH EXISTING FACILITIES

Where construction of new asphalt concrete pavement connects with an existing roadway surface, driveway, bridge, railway crossing, or other facility, the Contractor shall provide a smooth riding transition between the new and existing surface. Such work may require the modification of the existing roadway profile by burning, planing or milling in order to achieve the desired smooth riding transition or may require other adjustment of the connecting surface.

Where butt joints are required at the meet lines of new construction and existing surfaces, the existing abutting pavement shall be trimmed by chipping, planing, milling or such other method as may be approved in order to insure a minimum depth of 2 inches of compacted asphalt concrete at the point of connection. Meet lines shall be trimmed straight and the edges vertical. Waste material resulting from such trimming or chipping shall be disposed of by the Contractor. Butt joints will be required only at locations designated on the Drawings. Unless the existing roadway profile requires modification by planing, all other connections shall be made by shimming or feathering to provide the necessary smooth riding connection.

Where the transition is to be made by shimming or feathering, it shall be accomplished at the time the final course is being constructed by raking out the oversize aggregates of the asphalt concrete mix being used. The Contractor shall not leave the asphalt open graded when feathering and shimming down to an existing surface. If approved by the Engineer, shimming and feathering may be accomplished at a later date. In such case, asphalt concrete Class G shall be used.

Surfaces which will be in contact with the new asphalt shall be tacked in accordance with the requirements of Section 5-04.3(5)B5.

Meet lines shall be sealed while the new asphalt concrete is still warm by painting with Special Tack Coat (STE-1) asphalt and immediately covering the asphalt paint strip with clean, dry paving sand meeting the requirements of Section 9-03.8(1).

5-04.3(12) SAMPLES

The Engineer reserves the right to have samples cut or cored from the completed pavement or the individual courses. Additionally, the Engineer may take samples of the uncompressed asphalt concrete mixtures as well as all materials incorporated in the work. Where samples have been

taken from the uncompressed asphalt concrete, new material shall be placed and compacted to conform with the surrounding area.

5-04.3(13) SURFACE SMOOTHNESS

The completed surface of all courses shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds. The completed surface of the wearing course shall not vary more than 1/8 inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline. The transverse slope of the completed surface of the wearing course shall vary not more than 1/4 inch in 10 feet from the rate of transverse slope shown in the Drawings.

When deviations in excess of the above tolerances are found, the pavement surface shall be corrected by the addition of asphalt concrete mixture of an appropriate class to low places or the removal of material from high places by grinding with an approved grinding machine or by removal and replacement of the wearing course of asphalt concrete. Correction of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances.

All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above shall be removed and replaced to the satisfaction of the Engineer.

Castings, such as inlets, manholes, valve chambers, meter boxes, monument cases, etc., shall be adjusted to finish grade prior to construction of the final wearing course.

5-04.3(14) VACANT

5-04.3(15) ASPHALT CONCRETE DRIVEWAYS

Asphalt driveways shall be constructed at the locations shown on the Drawings or as directed by the Engineer in accordance with Section 5-04.

Unless indicated otherwise on the Drawings, the Contractor shall complete the necessary earthwork and provide a 3 inch compacted Asphalt Concrete, Class B and 4 inch Mineral Aggregate, Type 1 driveway section to the limits shown on the Drawings or designated by the Engineer.

The subgrade shall be treated with soil residual herbicide in accordance with requirements of Section 5-04.3(5)E.

5-04.3(16) WEATHER LIMITATIONS

Asphalt for prime coat shall not be applied when the ground temperature is lower than 50 degrees F, without written permission of the Engineer.

Asphalt concrete Class D shall not be placed when the air temperature is less than 60 degrees.

Asphalt concrete shall not be placed on any wet surface, or when the average surface temperatures are less than those specified in the following table, or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures:

	Surface Temperature Limitations	
		Sub-Surface
Compacted Thickness	Surface Course	Courses
Less than 0.10'	55° F.	55° F.
0.10' to 0.20'	45° F.	35° F.
0.21' to 0.35'	35° F.	35° F.
More than 0.35'	D.N.A.	25° F.*

*Only on dry subgrade, not frozen and when air temperature is rising.

5-04.3(17) PAVING UNDER TRAFFIC

When the roadway being paved is open to traffic the following requirements shall apply:

(a) The Contractor shall keep intersections open to traffic at all times except when paving through the intersection. Such closures shall be kept to the minimum time required to place and compact the mixture and shall include advance warning to traffic of the intersection closure. Work shall be scheduled so that consecutive intersections shall not be closed at the same time. In hot weather the Engineer may require the application of water to the pavement to accelerate the finished rolling of the asphalt and to shorten the time required before reopening to traffic. Traffic shall not be allowed on newly placed asphalt until approval has been obtained from the Engineer. The installation of advance warning signs, detours, and the maintenance of traffic shall be as specified in Section 1-07.23 and the Traffic Control Manual for In-Street Work.
(b) During paving operations, center line stripes shall be maintained throughout the project by applying temporary pavement marking tape each day to the roadway that was paved that day. Temporary centerline striping shall consist of placing strips of pressure-sensitive pavement marking tape at 10-15 foot intervals along the center line. Temporary marking tape shall be placed in sets of two 12-inch strips of yellow 4-inch wide marking tape set 4 inches apart and parallel to the center line with each set of 1-foot double line spaced 10 to 15 feet along the center line of the roadway. Additional temporary striping shall be installed wherever designated by the Engineer.
(c) Temporary stop bars shall consist of a 12-inch wide stop bar made up of three parallel 4-inch strips of temporary pavement marking tape placed at locations designated by the Engineer. All other temporary pavement markings utilizing pavement marking tape shall be designated by the Engineer.
(d) Pressure-sensitive pavement marking tape used on the wearing course prior to installation of permanent lane markers, traffic buttons, or permanent paint striping shall be removed from the pavement current with, or immediately subsequent to, the installation of permanent pavement markings. Damage to the pavement, resulting from removal of temporary marking tape, shall be repaired by the Contractor.
(e) Temporary pavement markings shall be maintained in servicable condition by the Contractor during the interval of time it is in use. Layout and marking in preparation for application and the application and removal of the temporary striping shall be the Contractor's responsibility. The Engineer will do the layout for permanent lane markings as specified in Section 8-22.3(1).
(f) Temporary pavement marking tape shall meet the requirements of Section 9-29.4.
(g) Within five days, weather permitting, after the preliminary layout of pavement marking control points has been completed by the Engineer, the Contractor shall install all permanent pavement markings. Installation shall be pursued vigorously thereafter until all permanent pavement markings and traffic channelization work is complete.

5-04.3(18) CHANGE IN GRADE OF ASPHALT

Refer to Section 5-02.3(4).

5-04.3(19) SEALING OF DRIVING SURFACES

Any wearing course or other pavement course to be used for the driving surface will be evaluated by the Engineer to determine whether a fog seal is required. When the results of nuclear or core density testing show that a seal is needed, or when the surface course is asphalt concrete Class D, the Contractor shall apply a fog seal of CSS-1 at the rate 0.05 to 0.10 (0.03 to 0.05 residual) gallons per square yard. Unless otherwise approved by the Engineer, fog seal shall be applied prior to opening to traffic.

5-04.3(20) ANTI-STRIPPING ADDITIVE

When directed by the Engineer, an anti-stripping additive shall be added to the asphalt material in accordance with Section 9-02.4.

5-04.3(21) SHOULDERS

Shoulders, if required, shall be constructed to the lines, grades, and cross-sections specified. Material for building up shoulders shall be "Mineral Aggregate, Type 1" manufactured from crushed ledge rock.

5-04.3(22) ASPHALT CONCRETE SIDEWALK

Asphalt walkways shall be constructed at the locations and to the width specified on the Drawings or as designated by the Engineer.

Asphalt walkways shall be constructed with a 4 inch section of compacted crushed rock and 2 inches of compacted Class B asphalt concrete. The subgrade shall be treated with a soil residual herbicide in accordance with the requirements of Section 5-04.3(5)E.

5-04.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for asphalt concrete pavement of the class specified will be by the ton whether the asphalt concrete is used for pavement, sidewalk, driveway, shims, feathering, or preleveling. The net weight of asphaltic concrete materials being delivered to the job site shall be weighed in the transport equipment on a certified platform scale which automatically prints the net weight on a load ticket. Only load tickets from automatic printing platform scales will be acceptable. Alternately, the Contractor may use a commercial certified platform scale having an automatic weight printing capability. The engineer will periodically observe and check such weighing operations. The weigher shall record on the load ticket the weight and other required information such as time, date, truck number, etc. The tare weight of each truck shall be recorded at least daily and recorded on a tare sheet. Tare weight is the weight of a truck without a load.

Measurement will be based upon the actual quantity incorporated into the work as determined by the material load tickets received and approved by the Engineer on the day the material was delivered and incorporated into the work. Deductions will be made for any asphaltic material included in the measurement that is not incorporated into the work on the day delivered.

The Owner reserves the right to make random checks at independent weigh stations of the gross and tare weights of transport equipment hauling asphaltic concrete material to the job site. In the event these random checks result in net weights that are different by more than 1 percent of the smaller net weight, the Contractor shall, at the Engineer's option, thereafter utilize a certified scale of the Engineer's choice. If the random check indicates the Contractor's scales have been underweighing, no additional payment to the Contractor will be allowed for materials previously weighed and recorded. Should the random check indicate the Contractor's scales were overweighing (indicating more than true weight) by more than 1 percent of the smaller net weight, then all materials received subsequent to the last previous random check will be reduced by the percentage or error in excess of the 1 percent.

Measurement for "Roadway Preparation" will be made by the linear foot once along the centerline of the main roadway being prepared. All related intersections, side street approaches, and irregular shaped areas thereto will be incidental. Measurement shall be to the nearest whole linear foot.

Measurement for "Surface Preparation, Plane Bituminous Pavement" will be by the square yard and shall be based on the average depth, shown on the Drawings plus any additional depth up to 4 inch maximum, to cover removal of high spots and the extra depth required to provide a 4 inch reveal along the curb line as specified in Section 5-04.3(5)B3. Should the Drawings indicate or the Engineer order an area to be planed in excess of 4 inches, the square yard of surface planed will be increased by the actual area of surface planed in excess of 4 inches. If the Engineer directs an additional planing beyond the depth required above, the total quantity of planed surface will be increased to include area replaned. The Engineer will determine depth of planing during each planing operation.

Measurement for "Surface Preparation, Prelevel" will be by the ton of asphalt concrete placed for preleveling surfaces based on the actual quantity incorporated into the work as determined by the material load tickets received and approved by the Engineer on the day the material was delivered and placed.

Measurement for "Surface Preparation, Heater-Scarify" will be by the square yard of area actually heater-scarified to a minimum depth of 3/4 inch.

Measurement for "Plasticizing Rejuvenator" will be by the gallon. Measurement of quantities will be based upon the actual quantities incorporated into the work.

5-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-04 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Pavement, Asphalt Concrete (Class)," per ton.
(2) "Roadway Preparation," per linear foot.
(3) "Surface Preparation, Prelevel," per ton.
(4) "Surface Preparation, Plane Bituminous Pavement," per square yard.
(5) "Surface Preparation, Heater Scarify," per square yard.
(6) "Plasticizing Rejuvenator," per gallon.
(7) "Crack Sealing," lump sum.

The unit contract price for "Pavement, Asphalt Concrete (Class)" shall include all costs for the work required to furnish, haul, place and compact the asphalt concrete mix as specified in Section 5-04, including asphalt for tack coat, fog seal and sealing joints and meet lines, sand for joints and meet lines, sweeping and other preliminary surface preparation, and such other work as may be necessary according to this section and not otherwise set forth as a separate bid item on the Bid Form.

All costs for the temporary pavement marking work specified in Section 5-04.3(5)B3 and 5-04.3(17) shall be included in the unit contract price bid for "Pavement, Asphalt Concrete (class)".

Asphalt concrete driveways, sidewalks, shims, and feathers will be paid for as "Pavement, Asphalt Concrete (Class)," which will include costs for soil residual herbicide.

MC 250 used for temporary asphalt shim will be paid in accordance with Section 5-07.

If the Engineer orders a change in grade of paving asphalt, any additional compensation will be limited to the actual additional cost of the asphalt based on invoices from the supplier. If the cost of the substituted paving asphalt is lower, the difference in the cost and that of the original material specified, based on invoices from the supplier, shall be deducted from monies due the Contractor.

The unit contract price for "Roadway Preparation" shall include all costs for the work required to prepare the untreated roadway, including scarifying, blading, shaping, and compacting to remove irregularities and secure a uniform surface, and such other work as specified in Section 5-04.3(5)C, except prime coat treatment which will be paid in accordance with Section 5-02.

The unit contract price for "Surface Preparation, Prelevel" shall include all costs for the work required to prelevel uneven or broken surfaces by placing asphalt, by spot planing or such other work as specified in Section 5-04.3(5)B2.

The unit contract price for "Surface Preparation, Plane Bituminous Pavement" shall include all costs for the work required to prepare the surface as specified including milling and planing, reworking or recycling existing surfacings, removing and disposing of cuttings, extra planing for butt joints, and feathering meet areas in preparation for an asphalt overlay of either leveling course or wearing course.

The unit contract price for "Surface Preparation, Heater Scarify" shall include all costs for the work required to heat, scarify, crush, mix, redistribute, level and compact to a minimum depth of 3/4 inch of an existing bituminous surface as specified herein.

The unit contract price for "Plasticizing Rejuvenator" shall include all costs for the work required to rejuvenate the scarified material as specified in Section 5-04.3(5)B4.

All costs for retreating areas with soil residual herbicide as required by Section 5-04.3(5)E shall be at the Contractor's expense.

All costs for the rejection and disposal of materials held for more than 24 hours after mixing, as specified in Section 5-04.3(8), shall be at the Contractor's expense.

When cores are taken by the Engineer at the request of the Contractor, as specified in Section 5-04.3(10)B, the Owner shall be reimbursed for the coring expenses at the rate of $75.00 per core.

Where samples have been taken from the uncompressed asphalt concrete as specified in Section 5-04.3(12), new material shall be placed and compacted at no additional expense to the Owner.

If surface deviations are found which exceed the allowable tolerances but are not in excess of twice the allowable tolerances specified in Section 5-04.3(13), and, in the opinion of the Engineer, correction by means of any of the methods specified above will not produce satisfactory results as to smoothness and serviceability, the Engineer may accept the completed pavement and shall deduct from monies due or that may become due to the Contractor the sum of $500.00 for each and every section of single traffic lane 100 feet in length in which any deviations as described above are found. Under the circumstances described above, the decision whether to accept the completed pavement or to require corrections as described above shall be vested entirely in the Engineer.

The lump sum contract price for "Crack Sealing" shall include all costs for the work required to clean and fill the cracks and joints as specified in Section 5-04.3(5)D.

All costs to repair pavement damaged by the removal of temporary marking tape specified in Section 5-04.3(17) shall be at the Contractor's expense.

SECTION 5-05 CEMENT CONCRETE PAVEMENT

5-05.1 DESCRIPTION

This work shall consist of constructing portland cement concrete pavements in streets and alleys on a prepared subgrade or base course in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown on Standard Plan No.'s 401, 402, 403, 405 and WSDOT Standard Plan No. A-1, Drawings or as established by the Engineer.

This work shall also consist of constructing portland cement concrete edge walls, support walls and curb walls at locations shown on the Drawings, and in accordance with these Specifications and Standard Plan No.'s 800 and 801.

5-05.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement	9-01
Fine Aggregate	9-03
Coarse Aggregate	9-03
Water	9-25
Reinforcing Bars	9-07
Tie Bars	9-07
Dowel Bars	9-07
Joint Filler	9-04
Curing Materials and Admixtures	9-23
Joint Sealants/Filler	9-04
Epoxy Resins	9-26

The concrete mix for street pavement and alleys shall be Class 6 (1-1/2), unless otherwise specified in the Drawings or the Project Manual.

Concrete mixes incorporating fly ash may be utilized for all classes of concrete, unless otherwise noted in the Project Manual. Mix proportions will be subject to approval by the Engineer and shall meet the requirements of Section 9-23.9.

5-05.3 CONSTRUCTION REQUIREMENTS

5-05.3(1) PROPORTIONING MATERIALS

The class of concrete for non-structural uses refers to the nominal number of sacks of cement per cubic yard, although this designation does not constitute a guarantee of yield. The figure in parenthesis indicates maximum aggregate size. Example: Cl 5 (1-1/2) is a 5 sack mix with 1-1/2 inch maximum size coarse aggregate.

H.E.S. indicates high-early-strength cement and may be required by the Engineer for any of the classes of mix.

With approval of the Engineer, the Contractor may use high-early-strength cement in any of the mixes.

Air-entrained concrete shall be used, unless otherwise provided for in the Project Manual.

The volume of air in freshly mixed concrete shall conform to that specified in the table which follows:

AIR CONTENT OF FRESHLY MIXED CONCRETE

Maximum Size of Coarse Aggregate (Inches)	Air Content Percent by Volume	
1-1/2, 2 and 3	5	± 1
3/4 and 1	6	± 1
3/8 and 1/2	7-1/2	± 1

If the measured air content is found above or below the values contained in the table, the Contractor shall immediately make changes in mixing or materials as will be necessary to comply with the requirements for air content.

Fine and coarse aggregates shall be proportioned by weight except that if the project is small, volumetric proportioning may be used with permission of the Engineer. In

proportioning, the unit of measure for cement will be by the 94 pound sack.

Weights of fine and coarse aggregate are based on a bulk specific gravity, saturated surface dry, of 2.67. When volume measurements are used, 1 cubic foot of sand shall be taken as equivalent to 100 pounds of sand, and 1 cubic foot of gravel shall be taken as equivalent to 105 pounds of gravel. Correction must be made for contained moisture in the aggregate and variation in specific gravity.

Concrete mixes shall be proportioned as specified in the table which follows. The weight of each size of aggregate is the estimated quantity to be used with one sack of cement. With approval of the Engineer, the proportion of aggregate may be altered to give better workability.

Class of Concrete	5 (3/4)	5 (1-1/2)	5.5 (1-1/2)	6 (1-1/2)	6.5 (1-1/2)	Reference Section
28 Day Compressive Strength, psi	2,300	2,300	2,500	3,000	3,600	-
Sacks per Cubic Yard	5	5	5.5	6	6.5	-
Pounds dry Fine Aggregate No. 1	...	275	248	220	210	9-03.1(2)B
Pounds dry Fine Aggregate No. 2	291	...	.....	...	.....	9-03.1(2)B
Pounds No. 2 Coarse Aggregate	...	...	.....	...	280	9-03.1(3)C
Pounds No. 4 Coarse Aggregate	...	166	150	132	.....	9-03.1(3)C
Pounds No. 5 Coarse Aggregate	387	248	223	201	.....	9-03.1(3)C

In adjusting concrete mixes, the following water-cement ratios shall not be exceeded:

Cement Sacks (Sacks Per Cubic Yard)	Maximum Water (Gal. per Sack)
4	8.2
5	6.5
5.5	6.0
6	5.5
6.5	5.1

5-05.3(2) CONSISTENCY (SLUMP REQUIREMENTS)

The materials shall be mixed with sufficient water to produce a stiff concrete which will hold its shape when deposited upon the subgrade. Concrete placed during wet weather must be mixed with sufficient water to produce a very stiff mixture. The consistency shall be such that separation of the mortar from the coarse aggregate will not occur in handling.

Slump shall be measured in accordance with ASTM C143 "Method of Test for Slump of Portland Cement Concrete."

Water/cement ratio mix shall not produce a concrete slump of more than 2 inches. Where additional workability is required due to weather conditions or other variables, the Contractor may add, on approval of the Engineer, a water reducing agent to increase the slump up to 3-1/2 inches. The Engineer has the authority to reject any concrete mix with a slump greater than 3-1/2 inches.

5-05.3(3) EQUIPMENT

Equipment necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the jobsite sufficiently ahead of the start of paving operations to be examined thoroughly and approved.

(a) **Batching plant and equipment:**

(1) **General:** The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The batching plant shall be equipped with a suitable nonresettable batch counter which will correctly indicate the number of batches proportioned.

(2) **Bins and hoppers:** Bins with adequate separate compartments for fine aggregate and for each size of the coarse aggregate shall be provided in the batching plant.

(3) **Scales:** Plant and truck scales shall meet the requirements of Section 1-09.2.

(4) The batching plant shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices of an approved type.

(b) **Mixers:**

(1) **General:** Concrete may be mixed at a batching plant or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

(2) **Batching plant:** Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released.

Mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 3/4 inch or more. The Contractor shall have available at the jobsite a copy of the manufacturer's design, showing dimensions and arrangements of the blades in reference to original height and depth, or provide permanent marks on blades to show points of 3/4 inch wear from new conditions. Drilled holes 1/4 inch in diameter near each end and at midpoint of each blade are recommended.

(3) **Truck mixers and truck agitators:** Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling plant-mixed concrete, shall conform to the requirements of Section 6-02.3(4)C.

(4) **Nonagitator trucks:** Bodies of nonagitating hauling equipment for concrete shall be smooth, mortar-tight, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. If discharge of concrete is accomplished by tilting the body, the surface of the load shall be retarded by a suitable baffle. Covers shall be provided when needed for protection. Plant-mixed concrete may be transported in nonagitated vehicles provided that the concrete is delivered to the site of the work and discharge is completed within 45 minutes after the introduction of mixing water to the cement and aggregates, and provided the concrete is in a workable condition when placed.

(c) **Finishing equipment:**

Refer to Section 5-05.3(8)D and 5-05.3(12).

(d) **Joint Sawing Equipment:**

The Contractor shall provide approved power driven saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously upon call by the Engineer on a 24 hour basis, including Saturdays, Sundays and holidays.

5-05.3(4) HANDLING, MEASURING AND BATCHING MATERIALS

The batch plant site, layout, equipment, and provisions for transporting material shall ensure a continuous supply of material to the work.

(a) **Measuring Materials:**

(1) **Aggregates:** The fine aggregate and each size of coarse aggregate shall be measured by weighing, the weight for the particular aggregates used being proportional to their respective bulk specific gravities. The weighing of each size of material shall be a separate and distinct operation.
Corrections shall be made for variations in weight of materials due to the moisture content.
The equipment for weighing aggregates shall conform to the requirements of Section 1-09.2.

(2) **Cement:** Cement shall be weighed on scales meeting the requirements of Section 1-09.2. Adequate provision shall be made to prevent loss of cement between the batch box and the mixer.

(3) **Water:** The amount of water required for each batch shall be determined by the Engineer. Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over 1 percent.

(b) **Batching Materials:**

On all projects requiring more than 2,500 cubic yards of portland cement concrete for paving, the batching plant shall be equipped to proportion aggregates and cement by weight by means of automatic and interlocked proportioning devices of approved type.

5-05.3(5) MIXING CONCRETE

5-05.3(5)A GENERAL

The concrete may be mixed in a batching plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of Section

6-02.8(4)C.

When mixed in a batching plant, the mixing time shall not be less than 50 seconds nor more than 90 seconds.

The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic feet, as shown on the manufacturer's standard rating plate on the mixer.

Each concrete mixing machine shall be equipped with a device for counting automatically the number of batches mixed during the day's operation.

All elements of a batch shall be simultaneously and continuously fed to the mixer to ensure uniform distribution of cement, water, aggregates, and admixtures.

Retempering concrete by adding water or by other means will not be permitted. Admixtures for increasing the workability or for accelerating the set will be permitted only when specified or approved by the Engineer.

5-05.3(5)B LIMITATIONS OF MIXING

Concrete shall not be mixed, placed, or finished when the natural light is inadequate, as determined by the Engineer, unless an adequate and approved artificial lighting system is operated.

Mixing and placing concrete shall be discontinued when a descending air temperature in the shade away from artificial heat reaches 40 degrees F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35 degrees F unless authorized in writing by the Engineer.

When mixing and placing is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete shall be not less than 50 degrees F and not more than 90 degrees F at the time of discharge into the hauling conveyance. No concrete shall be mixed with frozen aggregates.

5-05.3(6) SUBGRADE

Subgrade shall conform to the requirements of Section 2-06 except that the subgrade may be trimmed by equipment other than automatically controlled machine using reference lines.

After the forms have been securely set to grade and alignment, the subgrade between the forms shall be brought to true cross section by dragging a subgrade template as many times as may be necessary to secure a true subgrade. The finished subgrade shall be brought to an unyielding surface by rolling with compacting units meeting the requirements in Section 2-06.

Where thickened edges for pavements are required, such as shown on Standard Plan No. 405, the subgrade shall be excavated and shaped to provide for the section shown.

Wherever possible, vehicles shall be kept off the finished subgrade. If vehicles must travel on the subgrade ahead of the paving, a power drag shall be carried immediately ahead of placing concrete. Irregularities in the subgrade caused by any equipment during the placement of concrete shall be smoothed out and compacted immediately ahead of placing the concrete.

No concrete or base material shall be placed until the subgrade is approved by the Engineer. The subgrade as finally completed and approved shall be maintained by the Contractor at an optimum moisture content by wetting with water until the concrete or base material is actually placed.

5-05.3(7) PLACING, SPREADING, AND COMPACTING CONCRETE

5-05.3(7)A CONCRETE PAVEMENT CONSTRUCTION - GENERAL

Concrete may be placed, spread, and compacted between stationary forms or through the use of a slip-form paver at the Contractor's option, unless a specific method is required by the Contract Documents.

Unless designated otherwise in the Project Manual, paving widths from 25 feet to 44 feet shall be paved in 2 operations, with compensation allowed for thickened edge on each side of the included longitudinal construction joint. Should the Contractor be allowed to pave in more than 2 operations for the above widths, thickened edge required due to installation of more than one construction joint shall be constructed at no additional expense to the Owner. When "hand" screeding methods are allowed, paving widths shall not exceed 12 feet on arterials or 13 feet on non-arterials.

Keyways shall be provided at all longitudinal and transverse construction joints.

Unless designated otherwise in the Project Manual full width paving will be allowed only with the written permission of the Engineer.

Concrete shall not be placed in an adjacent lane sooner than 72 hours after finishing of the previous lane. Mixers and trucks shall be operated on the subgrade or on the shoulder adjacent to the lane being paved. Newly paved lanes shall not be used for mixers, trucks or other construction equipment unless the concrete pavement meets the requirements set forth in Section 5-05.3(17).

A protective ramp shall be constructed at the pavement edge where vehicles may be driven on and off the pavement. The forms shall be left on the outside edge of the first lane at all turnouts until the pavement is opened to traffic.

When tie bars are specified, they shall be placed before the concrete is struck off during the last pass with the strike-off screed whether hand or machine operated. If the tie bars impede the flow of traffic, the tie bars shall be protected from traffic by bending down and back against the side form. Prior to placing the adjacent lane, the tie bars shall be straightened.

A metal plate 3 inches wide by 1/8 inch thick and at least 5 feet in length shall be placed on the completed pavement in the adjacent lane near the common joint with the lane to be paved, and the concrete shall be struck off from the plate, whether by machine or hand placement.

All roadways, shoulders, and subgrade in use by the Contractor shall be kept adequately dampened to prevent the accumulation of dust upon the freshly placed concrete.

5-05.3(7)B SLIP FORM CONSTRUCTION

At the option of the Contractor and with the approval of the Engineer, concrete pavement may be constructed by the use of slip-form paving equipment.

Slip-form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape, and strength to support the concrete laterally for a sufficient period of time during placement to produce pavement of the required cross section; and the equipment shall spread, consolidate, screed, and float-finish the freshly placed concrete in such a manner as to provide a dense and homogeneous pavement.

The concrete shall be distributed uniformly into final position by the slip-form paver and the horizontal deviation in alignment of the edges shall not exceed the 1/2 inch from the alignment established by the Engineer.

The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of pavement and/or a series of equally spaced longitudinal vibrating units. The space from the outer edge of the pavement to the outer longitudinal unit shall not exceed 9 inches. The spacing of internal units shall be uniform and not exceed 18 inches.

The term internal vibration means vibration by vibrating units located within the specified thickness of pavement section and a minimum distance equal to the pavement thickness ahead of the screed.

The rate of vibration of each vibrating unit shall be not less than 5,000 vibrations per minute, and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1 foot. The frequency of vibration or amplitude shall be varied proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency, having a slump as specified in Section 5-05.3(2). The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

Regardless of the method or machinery used to construct pavement, depressed curb for driveways and ramps shall be provided at those locations indicated on the Drawings or as required by the Engineer. When a slip-form paving machine is used for pavement construction, the Contractor shall block out the pavement area beneath areas where depressed curb is to be constructed. Such blocked out pavement areas, together with the depressed curb sections, shall then be constructed concurrently with the cement concrete item needing the depressed curb.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement, shall be equipped with protective pads on crawler tracks or rubber-tired wheels and shall be offset to run a sufficient distance from the edge of the pavement to avoid breaking or cracking the pavement edge.

After the concrete has been given a preliminary finish by the finishing devices in the slip-form paving equipment, the surface of the fresh concrete shall be checked with a straightedge to comply with the tolerances and finish specified in Section 5-05.3(12)C.

5-05.3(7)C STATIONARY SIDE FORM CONSTRUCTION

5-05.3(7)C1 GENERAL

Forms and headers and their placement shall meet the requirements of Section 5-05.3(21).

The concrete shall be placed upon the prepared subgrade or base between the forms to the required depth and cross section in a continuous operation between construction or expansion joints. No concrete shall be placed until the forms are approved by the Engineer (refer to Section 5-05.3(21)).

The concrete shall be thoroughly consolidated by mechanical vibration. Complete consolidation is required along all forms or adjoining pavements by such means as will

prevent gravel pockets along the edges of the finished pavement. Any gravel pockets found after removing the forms shall be repaired by the Contractor.

When integral curb is being constructed with the pavement, fresh concrete for the integral curb shall be placed at such time as will enable the top section of the curb to be consolidated, finished, and bonded to the pavement slab while the concrete is plastic.

Where curb is required, and such curb is not being placed integrally with the pavement slab, dowels shall be placed in the pavement slab as detailed on Standard Plan No.'s 410, 411, 412 and 415, or as specified in Section 8-04.

Prior to placing concrete around manholes, catch basins, valve chambers, etc., a temporary cover fitting below the rim of the ring casting shall be provided to prevent the concrete from flowing into them.

5-05.3(7)C2 PLACING CONCRETE AT THROUGH JOINTS

Concrete placement around through joints shall be such that the through joint assembly will not be disturbed and that it will remain in a straight line perpendicular to the subgrade, as shown on the Standard Plans. The concrete shall then be vibrated along the entire length of the joint to consolidate the concrete and leave no rock pockets anywhere at the joint. If any rock pockets are exposed, they shall be repaired.

5-05.3(7)C3 PLACING CONCRETE WITH REINFORCING STEEL OR WIRE MESH

Concrete shall be placed in two courses. The first course shall be struck off at the elevation established for reinforcing steel bar or wire mesh. Immediately prior to placing the reinforcement, the concrete shall be brought to a fairly even surface by means of a template conforming to the depth of the reinforcement. Reinforcement shall be placed on the bottom course before the concrete attains initial set. No more than 45 minutes shall elapse between mixing of the first course and placement of the second course.

Reinforcement shall be free of dirt, mill scale, oil, grease, or other foreign material that may impair bond. Steel, coated with rust, may be used if the oxidations are not deep or loose coated.

Successive mats of steel or wire mesh shall be securely lapped together and tied so that longitudinal bars will lap 40 diameters and wire mesh will lap 6 to 12 inches.

Reinforcement shall be laid as a continuous mat. Continuity shall be maintained between expansion joints. Steel shall terminate within four inches of the joint.

Concrete may be placed in one lift, provided a method acceptable to the Engineer is used to position and secure the reinforcement at the designated locations in the slab.

If the concrete is placed in two courses where reinforcement is used, all dirt, sand, or dust which collects on the base course shall be removed before the top course is placed.

Other requirements for placing and fastening reinforcing steel shall be as specified in Section 6-02.3(24)D.

5-05.3(7)D COMPACTING CONCRETE

5-05.3(7)D1 GENERAL

All cement concrete pavement shall be vibrated. Vibration shall be by:

(a) internal vibration, and/or
(b) machine compaction.

5-05.3(7)D2 INTERNAL VIBRATION

Except when slip-form pavers are used internal vibrations shall be performed in accordance with Section 6-02.3(9).

5-05.3(7)D3 MACHINE COMPACTION

The machine used for compacting shall be self-propelled and designed to run on the side forms. Movable parts shall be capable of adjustment and they shall be adjusted so as to produce accurately the roadway sections shown on the Drawings. The machine shall be equipped with two reciprocating screeds. The tops of the forms shall be kept clean with a suitable device attached to the machine.

The travel of the machine on the forms shall be maintained true without lift, wobble or other variations which might prevent a precise strike off.

The machine shall be put in forward motion as soon as concrete is deposited on the subgrade. On the first pass, a roll of concrete shall be carried ahead of the screed. Screeds and tampers shall be operated so as not to disturb expansion joints and caps.

Machines shall be operated prior to placing longitudinal and transverse dummy joints.

Machines shall be operated at least twice and as many more times as may be necessary to compact concrete free from rock pockets, and to a section that can be finished properly.

Care must be exercised not to overwork the concrete and bring an excess of mortar to the surface.

5-05.3(7)D4 COMBINED VIBRATION AND MACHINE COMPACTION

The combined vibration and compaction equipment shall be demonstrated to the satisfaction of the Engineer as being capable of consolidating the concrete across the full width of the pavement into a homogeneous mass, free of rock pockets, and without separation of mortar and aggregate.

The equipment shall consist of the machine described in Section 5-05.3(7)D4, or an approved spreading machine to which is attached a vibrating unit composed of individual internal vibrators spaced not more than 29 inches apart. The vibrators shall be spaced equidistantly, and the distance from the side forms to the nearest vibrator shall not exceed 14 inches. The vibrators shall be carried behind and independent of the strike-off screed of the spreading machine, or ahead of and independent of the strike-off screed of the first compacting machine.

The vibrating unit shall not rest upon the side forms nor impart vibration to the strike-off screeds. The individual vibrators shall be attached to a frame in a manner which will permit adjustment of both the depth of penetration into the concrete and the angle of the vibrator with the horizontal.

The entire vibrating unit shall allow raising the vibrator tips completely clear of the concrete surface.

The vibrators shall be capable of vibrating at rates between 4,800 and 8,000 impulses per minute when inserted in the concrete. All vibrators shall be snychronized to vibrate at a frequency specified by the Engineer, within the limits established.

On the first trip over the freshly placed concrete the vibration equipment shall be submerged in the concrete to ensure adequate consolidation. Unless otherwise directed by the Engineer, the vibration equipment shall be operated on the first pass only. The vibration equipment shall not be operated when the machine is not in motion except when vibrating near an expansion joint.

After the first pass with vibration, one or more trips without vibration shall be made as described in Section 5-05.3(7)D4.

5-05.3(7)D5 VIBRATING SCREED CONCRETE PAVEMENT CONSTRUCTION

The type of vibrating screed which the Contractor proposes to use, whether roller or beam, shall be subject to approval by the Engineer. Upon request by the Engineer a test section of pavement shall be placed for the purpose of demonstrating the capabilities of the screed to satisfactorily compact and strike off the concrete to the established grade and section.

Concrete shall be uniformly distributed between the forms and it shall then be compacted and screeded to the level of the top of the forms by means of the vibrating screed. Supplemental compaction by mechanical vibration of the concrete adjacent to the forms will be required if the concrete cannot otherwise be adequately compacted.

The vibrating screed shall be operated over the freshly placed concrete in successive passes only a sufficient number of times to obtain maximum compaction. Over-vibration of the concrete, resulting in an excess of mortar at the surface of the pavement, will not be permitted.

After the final passages of the vibrating screed, the surface of the concrete shall be at the established pavement grade and cross section and shall be sufficiently smooth as to require only a very moderate amount of hand finishing for smoothness to meet approval of the Engineer.

5-05.3(8) JOINTS

5-05.3(8)A GENERAL

Transverse and longitudinal joints may be contraction or through joints (including construction joints). Joints shall be constructed in accordance with the Contract Documents at locations specified therein or designated by the Engineer. The faces of all joints shall be constructed perpendicular to the surface of the cement concrete pavement.

5-05.3(8)B CONTRACTION JOINTS

5-05.3(8)B1 FORMED CONTRACTION JOINTS

Formed contraction joints shall be constructed by imbedding a 1/4 inch thick preformed joint material. The depth of the formed joints shall be no less than 1/3 of the pavement thickness. The filler shall be cut to the exact sections of the joint. The length of the premolded joint filler shall extend to within 1/4 inch of both edges of any panel.

Transverse contraction joints (dummy joints) shall be placed after compaction and finishing of concrete have been completed and before initial set. A groove shall be cut into the surface at the location of the joint, using a tool provided with stops (tee iron) to prevent cutting the groove deeper than the planned depth of the joint filler. The joint filler shall then be forced into the groove until the top is flush with the pavement surface, with a deviation of not more than 1/8 inch below the surface. The joint filler shall be perpendicular to the surface and always in a straight line.

After the joint filler has been imbedded in the concrete, the surface of the pavement shall be finished against the filler strip with hand floats to restore the surface finish. While performing this operation, the filler strip must be maintained in a perpendicular position, true to alignment. After finishing the entire area the joint shall be true to grade and smoothness without any irregularities.

5-05.3(8)B2 SAWED CONTRACTION JOINTS

Sawed contraction joints shall be constructed by sawing a vertical groove in the hardened concrete on an approved schedule after placing and before development of random cracks in the concrete slab. Transverse contraction joints shall be sawed before the longitudinal joints are sawed. Transverse joints shall be sawed at a maximum of 60 foot intervals or such other spacing as directed by the Engineer, as soon as the cut can be made without undue raveling of concrete. Intermediate joints shall be sawed thereafter.

The Engineer shall direct the time schedule for sawing contraction joints.

Any scheduling for the sawing of joints that results in premature or uncontrolled cracking shall be revised immediately, under direction of the Engineer, by adjusting the time interval between placing of concrete and the sawing of joints. After the schedule has been approved, the sawing shall proceed as a continuous operation day and night until all joints have been completed.

Two or more sawing units may be required to accomplish the sawing in order to minimize random cracking. Standby equipment shall be on the job to ensure continuous sawing as specified regardless of any breakdown of equipment.

Where curing membrane is used, the area disturbed by sawing of joints shall be resprayed immediately upon completion of the sawing operation and care shall be exercised to prevent the curing compound from getting into the groove. Joint sealing compound shall not adhere to concrete if curing compound is present.

The depth of sawed longitudinal or transverse contraction joints shall be a minimum of 1/3 of the pavement thickness.

The concrete saw shall be powered adequately to perform the required cutting. It shall cut a uniform groove to the required depth and not less than 1/8 inch nor more than 1/4 inch in width. The Contractor will be expected to so arrange his schedule of sawing joints, including initial sawing, at the required intervals so that every possible effort is made to control cracking by the use of judiciously spaced and timed sawed joints. In the event random cracks occur, they shall be repaired to the satisfaction of the Engineer. The Contractor shall provide at least one standby saw in good working order to insure continuous sawing as specified regardless of any breakdown of equipment. An ample supply of sawblades shall be maintained at the site of work at all times during sawing operations. The contractor shall provide artificial lighting facilities for night sawing. All equipment required for sawing shall be on the job both before and continuously during concrete placement or formed, transverse contraction joints must be constructed every 60 feet. Sawing equipment shall be available immediately and continuously upon call by the Engineer on a 24 hour basis, including Saturdays, Sundays and other legal holidays.

Any damage to the curing material during the sawing operations shall be repaired immediately after the sawing is completed.

Formed transverse contraction joints shall be installed where designated by the Engineer, if necessary, to prevent uncontrolled transverse cracks from occurring before the pavement can be sawed.

5-05.3(8)B3 SEALING SAWED CONTRACTION JOINTS

After the curing period, sawed joints shall be cleaned and sealed with joint sealants meeting the requirements of Section 9-04.2(1). Excess sealing materials shall be cleaned off the surface of the pavement before opening to traffic. Sealing shall be per Section 5-05.3(8)C1.

Sawed contraction joints shall be filled with a joint sealant filler conforming to the requirements of Section 9-04.2. Joints shall be thoroughly clean at the time of sealing and if the hot-poured type is used the joints shall be dry. Care shall be taken to avoid air pockets. The hot-poured compound shall be applied in two or more layers, if necessary. The cold-poured compound shall be applied under sufficient pressure to fill the groove from bottom to top and to a point approximately 1/4 inch below the surface of the concrete. The joint filled with

cold-poured compound shall then be covered with a strip of nonabsorptive paper at least twice as wide as the joint and the paper shall be left in place.

If contraction joints are formed with plastic strips, sealing is not required.

5-05.3(8)C THROUGH JOINTS

5-05.3(8)C1 GENERAL

Through (expansion) joints are placed only where shown on the Drawings or where directed by the Engineer. The joint alignment must be at right angles to the pavement center line unless otherwise specified.

Longitudinal through joints shall be placed where shown on the Drawings or where required for concrete pavement between or along retaining walls, curbs or other structures.

Through joints shall be constructed with premolded material, 3/4 inch in thickness and conforming to Section 9-04.1(2). They shall extend from 1 inch below the subgrade to 1 inch below the top of the pavement. Transverse through joints shall extend the full width of pavement poured.

The joint material shall be held accurately in place during the placing and finishing of the concrete by a bulkhead, a holder, a metal cap or any other approved method. The joint must be perpendicular to the paved surface and the holder must be in place long enough to prevent sagging of the material, especially on streets having steep grades.

In multiple lane construction, the joints shall be matched so as to form a continuous alignment over all lanes.

Through joints shall extend continuously through all curbs, special care being exercised to preserve alignment perpendicular to the pavement in the curb section.

A wood filler strip or metal cap shall be placed on the top of the premolded joint filler to form the groove 1 inch deep, and it shall remain in place until after the finishing and the concrete is sufficiently set to resist sloughing into the groove. The joint filler must be stapled together at the ends to preserve continuity.

Immediately after removal of side forms, the edges of the pavement shall be carefully inspected and wherever the joint filler is not fully exposed, the concrete shall be chipped down until the edge of the filler is fully exposed for the entire depth.

5-05.3(8)C2 CONSTRUCTION JOINTS

Longitudinal construction joints shall be as shown on Standard Plan No. 405 and WSDOT Standard Plan No. A-1. The Contractor shall install a keyway and thickened edge for longitudinal construction joints. Thickened edge shall not be required for pavement 12 inches thick or greater. For tie bar requirements, refer to Section 5-05.3(10).

Transverse construction joints formed by placing a header board transversely across the subgrade shall be made at the end of each day's paving or when placing of standard mixed concrete is discontinued for more than 60 minutes or when placing of high early strength concrete is discontinued for more than 30 minutes. The header board shall be located to conform to the spacing for the transverse contraction joints (or an expansion joint) and shall be left in place until the paving is resumed. If the location of the header board is to be a contraction joint, then the header shall have fastened to the concrete side a wedge-shaped strip of wood or preformed plastic to form a key in the concrete. Thickened edge must be constructed at the construction joint header to provide ample depth of concrete above and below the keyway. For dowel bar requirements, refer to Section 5-05.3(10).

Where preformed contraction joints are used, the joint made by the construction joint header shall have a 2 inch strip of joint material imbedded against the hardened concrete when paving is resumed. Where sawed contraction joints are specified, the construction joint made by the header may be sawed and sealed, or may have a 2 inch strip inserted as specified above for preformed construction joints.

5-05.3(8)C3 SEALING THROUGH JOINTS

After the pavement is cured, and before any traffic, the space left by the removal of the wood filler strip or the metal cap above the top of the expansion joint filler strip shall be thoroughly cleaned of all loose material. The groove 3/4 inch wide shall be completely free of any projecting concrete from the sides and the groove shall be continuous across the slab to each edge. It shall then be filled level with the pavement surface with joint sealant meeting the requirements of Sections 9-04.2(2).

The joint sealant material shall be heated and placed in complete accord with the manufacturer's instructions. Burned material will be rejected. The through joint groove shall be dry at the time of pouring the sealing compound.

5-05.3(8)D JOINT LOCATION

5-05.3(8)D1 TRANSVERSE JOINTS

Standard spacing of transversely formed contraction joints along straight sections of streets between through expansion joints or between intersections or other irregular areas, shall be at intervals of 15 feet across the full width of the pavement at the right angles to the center line of roadway. Where the spacing between through expansion joints are not in even multiples of 15 feet for transverse joints, the last several spaces approaching the expansion joint or header shall be varied by shortening the spaces, as directed by the Engineer. On horizontal curves the spacing of 15 feet shall be along the outer edge of the pavement and at right angles to the center line.

When paving adjacent to existing pavement, joints shall be placed to match joint locations in the existing pavement. Where the existing joint spacing is greater than 15 feet, intermediate transverse joints shall be constructed when directed by the Engineer.

For intersections and other irregular areas, the arrangement of contraction joints shall be placed in accordance with standard intersection patterns, or as directed by the Engineer. The area of any one irregular pattern formed by contraction joints in intersections shall not exceed 225 square feet and the greatest dimensions thereof shall not exceed 16 feet.

When paving a second lane adjacent to the previously paved lane, the contraction joints shall be matched with the former, except on curves where the least dimension between transverse joints of the resultant panel would be less than 12-1/2 feet.

Where uncontrolled cracks are existing in the first lane, they shall be matched as nearly as possible in the second lane. Should the uncontrolled cracks in the existing paved lane be too frequent or in random locations and impossible to match with a uniform spacing in the second lane, then in that event the two lanes shall be completely separated by 3/8-inch joint material extending from the surface to one inch below the bottom of the concrete being placed. Reinforcing steel, or other approved joint material, may be required by the Engineer in lieu of the 3/16 inch joint material to control reflection cracks in the new pavement.

Where integral curb or doweled curb is placed along the concrete pavement, premolded joint filler material shall be placed transversely across the full section of the curb in true alignment with the pavement joint, perpendicular to the pavement grade.

5-05.3(8)D2 LONGITUDINAL JOINTS

Standard locations for longitudinal joints, whether contraction or construction, shall be as listed below unless otherwise specified in the Drawings or Project Manual, or as directed by the Engineer.

Width Curb to Curb	Joint Locations
25 Feet	Center line
32 Feet	Center line and 10 feet each side of center
36 Feet	Center line and 10 feet each side of center
40 Feet	Center line and 12 feet each side of center
44 Feet	Center line and 11 feet each side of center or match existing joint

In the event the roadway is divided into two lanes, the construction joints shall be located on the center line of the roadway unless otherwise approved by the Engineer. In separate lane construction, a joint filler 3/16 inch by 2 inches shall be placed between the two lanes when the second lane is constructed.

5-05.3(9) STEEL REINFORCING BARS

Reinforcing steel bars shall be used to reinforce pavement around castings when the casting is 18 inches or less from any joint or pavement edge. Reinforcing steel shall be 1/2 inch round deformed billet steel bars in accordance with ASTM Designation A615 Grade 60, and shall be a minimum length of 1-1/2 times the diameter of the casting. A minimum of 4 bars shall be installed around each casting, oriented parallel and perpendicular to the joint(s).

5-05.3(10) TIE BARS AND DOWEL BARS

Where indicated on the Drawings, dowel bars will be required for all transverse joints in new pavement including intersections, and shall be installed at the midpoint of the thickness of the pavement, parallel to the surface of the pavement, perpendicular to the transverse joint, and centered at the transverse joint. The tolerances for placement are + 1/8-inch. The size and spacing of dowel bars shall be as indicated on WSDOT Standard Plan No. A-1. The dowel bars shall be firmly held in place during the placing and setting of the concrete. Dowel bars are not required between new pavement and existing pavement, unless otherwise indicated on the Drawings. All joints in an intersection shall be considered transverse joints except those joints that terminate normal to the curb radii.

The dowels shall be installed by method of seating the dowels or dowel bar cage extended across the width of the transverse joint, or other methods approved by the Engineer. Dowels shall be smooth, round bars of Grade 60 Steel or better, and shall be epoxy encapsulated and coated with grease to prevent corrosion and dowel seizure. The grease coating on the dowel bars shall remain intact after installing and placing the concrete.

Where indicated on the Drawings, tie bars shall be placed at all longitudinal contraction and construction joints in new pavement in accordance with the Drawings, unless directed otherwise by the Engineer. Tie bars are not required between new pavement and existing pavement, unless otherwise indicated on the Drawings. Tie bars shall be located at the required elevation and spacing shown on the Drawings and placed in such a manner that the vertical edge of the concrete is not deformed or otherwise damaged during placement of the bars. Tie bars shall be deformed steel bars of Grade 40 steel or better and shall be epoxy coated.

5-05.3(11) FINISHING

5-05.3(11)A GENERAL

The pavement shall be consolidated and the surfaced finished true to grade and cross-section by hand or machine finishing methods. On all vertical curves at irregular intersections, modified tools shall be provided as necessary to secure a smooth, uniform contour and surface.

5-05.3(11)B SLIP-FORM CONSTRUCTION

After the concrete has been given a preliminary finish by means of finishing devices incorporated in the slip-form paving equipment, the surface of the fresh concrete shall be checked by the Contractor with a straightedge device not less than 10 feet in length. High areas indicated by the straightedge device shall be removed by the hand-float method. Each successive check with the straightedge device shall lap the previous check path by at least 1/2 of the length of the straightedge. The requirements of this paragraph may be waived, upon the approval of the Engineer if the Contractor can successfully demonstrate that other means will consistently produce a surface meeting the 10-foot straightedge requirement specified in Section 5-05.3(12).

Any edge slump of the pavement, exclusive of specified edging, in excess of 1/4 inch shall be corrected before the concrete has hardened. If edge slump on any 1 foot or greater length of hardened concrete exceeds 1 inch, the entire panel between the transverse and longitudinal joints shall be removed and replaced with concrete true to the specified line, grade, and cross-section.

High spots exceeding 1/4 inch shall be reduced by suitable grinding methods. Low spots exceeding 1/4 inch shall be filled with an approved epoxy-bonded grout in a manner approved by the Engineer.

5-05.3(11)C STATIONARY SIDE FORM CONSTRUCTION

5-05.3(11)C1 HAND FINISHING

After the concrete has been struck off and consolidated, it shall be smoothed by longitudinal floating. Movement ahead shall be in successive advances of not more than 1/2 the length of the float. Floating shall continue until all irregularities are removed. Longitudinal floating shall follow compaction of the concrete by not less than 30 feet. Free water on the pavement shall be removed with the float or other suitable tool. After floating, the surface shall be scraped with a grout rod at least 10 feet in length with a long handle for operating at the edge of the pavement. The grout rod shall be operated to correct irregularities in the pavement surface and remove water and laitance. Contraction joints shall be placed after all floating has been completed in accordance with provisions of Section 5-05.3(8)B2.

5-05.3(11)C2 MACHINE FINISHING

The finishing machine shall be of a type approved by the Engineer. The machine shall be adjustable to both crown and plane of the finished pavement surface. The screed shall oscillate longitudinally during its travel transversely across the pavement. It shall be operated in the forward direction so that the screed will pass over the same section of pavement at least 2 times during its transverse travel.

The finishing machine shall be moved over the pavement as many times as is necessary to give the pavement a smooth even textured surface, conforming to the exact crown and cross section specified on the Drawings.

The floating shall not be considered complete until all free water is removed from the surface.

The finishing operations shall be performed at a time and over such lengths of the pavement surface as existing conditions necessitate. All finishing operations are subject to strict control by the Engineer, and shall be performed to his satisfaction.

5-05.3(11)D EDGING

Before the final finishing is completed and before the concrete has taken the final set, the pavement shall be edged as indicated below:

Location	Radius
Edge of pavement	1/2 inch
Contraction joints	1/4 inch
Through or Construction Joints	1/2 inch

Particular attention shall be given to edge at the appropriate time. The concrete shall have attained a partial set and all free water shall have disappeared so that the edged joints will be clearly defined with no tearing or slump of the edges.

5-05.3(11)E FINAL FINISH

The pavement surface, after edging, shall be given a uniform, gritty texture true to grade and cross section. The final finish shall be accomplished by one of the methods described hereinafter, or as otherwise directed by the Engineer to achieve the specified surface texture.

Burlap Finish: A burlap drag having at least 3 feet of drag in contact with the pavement and the width of the pavement section shall be dragged forward over the pavement surface. The burlap drag shall be wet and clean when in use. The burlap shall not be left on the pavement surface between dragging operations.

Brush Finish: After edging, the pavement shall be brushed transversely with a fiber or wire brush of a type approved by the Engineer.

Before using either the drag or the brush, the concrete shall have set sufficiently so that the surface is not grooved or gouged in the finishing operation.

When directed by the Engineer, the Contractor shall give the pavement a final finish surface by texturing with a comb perpendicular to the center line of the pavement. The comb shall produce striations approximately 0.015 foot in depth at approximately 1/2-inch spacings in the fresh concrete. The actual nominal depths of the striations shall be determined in the field by the Engineer. The comb shall be operated mechanically either singly or in gangs with several placed end to end. Finishing shall take place with the elements of the comb as nearly perpendicular to the concrete surface as is practical, to eliminate dragging the mortar. If the striation equipment has not been previously approved, a test section shall be constructed prior to approval of the equipment. If the pavement has a raised curb without a formed concrete gutter the texturing shall end 2 feet from the curb line. This 2 foot untextured strip shall be hand finished with a steel towel.

5-05.3(12) SURFACE SMOOTHNESS

The surface smoothness shall be checked with a straightedge 10 feet long, mounted to a long handle to permit operation from outside the pavement. The straightedge shall be placed on the surface of the pavement parallel to the centerline and at intervals of no more than 5 feet across the full width of the pavement. At the conclusion of the finishing operation, the surface of the pavement shall not vary from a true surface when tested with a 10 foot testing straightedge, more than 1/8 inch in 10 feet on arterials, 1/4 inch in 10 feet on residential streets, 3/8 inch in 10 feet in alleys, 3/8 inch in 10 feet in concrete bases, and 1/8 inch in 10 feet in concrete bases for unit pavers.

The transverse slope of the finished pavement shall be uniform to a degree such that no variation greater than 1/4 inch is present when tested with a 10 foot straight edge laid in a direction perpendicular to the center line.

In no case shall the grade in the gutter be such that it will allow ponding of water. If the surface smoothness of the pavement after curing is found to exceed the tolerance permitted, the high spots shall be ground until they meet tolerance. If the surface tolerance cannot be met satisfactorily by grinding, the pavement shall be removed and be replaced in conformity with the Specifications.

When cement concrete pavement abuts bridges or pavement constructed under another contract, the finished pavement parallel to centerline within 15 feet of the abutting joint shall be uniform to a degree that no variations greater than 1/8 inch are present when tested with a 10-foot straightedge.

Only equipment and methods that consistently produce a finished surface meeting the requirements specified herein shall be used. Use of equipment or methods which do not meet these standards shall be discontinued until the Contractor can revise and demonstrate changes in construction operations that will meet the requirements of the Specifications.

5-05.3(13) CURING

5-05.3(13)A CURING PERIOD

Regardless of the curing method used, the Contractor shall maintain the curing protection and protect from damage from any cause for at least the length of time listed below for the various mixes, exclusive of the day the concrete is placed, or until the pavement is opened to traffic, whichever comes first:

Type II Portland Cement Concrete Pavement	7 days
High-Early-Strength Cement Concrete Pavement	5 days
Concrete Mixes Containing Fly Ash	14 days

5-05.3(13)B CURING METHODS

5-05.3(13)B1 GENERAL

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the methods in the following subsections as the Contractor may elect.

Pavement edges which are exposed by the removal of the forms shall be protected by the immediate application of a curing medium of moist earth.

All curing materials shall be free of all substances which are considered to be harmful to portland cement. The curing medium shall be capable of preventing checking, cracking, and dry spots regardless of conditions existing at the time of placement. Concrete placement will not be permitted unless curing materials are on the job site and ready for immediate application. Failure to comply with all provisions of the curing procedures hereinafter specified will be sufficient reason to suspend all concrete operations.

When the curb section is to be placed separately, the surface of the pavement directly underneath the curb section shall be covered with a protective cover to protect that area from the curing agent when the pavement is sprayed.

5-05.3(13)B2 WHITE PIGMENTED CURING COMPOUND

White pigmented curing compound meeting the requirements of Section 9-23.8 shall be applied to the entire area of the exposed surface of the concrete with an approved mechanical spray machine. The spray fog shall be protected from the wind with an adequate shield. It shall be applied uniformly at the rate of one gallon to not more than 150 square feet.

The compound shall be applied with equipment of the pressure tank or pump type equipped with a feed tank agitator which ensures continuous agitation of the compound during spraying operations. The nozzle shall be of the two line type with sufficient air to properly atomize the compound.

The curing compound shall not be applied during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it shall be covered with polyethylene sheeting which shall remain in place until weather conditions are favorable for the application of the curing compound.

In the event that rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or in the event of damage to the film from any cause, the Contractor shall apply a new coat of curing compound in one or two applications to the affected area at the rate which, in the opinion of the Engineer, will result in a film of curing value equal to that specified in the original coat.

Containers of curing compound shall be distributed on the work in a manner to enable the Engineer to determine the rate of application being used at any time. All curing compound placed in the spray tanks shall be withdrawn directly from manufacturer's original containers bearing the manufacturer's name, brand, and lot number.

Before placing the curing compound in the spray tank, it shall be thoroughly agitated by means of compressed air or other approved means until the pigments in the original container are uniformly suspended. The compound shall not be diluted by the addition of solvents nor be altered in any manner. If the compound has become chilled to the extent that it is too viscous for proper stirring or application or if portions of the vehicle have been precipitated from solution, it shall be heated to restore proper fluidity but it shall not be heated above 100 degrees F.

The curing compound shall be applied immediately after the concrete has been finished and after any surplus water that has collected on the surface has disappeared, or at a time designated by the Engineer. If hair checking develops in the pavement before finishing is completed, the Engineer may order the application of the curing compound at an earlier stage, in which event any concrete cut from the surface in finishing operations shall be removed entirely from the pavement. If additional mortar is then needed to fill torn areas, it shall be obtained ahead of the spraying operations. All areas cut by finishing tools subsequent to the application of the curing compound shall immediately be given new applications at the rate specified above.

The compound, after application, shall be protected by the Contractor from injury for the period of time specified above. All traffic, either by foot or otherwise, shall be considered as injurious to the film of the applied compound.

The Contractor shall provide on the job a sufficient quantity of white polyethylene sheeting to cover all the pavement laid in three hours of maximum operation. This sheeting shall be reserved exclusively for the protection of the pavement in case of rain or breakdown of the spray equipment used for applying the curing compound. The protective sheeting shall be placed over the pavement when ordered, and in the manner specified by the Engineer.

Areas from which it is impossible to exclude traffic shall be protected by a covering of sand or earth not less than 1 foot in thickness or by other suitable and effective means. The protective covering shall be placed no earlier than 24 hours after application of the compound.

The Contractor shall assume all liabilities for and protect the Owner from any damages or claims arising from the use of materials or processes described herein.

5-05.3(13)B3 WHITE POLYETHYLENE SHEETING

The sheeting shall be placed over the pavement immediately after finishing operations are completed, or at a time designated by the Engineer.

The sheeting shall be laid so that individual sheets overlap at least 2 feet, and the lapped areas shall be held in close contact with the pavement by weighting with earth or boards to prevent movement by the wind. The sheeting shall extend downward to cover the edges of the pavement and shall be secured to the subgrade with a continuous bank of earth or surfacing material. Any holes occurring in the sheeting shall be patched immediately to the satisfaction of the Engineer. The sheeting shall be maintained against injury and remain in place the minimum period of time as specified above.

White polyethylene sheeting shall conform to the requirements of Section 9-23.1.

5-05.3(13)B4 SPRINKLING SYSTEM

The sprinkling system shall keep the entire surface of the concrete pavement continuously wet, 24 hours a day. Care shall be taken to avoid damage to the surface of the pavement during placement of the equipment. The water flowing off the pavement shall be wasted in a manner satisfactory to the Engineer.

5-05.3(13)B5 WATERPROOF PAPER

The set concrete shall first be wetted with a fine spray of water and then completely covered with a waterproof paper, lapping all joints at least 12 inches. The paper shall be weighted sufficiently to prevent displacement. All tears and holes shall be repaired promptly. The waterproof paper shall conform to the requirements contained in Section 9-23.

5-05.3(13)B6 TRANSPARENT CURING COMPOUND

The use of transparent liquid curing compounds shall be restricted to areas not exceeding 1,000 square yards.

The compound shall meet requirements contained in Section 9-23.3. Sufficient pigment shall be present so that the sprayed compound is easily discernible. The application and the curing shall be the same as for "White Liquid Membrane Curing Compound" in Section 5-05.3(13)B3.

5-05.3(13)B7 EMULSIFIED ASPHALT

Concrete pavement when laid as a base for an asphalt wearing course shall be cured as specified in Section 5-05.3(20).

5-05.3(13)C CURING IN HOT WEATHER

In periods of low humidity, drying winds, or high temperatures, a fog spray shall be applied to concrete as soon after placement as conditions warrant in order to prevent the formation of shrinkage cracks. The spray shall be continued until conditions permit the application of a liquid curing membrane or other curing media. The Engineer shall make the decision when the use of a fog spray is necessary.

5-05.3(14) COLD WEATHER WORK

When the air temperature is expected to reach the freezing point during the day or night and the pavement has not cured for 50 percent of the time specified in Section 5-05.3(13)A, the concrete shall be protected from freezing. The Contractor shall provide a sufficient supply of straw, hay, grass, earth, blankets, or other suitable blanketing material and spread it over the pavement to a sufficient depth to prevent freezing of the concrete. The Contractor shall be responsible for the quality and strength of the concrete thus cured. Any concrete injured by frost action or freezing shall be removed and replaced by the Contractor in accordance with these Specifications.

5-05.3(15) CONCRETE PAVEMENT CONSTRUCTION IN ADJACENT LANES

Refer to Section 5-05.3(7)A.

5-05.3(16) PROTECTION OF PAVEMENT

The Contractor shall protect the pavement and its appurtenances from any damage. Protection shall include personnel to direct traffic and the erection and maintenance of warning signs, lights, barricades, temporary take-down bridges across the pavement with adequate approaches, and whatever other means may be necessary to accommodate local traffic and to protect the pavement during the curing period or until opened to traffic as specified in Section 5-05.3(17).

5-05.3(17) OPENING PAVEMENTS TO TRAFFIC

Unless otherwise approved in writing by the Engineer, the Contractor shall not open newly constructed cement concrete pavement to traffic, including construction equipment, until the pavement has cured for the period of time specified in Section 5-05.3(13)A and attained a comprehensive strength of 3500 psi. Approval to open newly constructed pavement to use of construction equipment (or other vehicular traffic) in less time than the time period specified in Section 5-05.3(13)A will be limited to those paving situations when the Contractor is unable to use the subgrade of the lane being paved or the shoulder adjacent to it for paving equipment. Approval will be conditioned upon the Contractor agreeing to the following restrictions:

(a) The concrete in the newly paved lane has attained a flexural strength of 500 psi as determined with a Beam Test pursuant to AASHTO T-177 or ASTM C293.

(b) The Beam Test is performed at the Contractor's expense by an independent materials laboratory retained by the Contractor. The laboratory retained by the Contractor shall be a laboratory acceptable to the Engineer.

(c) The surface of the new pavement shall be protected from scarring and abrasion by operating mixers, trucks, and other construction equipment on mats, skids, or other protective devices approved by the Engineer. Accumulation of sand, gravel, dirt, concrete or other debris deposited on the new pavement shall be removed daily. Curing compound protection damaged as a result of using the paved lane shall be replaced concurrent with spraying of curing compound on the newly placed concrete.

(d) The Contractor shall remove and replace at no expense to the City any panels on the new pavement that are cracked or broken as a result of the Contractor's early opening of the lane to vehicle use.

Streets with curbs shall not be opened until the curb has cured for at least 72 hours and has attained 2500 psi strength. If the curb has not attained the above-mentioned 2500 pounds per square inch strength, the Contractor shall place form lumber on the pavement 2 feet away from the curb, or place standard barricades and maintain them to the satisfaction of the Engineer. Such curb protection shall remain in place as long as may be necessary for protection of the curb.

Streets shall not be opened to traffic until the smoothness criteria specified in Section 5-05.3(12) have been met.

Temporary pavement markings, when required by the Engineer, shall be installed, maintained, and subsequently removed in accordance with Section 5-04.3(17).

Prior to opening traffic, the pavement shall be cleaned. The Engineer will decide when the pavement shall be open to traffic. Refer to Section 1-07.23 and the Traffic Control Manual for In-Street work.

5-05.3(18) CEMENT CONCRETE APPROACH

Concrete approaches shall be constructed at the locations shown in the Drawings or as staked by the Engineer and in accordance with WSDOT Standard Plan No. F-4.

The provisions of Section 5-05 shall pertain in the construction of concrete approaches, and, in addition, the following shall apply:

Placing, Compacting, and Finishing: Concrete may be placed, compacted, and finished using hand methods. The tools required for these operations shall be approved by the Engineer.

5-05.3(19) BRIDGE APPROACH SLABS

Reinforced concrete bridge approach slabs shall be constructed at the locations shown in the Drawings or as staked by the Engineer and in accordance with the Contract Documents.

The approach slabs shall conform to the requirements of Section 5-05 except that the concrete shall be Class A mix conforming to the requirements of Section 6-02, and finishing may be accomplished by hand methods. Bridge approach slab anchors shall be installed in accordance with the contract documents.

The finished and cured bridge approach slabs shall be free from any deviation exceeding 1/8 inch under a 10-foot straightedge placed parallel and perpendicular to the centerline of the roadway.

The top face longitudinal and transverse reinforcing steel shall be epoxy coated including the reinforcing bars extending from the slab into the roadway side of the barrier curb. Epoxy coating of bottom face reinforcing steel will not be required. The Contractor shall place longitudinal construction joints to suit his method of operation.

5-05.3(20) UNFINISHED CEMENT CONCRETE PAVEMENT

Cement concrete pavement, which is intended as a base for an asphalt wearing course, shall conform to all requirements of Section 5-05 with the following exceptions:

(a) The surface tolerance shall be 3/8 inch in 10 feet.

(b) The surface of the concrete base, if hand compacted, may be struck off with only one strike-off rod.

(c) Contraction joints shall be constructed as follows:

(1) A weakened plane shall be made in the plastic concrete every 15 feet or to match existing cracks as designated by the Engineer.

(2) The plane shall be weakened with a joint cutter to a minimum depth of 2 inches.

(3) Bulging caused by the joint cutter shall be corrected by floating lightly.

(4) Joint material shall be placed completely through the curb at the point where the weakened plane intersects the curb.

(d) Liquid curing compounds which leave a waxy film on the concrete shall not be used for curing concrete base pavement. If cured with a liquid curing compound, it shall meet the requirements of Section 9-23.2 for the clear type and the rate of coverage shall be at least one gallon per 125 square feet; or emulsified asphalt CSS-1 or CRS-1 meeting the requirements of Section 9-02.1 applied at a rate between 0.15 gallon and 0.25 gallon per square yard of surface.

5-05.3(21) SIDE FORMS

When specified or approved by the Engineer, side forms may be used for pavement construction.

Side forms shall have a height of not less than the specified depth of pavement, and thickened edge when applicable, and shall be of ample strength to resist deformation. They shall be provided with adequate devices for secure setting so that when in place they shall withstand, without visible springing or settlement, the weight, impact, and vibration of the finishing machines. The forms shall be free from warps, bends, or kinks.

Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars where these are specified.

Forms shall remain in place at least 12 hours after the concrete has been placed and shall be cleaned and oiled each time they are used. Curing compound shall be applied to the concrete immediately after the forms are removed.

The alignment and grade elevations of the forms shall be checked and the necessary corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any subgrade thereunder has become unstable, the form shall be reset and rechecked.

Forms may be of wood or metal or any other material at the option of the Contractor, provided the forms as constructed result in a pavement of specified thickness, cross section, grade, and alignment as shown on the Drawings.

Forms shall be adequately supported to prevent deflection or movement and which will result in concrete pavement conforming with the Drawings and Specifica tions. The top of the forms shall not deviate more than 1/8 inch in 10 feet and the alignment of forms shall be within 1/4 inch in 10 feet. The forms may be removed the day after pouring if the concrete is sufficiently set to withstand removal without danger of chipping or spalling. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with moist earth or sprayed with curing compound. All forms shall be cleaned, oiled and examined for defects before they are used again.

5-05.3(22) REPAIR OF DEFECTIVE PAVEMENT SLABS

Broken slabs, random cracks, nonworking contraction joints near cracks, and spalls along joints and cracks shall be replaced or repaired as specified and shall be accomplished prior to completion of joint sealing.

Pavement slabs containing multiple cracks through the full depth of the slab, separating the slab into three or more parts, shall be entirely removed and replaced. Pavement slabs containing a single diagonal crack intersecting the transverse and longitudinal joints within 1/3 of the width and length of the slab from the corner shall be repaired by removing and replacing the smaller portion of the slab.

Random cracks penetrating the full depth of the pavement shall be grooved and sealed. The top of the crack shall be grooved to a minimum depth of 3/4 inch and to a width not less than 3/8 inch nor more than 5/8 inch by means of an approved grooving machine. The grooving machine shall be capable of following closely the path of the crack and of widening the top of the crack to the required section without spalling, or otherwise damaging the concrete. Loose and fractured concrete shall be removed, and the groove shall be thoroughly cleaned and sealed. Random cracks that are tight and that do not penetrate the full depth of the pavement shall be left undisturbed. When necessary, the depth of crack penetration shall be determined by inspection of cores drilled.

When a transverse random crack terminates in or crosses a transverse contraction joint, the uncracked portion of the joint shall be filled with epoxy-resin mortar or grout and the crack shall be routed and sealed. When a transverse random crack approximately parallels the planned contraction joint and is within a distance of 5 feet from a contraction joint in the pavement, the crack shall be routed and sealed, and the joint shall be filled with epoxy-resin mortar or grout. When a transverse random crack is more than 5 feet from the nearest contraction joint in the pavement, both the joint and the crack shall be sealed. Joints to be filled with epoxy-resin mortar or grout shall be thoroughly cleaned.

Spalls shall be repaired by making a saw cut at least 1 inch outside the spalled area and to a minimum depth of 2 inches. When the spalled area abuts a joint, the saw cut shall be made to a depth of 2 inches or 1/6 the slab thickness, whichever is greater. The concrete between the saw cut and the joint or primary crack shall be chipped out to solid concrete. The cavity thus formed shall be thoroughly cleaned of all loose material. A prime coat of epoxy-resin binder shall be applied to the dry, cleaned surface of all sides of the cavity, except the joint or primary crack face. The prime coat shall be applied by scrubbing prime coat material into the surface with a stiff-bristle brush. Placement of portland cement concrete or epoxy-resin concrete or mortar shall immediately follow the application of the prime coat. If the spalled area to be patched abuts a working joint or a working crack which penetrates the full depth of a slab, an insert or other bond-breaking medium shall be used to maintain working joints or cracks during the repair work.

5-05.3(23) CEMENT CONCRETE PAVEMENT FOR ALLEY

5-05.3(23)A PAVEMENT AND ALLEY RETURN REQUIREMENTS

Cement concrete pavement for alleys shall meet the requirements of Section 5-05 and Standard Plan No. 403. Alley returns shall meet the requirements for driveways in Section 8-19.

5-05.3(23)B EXTRA CONCRETE FOR ALLEY APPROACH RAMP

When constructing and finishing cement concrete alley pavement, the Engineer may in some cases require the Contractor to place additional concrete over the surface of the alley pavement to serve as an integral ramp or vehicular access to abutting private property. Such extra concrete shall be placed and finished to the additional thickness directed by the Engineer. Additional thickness for such ramps shall not exceed 6 inches above the original planned concrete surface at any point.

5-05.3(23)C EDGE AND SUPPORT WALL

Where shown on the Drawings, the Contractor shall construct the edge wall as detailed on Standard Plan No. 403 or the support wall as detailed on Standard Plan No. 800, except that the alley width indicated on the Drawings shall be taken to the face of the curb.

After removal of forms, all lips and edgings where form boards have met shall be removed with a sharp tool or stone. Bolts or concrete ties shall be removed and the holes filled with 1:2 mortar and floated to an even uniform surface. If in

the opinion of the Engineer a satisfactory surface has been obtained, no further finishing shall be done. If, however, the surface is not satisfactory, these surfaces shall be thoroughly washed with water and a 1:1 mortar applied with brush and well worked in the small air holes and other crevices. After initial set, the surface shall be rubbed with a damp sack.

The curb shall extend a net 6 inches above the alley pavement.

5-05.3(23)D CURB WALL

Curb wall shall be constructed as indicated on Standard Plan No. 801. Deformed steel bars shall be in accordance to ASTM Designation A615 Grade 60.

5-05.3(24) CONCRETE UNDERPINNING

Where designated by the Engineer, existing concrete foundations left above grade shall be supported with concrete underpinning.

5-05.3(25) WATER

Water for pavement construction will be furnished as provided in Section 2-07. Refer to Section 9-25.

5-05.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for pavement or pavement base will be by the square yard of concrete in place, including the area underneath curbs. No deduction will be made for castings in pavement.

Measurement for thickened edge will be by the linear foot as measured along the face of the thickened edge.

Measurement for concrete underpinning will be by cubic yard placed as computed by the Engineer.

Reinforcing steel shown on the Standard Plans and required for ties of the pavement to driveway, curb, and curb and gutter and around castings will not be measured.

Measurement for edge wall, support wall and curb wall will be per cubic yard of concrete based on neat lines indicated on the Standard Plans.

Steel required for pavement reinforcement as specified in Section 5-05.3(7)C3 will be measured by the pound of steel reinforcement in place.

Measurement and payment for curb constructed with alley pavement will be in accordance with Section 8-04.

5-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-05 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Pavement, Cement Concrete (Class), (Thickness)," per square yard.
(2) "Pavement, Cement Concrete (Class), HES, (Thickness)," per square yard.
(3) "Pavement Base, Cement Concrete (Class), (Thickness)," per square yard.
(4) "Pavement, Thickened Edge (18 inch x 3 inch)," per linear foot.
(5) "Underpinning, Cement Concrete CL 5 (3/4)," per cubic yard.
(6) "Wall, Cement Concrete, Edge, Type 403B," per cubic yard.
(7) "Wall, Cement Concrete, Support, Type 800," per cubic yard.
(8) "Wall, Cement Concrete, Curb, Type 801," per cubic yard.
(9) "Steel Reinforcing Bar, Grade 60," per pound.

The unit contract price for "Pavement, Cement Concrete (Class), (Thickness)", "Pavement, Cement Concrete (Class), HES, (Thickness)", and "Pavement Base, Cement Concrete (Class), (Thickness)," shall include all costs for the work of the specified class and thickness of pavement, including construction joints, contraction joints, through joints, saw cutting, keyways, sealing joints and when required, tie bars and dowel bars as specified in Section 5-05.3(10).

All costs for temporary pavement marking work as specified in Section 5-06.3(17) shall be included in the unit contract price bid for "Pavement, Cement Concrete, (Class), (Thickness)."

The unit contract price for "Pavement, Thickened Edge (18 inch x 3 inch)" shall include all costs for the work required to shape and compact the subgrade for the thickened edge including the concrete.

The unit contract price for "Underpinning, Cement Concrete, CL 5 (3/4)" shall include all costs for the work required including furnishing and placing the underpinning and reinforcing steel and excavating as required.

The unit contract price for "Wall, Cement Concrete, Edge, Type 403B" shall include all costs for the work required to construct the wall as shown on the Drawings and as specified. Excavation for the edge wall shall be considered incidental to the wall and no separate payment will be made.

The unit contract price for "Wall, Cement Concrete, Support, Type 800" shall include all costs for the work required to construct the wall as shown on the Drawings and as specified. Excavation and reinforcing steel (including steel extending into pavement slab) for the support wall shall be considered incidental to the wall and no separate payment will be made.

The unit contract price for "Wall, Cement Concrete, Curb, Type 801" (including reinforcing steel extending into pavement slab) shall include all costs for the work required to construct the wall as shown on the Drawings and as specified. Excavation and reinforcing steel for curb wall shall be considered incidental to the wall and no separate payment will be made.

The unit contract price for "Steel Reinforcing Bar, Grade 60" shall include all costs for the work required to furnish and install the reinforcing steel as specified in Section 5-05.3(7)C3.

Steel required for pavement ties to driveway, curb, and curb and gutter, and for reinforcement around castings as specified in Section 5-05.3(9) will be considered incidental to the pavement and no separate payment will be made.

Payment for roadway ballast will be as "Mineral Aggregate, (Type)" in accordance with Section 4-01.5.

The unit contract price for each specific concrete Bid Item shall include all costs for curing and admixtures.

All costs in connection with replacing Portland cement with fly ash as specified shall be included in the unit contract price for the various classes of concrete involved. If the concrete is to be paid for other than by class of concrete, all costs involved with replacing Portland cement with fly ash as specified shall be included in the unit contract price for the applicable item or items of work.

All costs required to furnish and mix additional cement to concrete as specified in Section 9-01.4 shall be by the Contractor.

All costs for the work required to repair defective pavement slabs as specified in Section 5-05.3(22) shall be at no expense to the Owner.

SECTION 5-06 VACANT

SECTION 5-07 PAVEMENT PATCHING

5-07.1 DESCRIPTION

This work shall consist of the patching of various types of pavement cuts, the performance of which shall be in accordance with these Specifications and as shown on Standard Plan No.'s 404a and 404b.

5-07.2 MATERIALS

All materials shall conform to the requirements specified for material in other sections of these Standard Specifications, such as Sections 9-02 and 5-05.

Asphalt concrete pavement patch shall be Class B meeting the requirements of Section 5-04.

Asphalt for temporary pavement patch shall be MC 250 meeting the requirements of Section 9-02. Mineral aggregate used in the MC 250 asphalt concrete mix shall meet the same requirements as the aggregates used in Asphalt Concrete Class B.

Cement concrete pavement patch shall be Class 6.5 (1-1/2) HES meeting the requirements of Section 5-05.

Crushed rock for surfacing and shoulders shall meet the requirements of Mineral Aggregate Types 1 and 2 in accordance with Section 9-03.

5-07.3 CONSTRUCTION REQUIREMENTS

5-07.3(1) GENERAL

Pavement patching shall be scheduled to accommodate the demands of traffic, and shall be performed as rapidly as possible to provide maximum safety and convenience to public travel.

The placing and compaction of the trench backfill, and the preparation and compaction of the subgrade shall be in accordance with the requirements of the various applicable sections of these Specifications.

Before the patch is constructed all pavement cuts shall be trued so that the marginal lines of the patch will form a rectangle with straight edges and vertical faces. The use of a concrete saw will not be required unless so indicated in the Project Manual.

The class of concrete used in patches will depend upon the urgency of opening the street to traffic. The class of concrete shall be as specified in the Project Manual. Curing compound as specified in Section 5-05.3(13) shall be placed on the concrete immediately after finishing.

Proper signs, barricades, lights and other warning devices, as may be required by the Engineer, shall be maintained all 24 hours of the day until the patch is completed and ready for traffic.

On all public works contracts, the Contractor shall perform all work required to backfill the excavations made under existing pavements and to restore pavement cuts with patching in accordance with these Specifications unless otherwise provided in the Project Manual.

Compaction of the subgrade shall be completed prior to the required patching. Compaction shall be to 95% maximum density as determined by the methods specified in Section 2-03.3(14)E.

5-07.3(2) CEMENT CONCRETE PAVEMENT

After the subgrade for the pavement has been constructed and compacted to line and grade, the cement concrete pavement patch shall be placed, compacted and struck off to the grade of the adjacent pavement in accordance with the pertinent provisions of Section 5-05. Through joints and dummy joints shall be placed and edged where directed. The surface shall be finished and brushed with a fiber brush. Approved curing compound shall be placed on the finished concrete immediately after finishing.

5-07.3(3) RIGID PAVEMENT RESURFACED WITH ASPHALT CONCRETE

Streets which have rigid type pavements surfaced with asphalt concrete shall be patched as shown on Standard Plan No.'s 404a and 404b, or as otherwise specified. The cement concrete portion of the patch shall be Class 6.5 (1+) H.E.S. The thickness shall match the existing rigid base or 9 inches, whichever is greater. The top surface of the concrete shall match the top surface of the existing rigid base; in no case shall the top of the concrete be higher than the top of the existing rigid base. Brush finishing will not be required. Joints shall be placed if directed by the Engineer. Curing shall be accomplished with STE-1 asphalt emulsion diluted with water as directed by the Engineer.

Asphalt concrete or bituminous plant mix shall not be placed until 3 days after the cement concrete has been placed unless otherwise permitted by the Engineer. The edges of the existing asphalt pavements and castings shall be painted with STE-1 cationic special tack emulsion immediately before placing the asphalt patching material. The asphalt concrete pavement shall then be placed, leveled, and compacted to conform to the adjacent paved surface. Immediately thereafter, all joints between the new and original asphalt pavement shall be painted with STE-1 asphalt emulsion and be covered with dry paving sand before the asphalt solidifies. Tacking and sealing of asphalt concrete patches shall be in accordance with the requirements of Section 5-04.

5-07.3(4) ASPHALT CONCRETE ON GRANULAR BASE

After the subgrade has been prepared as shown on Standard Plan No.'s 404a and 404b, or as directed by the Engineer, asphalt concrete pavement Class B or Class F shall be placed to a thickness of the existing asphalt pavement depth, or to a minimum of 2 inches, whichever depth is the greater, and compacted in the manner specified in Section 5-07.3(3).

Restoration of asphalt concrete roadway pavement on granular base (non-rigid pavement) shall consist of Mineral Aggregate Type 1 and 2, to a compacted depth of 6 inches consisting of a 2-inch top course of Mineral Aggregate Type 1 placed on a 4-inch base course of Mineral Aggregate Type 2. "Pavement, Asphalt Concrete Cl B" shall be compacted to a thickness equal to the thickness of the adjacent pavement or 2 inches, whichever is greater.

Restoration of MC 800 paved roadway surfaces, or seal coats, on a granular base shall consist of "Mineral Aggregate, Type 2," to a compacted thickness of 4 inches and "Pavement, Asphalt Concrete Cl B" to a compacted thickness of 3 inches.

Restoration of asphalt driveways shall be the same as specified above for MC 800 pavements.

All shoulders on paved roads, disturbed during the course of construction, shall be restored by furnishing and placing Mineral Aggregate, Type 1 to a compacted thickness of 2 inches and width up to 4 feet or as required by the Engineer. Only crushed ledge rock shall be used in the shoulders.

5-07.3(5) UNTREATED ROADWAY SURFACES

Existing crushed rock, gravel, and oil mat streets shall be restored with Mineral Aggregate Type 1, to a compacted depth of 4 inches within the neat line limits of the trench as detailed on Standard Plan No.'s 404a and 404b. Final surfacing shall be constructed as specified in Section 5-04.3(5)C2.

5-07.3(6) TEMPORARY PAVEMENT PATCHING

The Contractor shall furnish, place and maintain a 2 inch thick crushed rock surfacing and a 2 inch thick MC 250 patch over trench areas when and where directed by the Engineer. Such temporary asphalt patching will be required where roadway or walk is needed for vehicular or pedestrian traffic and permanent pavement cannot be placed immediately. The trench backfill shall be compacted as specified in Section 7-17.3(3)B and the MC 250 tamped and leveled to coincide with adjacent surfaces. In the event that the temporary surface subsides after the initial placement, additional MC 250 and crushed surfacing shall be applied to maintain the surface. Stockpile of the plant mix and crushed surfacing shall be provided on the site by the Contractor. Prior to final restoration of the pavement, the Contractor shall remove the temporary asphalt, clean the exposed face of the existing pavement and restore the pavement.

5-07.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement of concrete pavement patching will be by the cubic yard for cement concrete patching, by the ton for asphalt concrete and for temporary MC 250 pavement patching. Quantities for surface restorations for sewers, drains and watermains will be based upon computations made by the Engineer using the required pavement patch thickness and the pavement and sidewalk removal criteria specified in Section 2-02.3(3).

Quantities for pavement patching for electrical conduit will be based on actual measured dimensions with the provision that the width of restoration for payment purposes shall be no greater than 24 inches.

Measurement of temporary pavement patch will be made for the initial placement only. Additional MC 250 and crushed rock surfacing required to maintain the surface of the temporary patch level with adjacent roadway surfaces will not be measured.

5-07.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-07, will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Pavement Patch, Cement Concrete Class 6.5 (1+), H.E.S.", per cubic yard.
(2) "Pavement Patch, Asphalt Concrete Class B", per ton.
(3) "Pavement Patch, Temporary, MC 250", per ton.

The unit contract price for pavement patching of the type required shall be limited to the maximum pay width as shown on Standard Plan No.'s 404a and 404b, or the City's current Board of Public Works Street and Sidewalk Pavement Opening and Restoration Rules, and shall include the costs for all work described in Section 5-07, and not otherwise provided for in this pay section, necessary to temporarily restore and maintain or permanently restore, as applicable, pavements or other traffic bearing surfaces which have been opened by trench excavation or similar work. All incidental work required to complete the patching of street surfaces as specified, including installing joints where required, shall be considered incidental to the patching, and the costs thereof shall be included in the items for which payment is provided. Payment for "Pavement Patch, Temporary, MC 250" will include reimbursement for removal of temporary patch before final patching.

The costs for additional MC 250 and crushed surfacing material required to maintain temporary pavement patches after the initial installation shall be borne by the Contractor.

Payment for backfill and compaction of the subgrade shall be included in the unit contract price for the particular work item which necessitated the pavement cut.

Payment for crushed rock surfacing shall be paid separately in accordance with Section 4-01.

DIVISION 6
STRUCTURES

SECTION 6-01 GENERAL REQUIREMENTS

6-01.1 DESCRIPTION

This section shall consist of work relates to structural and incidental items used in any or all types of existing or proposed structures. These provisions supplement the detailed Specifications supplied for any given structure. These provisions apply only when relevant and when they do not conflict with the Drawings or Project Manual.

6-01.2 FOUNDATION DATA

Foundation data, when shown in the Drawings or Project Manual, have been obtained from test borings, test pits or other sources and were obtained only to guide the Engineer in planning and designing the project. These data reasonably represent the best information available to the Engineer concerning conditions and materials at the locations actually tested at the test sites at the time the investigations were made.

6-01.3 CLEARING THE SITE

The Contractor shall clear the entire site of the proposed structure to the limits staked by the Engineer and in accordance with Section 2-01.

6-01.4 APPEARANCE OF STRUCTURES

To achieve a more pleasing appearance, the Engineer may require the Contractor to adjust the height and alignment of bridge railings, traffic barrier, and structural curbs.

6-01.5 ERECTION METHODS

Before beginning to erect any steel structure, and/or prestressed concrete structure, the Contractor shall provide the Engineer with a plan describing the methods he intends to use. (The Drawings or Project Manual may require a similar plan for other structures.) The erection procedure shall be reviewed by the fabricator prior to being submitted to the Engineer.

This plan shall provide complete details for all steps of the erection process. For example, complete details would include any falsework bents, bracing, guys, dead-men, lifting devices and attachments to the bridge members, sequences in erection, locations of cranes and barges, crane capacities, locations of lifting points on bridge members, and weights of bridge members.

If a method requires drawings to describe it clearly, the Contractor must include them in the plan. These drawings shall be prepared by (or under the direction of) a Professional Engineer, licensed under Title 18 RCW, State of Washington, and shall carry his/her signature and seal. The drawing shall note all assumptions, dimensions, material properties, and other data used in making the structural analysis. The Contractor shall provide copies of design calculations for approval. Any material returned to the Contractor for correction shall be resubmitted to and approved by the Engineer before construction begins.

The plan and detail drawings shall be submitted for approval as prescribed in Section 1-05.3.

6-01.6 LOAD RESTRICTIONS ON BRIDGES UNDER CONSTRUCTION

Bridges under construction shall remain closed to all traffic, including construction equipment, until the substructure and the superstructure, through the roadway deck, are complete for the entire structure, except as provided herein. Completion includes release of all falsework, removal of all forms, and attainment of the minimum design concrete strength and specified age of the concrete in accordance with these Specifications. Once the structure is complete, Section 1-07.7 shall govern all traffic loading, including construction traffic (equipment).

If necessary and safe to do so, and if the Contractor requests it in writing, the Engineer may approve traffic on a bridge prior to completion. The written request shall:

(a) Describe the extent of the structure completion at time of the proposed equipment loading.
(b) Describe the loading arrangement, movement, and position of traffic (equipment) on the bridge.
(c) Provide stress calculations prepared by (or under the direction of) a professional engineer, licensed under Title 18 RCW, State of Washington, and carrying the professional engineer's signature and seal, and
(d) State that the Contractor assumes all risk for damage.

Construction traffic shall not occupy the structure until the Engineer's approval has been obtained in writing.

Contract prices shall cover all costs associated with preparation and submittal of the request and operation of approved traffic (equipment) as outlined herein. Nothing in this section affects the Contractor's other responsibilities under these Specifications or under public highway laws.

6-01.7 NAVIGABLE STREAMS

The Contractor shall keep navigable streams clear so that water traffic may pass safely, providing and maintaining all lights and signals required by the U.S. Coast Guard. The Contractor shall also comply with all channel depth and clearance line requirements of the U.S. Corps of Engineers. This may require removing material deposited in the channel during construction.

6-01.8 APPROACHES TO MOVABLE SPANS

No roadway or sidewalk slab on the approach span at either end of a movable span may be placed until after the movable span has been completed, adjusted and closed.

6-01.9 VACANT

6-01.10 VACANT

6-01.11 NAME PLATES

The Contractor shall install no permanent plates or markers on a structure unless the Drawings designate it.

6-01.12 FINAL CLEANUP

When the structure is completed, the Contractor shall leave it and the entire site in a clean and orderly condition. Structure decks shall be swept and washed. Temporary buildings, falsework, piling, lumber, equipment, and debris shall be removed. The Contractor shall level and fine grade all excavated material not used for backfill, and shall fine grade all slopes and around all piers, bents, and abutments.

6-01.13 ARCHITECTURAL FEATURES

To ensure uniform texture and color, the Contractor shall obtain all cement for the structure from the same manufacturing plant unless the Engineer waives this requirement in writing.

6-01.14 PREMOLDED JOINT FILLER

When the Drawings call for premolded joint filler, the Contractor shall fasten it with galvanized wire nails to one side of the joint. The nails must be no more than 6 inches apart and shall be 1-1/2 inches from the edges over the entire joint area. The nails shall be at least 1-1/2 inches longer than the thickness of the filler.

The Contractor may substitute for the nails any adhesive approved by the Engineer. This adhesive, however, shall be compatible with Resilient Bituminous Preformed Expansion Joint Filler (ASTM D 1751) and capable of bonding the filler to portland cement concrete.

6-01.15 NORMAL TEMPERATURE

Bridge plans state dimensions at a normal temperature of 64 degrees F. Unless otherwise noted, these dimensions are horizontal or vertical.

6-01.16 MAINTENANCE OF BRIDGE DRAINS

The Contractor shall keep the existing and/or new bridge drains open during construction as deemed necessary by the Engineer. The Contractor shall exercise care in keeping the bridge drains clean and free of debris during construction. Before final acceptance of the bridge drains the existing and new bridge drains will be tested and any clogged drain shall be cleaned and cleared by the Contractor.

SECTION 6-02 CONCRETE STRUCTURES

6-02.1 DESCRIPTION

Section 6-02 applies to the construction of all structures (and their parts) made of portland cement concrete with or without reinforcement. Any part of a structure to be made of other materials shall be built as these Specifications require elsewhere.

6-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement	9-01
Aggregates for Portland Cement Concrete	9-03.1
Gravel Backfill	9-03.12
Joint and Crack Sealing Materials	9-04
Reinforcing Steel	9-07
Epoxy-Coated Reinforcing Steel	9-07
Prestressed Concrete Girders	9-19
Curing Materials and Admixtures	9-23
Concrete Mixes Incorporating Fly Ash	9-23.9
Plastic Waterstop	9-24
Water	9-25
Elastomeric Bearing Pads	9-35
Bridge Drains	9-06
Downspouts	9-06

6-02.3 CONSTRUCTION REQUIREMENTS

6-02.3(1) CLASSIFICATION OF STRUCTURAL CONCRETE

Unless specified otherwise, the Contractor shall use Type II portland cement in all concrete. The mix to be used in various parts of the structure is noted in the Drawings and generally follows these guidelines:

Class Of Concrete	Used In:
A	Approach slabs.
AX	Thin and heavily reinforced members; in all roadway slabs subject to abrasive action of traffic; in all cast-in-place beams and girders; in all traffic barriers, columns, arch ribs and arch rings.
B	All reinforced sections other than those covered by Classes A or AX.
C	Unreinforced sections of footing blocks, heavy walls, and other mass construction.
D, DX	Areas where concrete is to be deposited under water, such as seals.
LS	Areas where shrinkage must be reduced, such as closure pours.

If the Engineer approves in writing, the Contractor may use a class of concrete with a higher 28-day design strength than that required in the Special Provisions, Plans, and/or these Specifications. Any request for a change shall be in writing. The Contractor shall bear any added costs that result from this change.

6-02.3(2) PROPORTIONING MATERIALS

6-02.3(2)A GENERAL

The 28-day design strength for each class of concrete listed in Section 6-02.3(1) is shown below. The Contractor shall use as little water as possible for satisfactory placement but shall not exceed the amounts shown below. The table below also provides a guideline for concrete mixes, assuming a bulk specific gravity of 2.67 for each size of aggregate. The weight shown for each size of aggregate is only an estimate of the amount to be used per cubic yard of concrete. Actual amounts may vary from those shown, because the Engineer will adjust the mix to correct for actual bulk specific gravity, moisture content, or may ensure proper consistency, workability, and correct cement content.

CLASS OF CONCRETE	A	B	C	D	DX	AX	AX(1)	LS
Compressive strength ,psi	3,600	3,000	2,300	3,600(2)	3,600(2)	4,000	4,000	4,000
Max. gals. of mixing water per 100. lbs. of portland cement	5.33	6.15	7.23	5.33	5.33	5.30	5.33	4.55(3)
Lbs. of cement per cubic yd.	610	540	470	610	610	660	610	660
Lbs. of dry fine aggregate	1,395	1,470	1,375	1,195	1,300	1,420	1,465	1,420
Lbs. of dry No. 2 course aggregate	1,860	1,820	1,970	2,060	—	—	—	—
Lbs. of dry No. 5 course aggregate	—	—	—	—	1,955	1,735	1,790	1,735

Proportions by Weight: 1-1/2 Inch Maximum Size Aggregate

(1) If the concrete mix develops at least 95 percent of the strength of concrete using washed sand and gravel from Steilacoom, Washington (when tested as required in Section 9-03.1), the Contractor may use these proportions in Class AX concrete instead.
(2) Design strengths. Assumed strengths, however, are 2,200 psi resulting from manner of placement.
(3) A water-reducing admixture shall be used in Class LS concrete as outlined in Section 6-02.3(3)B.

In place of Grading No. 2 as specified in Section 9-03.1(3)D, the Contractor may substitute a 50-50 mix of Gradings No. 4 and 5. When the Engineer approves, the coarse aggregate may be blended from other sizes if:

(a) The resulting aggregate meets all requirements for No. 2;
(b) Each size used makes up at least 25 percent of the blend; and
(c) The Contractor supplies the Engineer with gradings for the proposed sizes, along with their proper proportions before producing the aggregate. If the aggregate will come from commercial sources, the Contractor shall supply this information and have it approved before proportioning and mixing the concrete.

The total Chloride ion (Cl^-) content of the mixed concrete shall not exceed 0.06 percent of cement weight for prestressed concrete nor 0.10 percent for reinforced concrete.

6-02.3(2)B MEASURING MATERIALS

Unless the Project Manual or the Engineer state otherwise, all materials that make up a batch of concrete will be measured by weight on scales that comply with Section 1-09.2.

The cement, the fine aggregate, and each size of coarse aggregate shall be weighed separately, the weight for each being proportional to its bulk specific gravity. The Engineer will correct the weight to adjust for free water held by the aggregate.

The volume in cubic feet will equal the total batch weight (the weight, in pounds, of all materials including water) divided by the unit weight of the concrete in pounds per cubic foot. WSDOT Test Method 806 will determine the unit weight of the concrete.

If the Engineer approves, the Contractor may use mobile mixers that measure material by volume.

6-02.3(3) ADMIXTURES

6-02.3(3)A AIR-ENTRAINED CONCRETE

In all cast-in-place concrete above the finished ground line, the Contractor shall use air-entrained concrete containing 5 percent (plus or minus 1-1/2 percent) air. The Engineer will determine the exact percentage of air. The Contractor may decide whether to use air-entrained material in concrete below the finished ground line.

The Contractor may add air-entraining admixture in either of two ways: (1) with an automatic dispenser approved by the Engineer, or (2) by manually pouring the admixture onto the aggregates in the skip of the mixer. If the admixture is to be added manually, the Engineer will specify proportions for diluting it with water. At least 1 quart of the diluted solution shall be measured and added to each batch of concrete. The Contractor shall adjust the quantity or strength of the solution to comply with all air-content requirements.

Air-entraining increases the volume of concrete. The Engineer will adjust the weights of aggregates to maintain the required quantity of cement per cubic yard.

6-02.3(3)B WATER-REDUCING ADMIXTURE

Water reducing and retardant admixtures shall be used in the concrete mix when required by the Project Manual or the Engineer.

Concrete used in all bridge roadway slabs, traffic and pedestrian barriers, and all Class LS concrete shall include a water-reducing admixture that conforms to AASHTO M 194, Type A.

If temperature of the surrounding air exceeds 80 degrees F, the Contractor may use a combination of water-reducer and retardant admixture that conforms to AASHTO M 194, Type D. In this case, the chloride in the mixture shall conform with Section 9-23.6 of these Specifications and shall be approved by the Engineer. The Engineer may require that the Materials Laboratory sample and test the mixture before use.

The Contractor shall add any water-reducer at the manufacturer's recommended rate and as the Engineer may direct. The water-reducer shall be added as a liquid through an automatic dispenser approved by the Engineer. This dispenser shall inject the reducer into the first 75 percent of the mixing water that enters the batch.

Water-reducers and air-entrainers shall be from the same source and manufacturer unless the Contractor provides the Engineer with test reports from the manufacturers certifying that the two agents are compatible.

6-02.3(3)C CONCRETE MIXES INCORPORATING FLY ASH

Concrete mixes incorporating fly ash may be utilized for all classes of concrete, unless otherwise noted in the Project Manual. Mix proportions will be subject to approval by the Engineer and shall be in compliance with Section 9-23.9.

6-02.3(3)D NON-SHRINK CEMENT SAND GROUT

Non-shrink cement sand grout shall be proportioned as follows:

1 part high early strength (H.E.S.) cement.
2 parts clean fine-grained sand by weight and well-mixed with sufficient water to obtain a stiff consistency.

Unpolished aluminum powder shall be added to the dry cement in the proportion of one heaping teaspoonful per sack of cement no more than 30 minutes before the grout mixture reaches its final in-place position.

The required strength of the non-shrink concrete or grout shall be $f'c$=4,000 psi and be verified by the cube strength test. The strength shall be confirmed by schmidt hammering of the pads.

Prior to placing the grout, the contact surface shall be thoroughly cleaned, roughened and wetted with water. The grout shall be covered with burlap sacks after the initial concrete set and wetted at regular intervals until the required strength is obtained.

6-02.3(4) MIXING CONCRETE

6-02.3(4)A MACHINE MIXING

All concrete shall be mixed thoroughly in a batch mixer that:

(a) Meets the Engineer's approval,
(b) Distributes materials uniformly throughout the batch,
(c) Includes a mechanical device to prevent aggregates being added after mixing begins,
(d) Has a batch meter or other device for recording the number of revolutions per batch,
(e) Is rated for at least a two-sack batch capacity, and

(f) Automatically locks the charging device to prevent emptying the materials until they have been mixed for a set time.

To prepare the mixer, the Contractor shall first place enough sand, cement, and water in the drum to coat its inside surface with cement mortar.

Batches shall be proportioned on the basis of pounds of cement. For each batch, some water shall enter the drum before any cement or aggregate. All water shall be added by the end of the first one-fourth of the required mixing time. Heated water used in cold weather may require the Contractor to adjust this order to prevent flash setting. The Engineer shall determine the amount of water required for each batch.

The entire batch shall be removed from the drum before materials for the next batch are added. If mixing stops long enough that the concrete shows signs of hardening, the mixer shall be thoroughly cleaned.

Concrete shall be mixed for at least 1 minute after all materials and water are in the drum. Classes D and DX, however, shall be mixed 1-1/2 minutes. The Engineer may permit a shorter mixing time for special mixers if tests show equal or better results.

During mixing, the drum shall rotate within its designed speed range. This speed should not be less than 175 nor more than 225 feet per minute at the sides of the drum, and not less than 14 nor more than 20 rpm.

The Contractor shall use an Engineer approved device to measure and control the amount of water used in each batch. This device shall control flow to an accuracy of plus or minus 1/2 percent. It shall include an easy to read gauge that is clearly visible at all times.

6-02.3(4)B HAND MIXING

The Contractor shall not hand-mix concrete except in emergencies and then only with written permission from the Engineer. Hand-mixing is never permitted for concrete to be placed in water.

If the Engineer permits, hand-mixing shall be done on a watertight platform in a way that distributes materials evenly throughout the mass. Mixing shall continue long enough to produce a uniform mixture. No hand-mixed batch shall exceed 1/2 cubic yard.

6-02.3(4)C READY-MIXED CONCRETE

Ready-mixed concrete may be used if the Engineer, after inspecting the plant and delivery system, approves. Approval will be given if the supplier can produce and deliver concrete that conforms to all WSDOT requirements. The delivery rate shall provide for placing of the concrete as required in Section 6-02.3(6). Delivery and handling methods shall also permit placement with a minimum of rehandling and without damage to the structure or the concrete.

The central ready mix plant shall meet the requirements of ASTM C 94. In general, the batching plant shall include bins, weighing hoppers and scales for the fine aggregates and each size of coarse aggregate. If cement is used in bulk, a bin, hopper and separate scale for cement shall also be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The batching plant shall be equipped with a suitable non-resettable batch counter which will correctly indicate the number of batches proportioned during a day. Bins and hoppers shall have separate compartments of adequate size for the fine and each size of coarse aggregate. Scales shall meet the requirements of Section 1-09.2. Plants shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices of an approved type.

An approved supplier may use any cement after obtaining certification from the manufacturer that the cement meets the all requirements of these Specifications. The supplier shall store this cement separately so that it may be easily distinguished from all other cement.

The supplier may use one or more of the following methods for mixing and delivering ready-mixed concrete:

(a) Central-mixed concrete–completely mixed in a stationary mixer and delivered to the site in a truck agitator or truck mixer rotating at agitator speed.
(b) Shrink-mixed concrete–partially mixed in a stationary mixer with mixing completed in a truck mixer.
(c) Transit-mixed concrete–completely mixed in a truck mixer.

A clearly visible metal plate (or plates) attached to each mixer and agitator shall display: (1) the concrete-volume capacity of the drum or container, and (2) the rotation speed of the drum or blades. Mixers and agitators shall always operate within capacity and speed-of-rotation limits set by the manufacturers. Any mixer, when fully loaded, shall mix the ingredients into a uniform mass within the required time. Any agitator, when fully loaded, shall keep the concrete uniformly mixed. All mixers and agitators shall empty the concrete at a steady rate.

Any stationary mixer shall have a timer that prevents the batch from discharging until a set mixing time has elapsed. In shrink-mixing, the batch may be discharged from the stationary mixer as soon as the ingredients have been thoroughly intermingled (about 30 seconds).

If a truck mixer or agitator transports the concrete, the batch shall be discharged at the site no more than 1-1/2 hours after the cement enters the mix. When conditions would speed stiffening of the concrete, the Engineer may require a shorter delivery time. The Engineer may extend this limit if the concrete will be used for fence post foundations, so long as the mix remaining after the 1-1/2 hour limit remains usable without adding excessive water.

In transit-mixing, mixing shall begin within 30 minutes after the cement is added to the aggregates.

Each truck mixer or agitator shall have a nonresettable counter to record the number of revolutions of its drum, blades, or paddles. In transit- or shrink-mixing, each batch shall be mixed at least 70, but not more than 100, revolutions of the drum or blades at the mixing speed designated by the equipment manufacturer. Any additional mixing shall proceed at the manufacturer's designated agitating speed.

Any concrete transported by truck mixer or agitator shall not undergo more than 250 revolutions of the drum or blades before pouring. To remain below this limit, the supplier may agitate the concrete intermittently within the 1-1/2 hour deadline.

The Inspector shall monitor all mixing done at a plant or job site. At least once each day the Inspector shall examine mixers and agitators to find any build-ups of hardened mix or worn blades. If this examination reveals a problem, or if the Inspector wishes to test the quality of the concrete, slump tests may be performed with samples taken at approximately the 1/4 and 3/4 points as the batch is discharged. If the two slumps differ by more than 2 inches, the equipment shall not be used until the condition is corrected. However, the equipment may continue in use if longer mixing times or smaller loads produce batches that pass the slump tests.

6-02.3(4)D RETEMPERING

Concrete shall be mixed only in such quantities as are required for immediate use and shall be used while fresh before initial set has taken place. Any concrete having initial set before placing and finishing shall be wasted and not used for the work. Retempering of concrete (remixing with water or other materials) will not be allowed.

6-02.3(5) CONSISTENCY

Slump tests shall follow WSDOT Test Method No. 804. For vibrated concrete, the maximum slump shall be 3 inches for all concrete except for columns, crossbeams, and diaphragms. For vibrated concrete in columns, crossbeams, and diaphragms, the maximum slump shall be 4 inches. The maximum slump for nonvibrated concrete shall be 7 inches.

If the right consistency cannot be achieved, a water-reducing admixture may be used provided the batch meets the slump limit and complies with proportions required in Section 6-02.3(2).

6-02.3(6) PLACING CONCRETE

6-02.3(6)A GENERAL

The Contractor shall not place concrete:

(a) On frozen or ice-coated ground or subgrade;
(b) Against or on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints;
(c) Under rainy conditions; placing of concrete shall be stopped before the quantity of surface water is sufficient to effect or damage surface mortar quality or cause a flow or wash of the concrete surface.
(d) In any foundation until the Engineer has approved its depth and character;
(e) In any form until the Engineer has approved it and the placement of any reinforcing in it; or
(f) In any work area where vibrations from nearby work (driving or pulling piles, etc.) may harm the concrete's initial set or strength. Such work shall not begin until the concrete has reached a compressive strength of at least 1,000 psi.

When a foundation excavation contains water, the Contractor shall pump it dry before placing concrete. If this is impossible, an underwater concrete seal shall be placed that complies with Section 6-02.3(6)D. This seal shall be thick enough to resist any uplift.

All foundations and forms shall be moistened and with water just before the concrete is placed. Any standing water on the foundation or in the form shall be removed.

The Contractor shall place concrete in the forms as soon as possible after mixing (never later than 1-1/2 hours after the cement was added to the mix). The concrete shall always be plastic and workable. For this reason, the Engineer may reduce the mix-to-placement time even further. Concrete placement shall be continuous, with no interruption longer than 20 minutes between adjoining layers. Each layer shall be placed and consolidated before the preceding layer takes initial set. After initial set, the forms shall not be jarred, and projecting ends of reinforcing bars shall not be disturbed.

In girders or walls, concrete shall be placed in continuous, horizontal layers 1-1/2 to 2-feet deep. Consolidation shall leave no line of separation between layers. In each part of a form, the concrete shall be deposited as near its final position as possible.

Any method for placing and consolidating shall not segregate aggregates or displace reinforcing steel. Any method shall leave a compact, dense, and impervious concrete with smooth faces on exposed surfaces. Plastering is not permitted.

To prevent aggregates from separating, the length of any conveyor belt used to transport concrete shall not exceed 300 feet. If the mix needs protection from sun or rain, the Contractor shall cover the belt.

Use of a concrete pump requires a reserve pump (or other backup equipment) at the site to prevent missed deadlines from breakdowns.

If the concrete will drop more than 5 feet, it shall be deposited through a sheet metal (or other approved) conduit. If the form slopes, the concrete shall be lowered through approved conduit to keep it from sliding down one side of the form. No aluminum conduits or tremies shall be used to pump or place concrete.

Before placing concrete for roadway slabs on steel spans, the Contractor shall release the falsework under the bridge and let the span swing free on its supports. Concrete in flat slab bridges shall be placed in one continuous operation for each span or series of continuous spans.

Concrete for roadway slabs and the stems of T-beams or box-girders shall be placed in separate operations if the stem of the beam or girder is more than 3-feet deep. First the beam or girder stem shall be filled to the bottom of the slab fillets. Roadway slab concrete shall not be placed until enough time has passed to permit the earlier concrete to shrink (at least 12 hours). If stem depth is 3 feet or less, the Contractor may place concrete in one continuous operation if the Engineer approves. But in this case, placing and finishing shall be completed during daylight.

Between expansion or construction joints, concrete in beams, girders, roadway slabs, piers, columns, walls, and traffic and pedestrian barriers, etc. shall be placed in a continuous operation.

No traffic or pedestrian barrier shall be placed until after the roadway and sidewalk slabs are complete for the entire structure. No concrete barriers shall be placed until the falsework has been released and the span supports itself. No barrier, curb, or sidewalk shall be poured on steel or prestressed concrete girder bridges until the roadway slab reaches a compressive strength of at least 3,000 psi.

The Contractor may construct traffic and pedestrian barriers by the slipform method. However, the barrier may not deviate more than 1/4 inch when measured by a 10-foot straightedge held longitudinally on the front face, back face, and top surface.

If an unsatisfactory barrier is constructed, the Contractor shall stop work, remove the unsatisfactory barrier, and take corrective action before proceeding.

When placing concrete in arch rings, the Contractor shall ensure that the load on the falsework remains symmetrical and uniform.

Unless the Engineer approves otherwise, arch ribs in open spandrel arches shall be placed in sections. Small key sections between large sections shall be filled after the large sections have shrunk.

6-02.3(6)B WEATHER AND TEMPERATURE LIMITS TO PROTECT CONCRETE

As it is placed, concrete shall remain between 60 and 90 degrees F and shall never exceed 90 degrees F. To keep the concrete within this temperature range, the Contractor shall use one or more of these methods: shading or cooling aggregate piles (sprinkling these piles with water is not allowed); refrigerating mixing water; or replacing all or part of

the mixing water with crushed ice, provided the ice is completely melted by placing time.

If the concrete would probably exceed 90 degrees F using normal methods, the Engineer may require approved temperature-reduction measures be taken before the placement begins.

If air temperature exceeds 90 degrees F, the Contractor shall use water spray or other approved methods to cool all concrete-contact surfaces to less than 90 degrees F. These surfaces include forms, reinforcing steel, steel beam flanges, and any others that touch the mix. Water-reducing admixtures shall be used to ensure compliance with slump and water quantity requirements. The Contractor shall reduce the time between mixing and placing to a minimum and shall not permit mixer trucks to remain in the sun while waiting to discharge concrete. Chutes, conveyors, and pump lines shall be shaded.

If bridge roadway slabs are placed while air temperature exceeds 90 degrees F, the Contractor shall:

(a) Cover the top layer of reinforcing steel with clean, wet burlap immediately before concrete placement;
(b) Sprinkle cool water on the forms and reinforcing steel just before the placement if the Engineer requires it;
(c) Finish the concrete slab without delay; and
(d) Provide at the site water-fogging equipment to be used if needed after finishing to prevent plastic cracks.

If the evaporation rate at the concreting site is 0.20 pounds per square foot of surface per hour or more (determined from Table 6-02.3(6)-1), the Contractor shall surround the fresh concrete with an enclosure. This enclosure shall protect the concrete from wind blowing across its surface until the curing compound is applied. If casting deck concrete that is 80 degrees F or hotter, the Contractor shall install approved equipment at the site to show relative humidity and wind velocity.

The Contractor assumes all risks connected with the placing of concrete during cold weather. The Contractor shall provide a written procedure of cold weather concreting to the Engineer for review and approval. permission given by the Engineer to place concrete during cold weather will in no way ensure acceptance of the work by the Owner. Should the concrete placed under such conditions prove unsatisfactory in any way, the Engineer shall still have the right to reject the work although the plan and the work was carried out with his permission.

The Engineer may require the Contractor to provide and maintain a recording thermometer near the concreting site. During freezing or near-freezing weather, data from this thermometer shall be readily available to the Engineer.

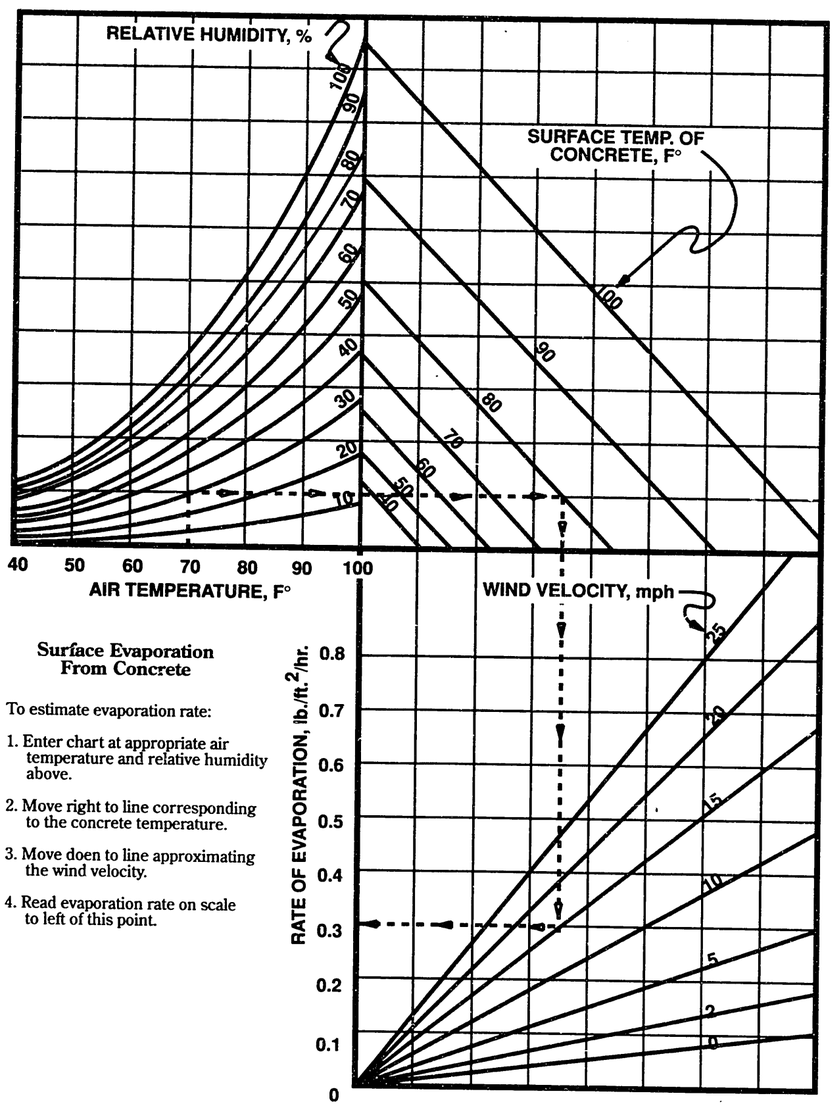
The Contractor shall not mix nor place concrete while the air temperature is below 35 degrees F, unless the water or aggregates (or both) are heated to at least 70 degrees F. The aggregate shall not exceed 150 degrees F. If the water is heated to more than 150 degrees F, it shall be mixed with the aggregates before the cement is added. Any equipment and methods shall heat the materials evenly and shall not alter or prevent the required amount of air entrainment.

The Contractor may warm stockpiled aggregates with dry heat or steam, but not by applying flame directly or under sheet metal. If the aggregates are in bins, steam or water coils or other heating methods may be used if aggregate quality is not affected. Live steam heating is not permitted on or through aggregates in bins. If using dry heat, the Contractor shall increase mixing time enough to permit the super-dry aggregates to absorb moisture.

Any concrete placed in air temperatures below 35 degrees F shall be immediately surrounded with a heated enclosure. Air temperature within the enclosure shall be maintained between 50 and 90 degrees F and the relative humidity shall be above 80 percent. These conditions shall be maintained for a minimum of 7 days or for the cure period required by Section 6-02.3(11), whichever is longer. The Contractor shall stop adding moisture 24 hours before removing the heat. Extra protection shall be provided for areas especially vulnerable to freezing (such as exposed top surfaces, corners and edges, thin sections, and concrete placed into steel forms).

If weather forecasts predict air temperatures below 35 degrees F during the 7 days just after the concrete placement, the Contractor may place the concrete only if he protects it by surrounding with a heated enclosure. Concrete shall not be placed on frozen ground or against frosted reinforcing steel or frosted forms.

Table 6-02.3(6)-1 Surface Evaporation From Concrete



Surface Evaporation From Concrete

To estimate evaporation rate:

1. Enter chart at appropriate air temperature and relative humidity above.
2. Move right to line corresponding to the concrete temperature.
3. Move doen to line approximating the wind velocity.
4. Read evaporation rate on scale to left of this point.

6-02.3(6)C PLACING CONCRETE IN WATER

If the Drawings require a concrete seal, the Contractor shall place the concrete underwater inside a watertight cofferdam, tube, or caisson. (No concrete other than that used for seals may be placed in or underwater.) Seal concrete shall be placed in a compact mass in still water. It shall remain undisturbed and in still water until fully set. While seal concrete is being deposited, water elevation inside and outside the cofferdam shall remain equal to prevent any flow through the seal in either direction. The cofferdam shall be vented at the vent elevation shown in the Drawings. The thickness of the seal is based upon this vent elevation.

The seal shall be at least 18-inches thick unless the Drawings show otherwise. The Engineer may change the seal thickness during construction which may require redesign of the footing and the pier shaft or column. Although seal thickness changes may result in the use of more or less concrete, reinforcing steel, and excavation, payment will remain as originally defined in unit contract prices.

To place seal concrete underwater, the Contractor shall use a concrete pump or tremie. The tremie shall have a hopper at the top that empties into a watertight tube at least 10 inches in diameter. The discharge end of the tube on the tremie or concrete pump shall include a device to seal out water while the tube is first filled with concrete. Tube supports shall permit the discharge end to move freely across the entire work area and to drop rapidly to slow or stop the flow. One tremie may be used to concrete an area up to 18 feet per side. Each additional area of this size requires one additional tremie.

Throughout the underwater concrete placement operation, the discharge end of the tube shall remain submerged in the concrete and the tube shall always contain enough concrete to prevent water from entering. The concrete placement shall be continuous until the work is completed, resulting in a seamless, uniform seal. If the concreting operation is interrupted, the Engineer may require the Contractor to prove by core drilling or other tests that the seal contains no voids or horizontal joints. If testing reveals voids or joints, the Contractor must repair them or replace the seal.

Concrete placed under water shall be Class D or DX mix and shall be proportioned for a maximum slump of 7 inches. The length and width of section of footing being poured shall not exceed 18 feet for each tremie used.

6-02.3(6)D DEWATERING CONCRETE FOUNDATION SEALS

After a concrete seal is constructed, the Contractor shall pump the water out of the cofferdam and place the rest of the concrete in the dry. This pumping shall not begin until the seal has set enough to withstand the hydrostatic pressure–normally at least 3 days for gravity seals and at least 10 days for seals containing piling. The Engineer may extend these waiting periods to ensure structural safety or to meet a condition of the operating permit.

If weighted cribs are used to resist hydrostatic pressure at the bottom of the seal, the Contractor shall anchor them to the foundation seal. Any method used (such as dowels or keys) shall transfer the entire weight of the crib to the seal.

Pumping from the inside of any foundation enclosure shall be done in a way that rules out any chance of concrete being carried away. No pumping shall be done during or for 24 hours after concrete placement unless done from a suitable sump separated from the concrete work by a watertight wall.

6-02.3(6)E POINT OF ACCEPTANCE

Determination of concrete properties for acceptance will be made based on samples taken to most nearly represent the condition of the concrete as placed in the forms. Any placement system which, in operations, alters the specified properties of the concrete will require sampling at the discharge from the placement system.

It shall be the Contractor's responsibility to provide adequate and representative samples of the fresh concrete to a location designated by the Engineer for the testing of concrete properties and making of cylinder specimens. Samples shall be provided as directed in Sections 1-06.1 and 1-06.2.

When mutually agreeable to the Owner and the Contractor, samples may be taken at a location other than the point of discharge. The alteration of concrete properties in passage through the placement system shall be recognized in analyzing results of such samples and in determining acceptance of the fresh concrete.

6-02.3(7) CONCRETE EXPOSED TO SEA WATER

If sea water will contact a completed concrete structure, the Contractor shall:

(a) Mix the concrete for at least 2 minutes.
(b) Control water content to produce concrete that will be as impermeable as possible.
(c) Compact the concrete as the Engineer may require, avoiding the formation of any stone pockets.
(d) Place only clean, rust-free reinforcement bars in the concrete.
(e) Coat form surfaces heavily with shellac and any approved form release agent.
(f) Leave forms intact for at least 30 days after concrete placement (longer if the Engineer requires) to prevent sea water from contacting the concrete.
(g) Leave the surface of concrete just as it comes from the forms.
(h) Provide special handling for any concrete piles used in sea water to avoid even slight deformation cracks.
(i) Avoid sharp corners in concrete work.

The Engineer shall decide the range of disintegration possible by exposure to sea water. This range shall extend from a point below the level of extreme low tide up to a point above the level of extreme high tide. Wave action and other conditions will also affect the Engineer's decision on this range. Unless the Engineer approves otherwise, the Contractor shall not locate construction joints within this range. All concrete within this range shall be poured in the dry.

6-02.3(8) CONCRETE EXPOSED TO ALKALINE SOILS OR WATER

The requirements for concrete in sea water shall also apply to concrete in alkaline soils or water. In addition, the Contractor shall:

(a) Let the concrete set at least 30 days (longer if possible) before allowing soil or water to contact it directly;
(b) Vibrate each batch of concrete immediately after it has been placed into the forms, using enough vibrating tampers to do this effectively; and
(c) Hand tamp, if necessary, to produce smooth, dense outside surfaces.

6-02.3(9) VIBRATION OF CONCRETE

The Contractor shall supply enough vibrators to consolidate the concrete (except that placed underwater) according to the requirements of this section. Each vibrator must:

(a) Be designed to operate while submerged in the concrete,
(b) Vibrate at a rate of at least 7,000 pulses per minute, and
(c) Receive the Engineer's approval on its type and method of use.

Immediately after concrete is placed, vibration shall be applied in the fresh batch at the point of deposit. In doing so, the Contractor shall:

(a) Space the vibrators evenly, no farther apart than twice the radius of the visible effects of the vibration;
(b) Ensure that vibration intensity is great enough to visibly affect a mass of 4-inch slump concrete across a radius of at least 18 inches;
(c) Insert the vibrators slowly to a depth that will effectively vibrate the bottom of each layer;
(d) Protect partially hardened (non-plastic) concrete by preventing the vibrators from penetrating it or making direct contact with steel that extends into it;
(e) Not allow vibration to continue in one place long enough to form pools of grout;
(f) Continue vibration long enough to consolidate the concrete thoroughly, but not so long as to segregate it; and
(g) Withdraw the vibrators slowly when the process is complete.

When vibrating and finishing top surfaces that will be exposed to weather or wear, the Contractor shall not draw water or laitance to the surface. In high lifts, the top layer shall be shallow and made up of a concrete mix as stiff as can be effectively vibrated and finished.

To produce a smooth, dense finish on outside surfaces, the Contractor shall hand tamp the concrete.

6-02.3(10) ROADWAY SLABS

6-02.3(10)A GENERAL

A preconcreting conference shall be held 5 to 10 working days before placing concrete to discuss construction procedures, personnel, and equipment to be used. Those attending shall include:

(a) (representing the Contractor) The superintendent and all foremen in charge of placing steel reinforcing bars, of placing the concrete, and of finishing it.
(b) (representing the Owner) The Project Engineer and his key inspection assistants.

If the project includes more than one slab, and if the Contractor's key personnel change between concreting operations, an additional conference shall be held just before each slab is placed.

The Contractor shall not place roadway slabs until the Engineer agrees that:

(a) Concrete production and placement rates will be high enough to meet placing and finishing deadlines,
(b) Finishers with enough experience have been employed, and
(c) Adequate finishing tools and equipment are at the site.

The strike-board, a mechanically operated machine approved by the Engineer, shall be able to finish the slab to a smooth driving surface within the tolerances these Specifications require. This requires that the strike-board be adjustable to compensate for sag and for vertical curvature in the grade. The Contractor shall immediately adjust the machine if it fails to consolidate or smooth the concrete acceptably. If performance is not acceptable, the Engineer may reject the equipment, any concrete already placed, or both.

The Contractor may use hand-operated strike-boards only when the Engineer approves for special conditions and small areas. These boards must be sturdy and able to strike off the width of a full roadway lane without intermediate screeds. Strike-boards, screeds, and any specially made auxiliary equipment shall receive the Engineer's approval before use. All finishing requirements in these Specifications apply to hand-operated finishing equipment.

Screeds shall rest on adjustable supports that can be removed with the least possible disturbance to the screeded concrete. The supports shall rest on structural members or on forms rigid enough to resist deflection. Supports shall be removable to at least 2 inches below the finished surface. If possible, the Contractor shall place screeds outside the finishing area. But if they are placed inside the area, they shall be placed above the finished surface.

Screeds (with their supports) shall be strong enough and stiff enough to permit the finishing machine to operate effectively on them. All screeds shall be placed and secured for the full length of the slab before the concreting begins. If the Engineer approves in advance, the Contractor may move rails ahead onto previously set supports while concreting progresses. But such movable rails and their supports shall not change the set elevation of the screed.

On steel truss and girder spans, screeds and bulkheads may be placed directly on transverse steel floorbeams, with the strike-board moving at right angles to the centerline of the roadway.

Before any concrete is placed, the finishing machine shall be operated over the entire length of the slab to check screed deflection. Concrete placement may begin only if the Engineer approves after this test.

Immediately before placing concrete, the Contractor shall check (and adjust if necessary) all falsework and wedges to minimize settlement and deflection from the added weight of the concrete slab. The Contractor shall also install devices, such as telltales, by which the Engineer can readily measure settlement and deflection.

The Contractor shall schedule the concrete placement so that it can be completely finished during daylight. After dark finishing is permitted if the Engineer approves and if the Contractor provides adequate lighting.

The placement operation shall cover the full width of the roadway or the full width between construction joints. The Contractor shall locate any construction joint over a beam or web that can support the slab on either side of the joint. The joint shall not occur over a pier unless the Drawings permit. Each joint shall be formed vertically and in true alignment. The Contractor shall not release falsework or wedges supporting pours on either side of a joint until each side has aged as these Specifications require.

Placement of concrete for slabs shall comply with Section 6-02.3(6)A. The Engineer shall approve the placement method. In placing the concrete, the Contractor shall:

(a) Place it (without segregation) against concrete placed earlier, as near as possible to its final position, approximately to grade, and in shallow, closely spaced piles;
(b) Consolidate it around reinforcing steel by using vibrators before strike-off by the finishing machine;
(c) Not use vibrators to move concrete;
(d) Remove any concrete splashed onto reinforcing steel in adjacent segments before concreting them;
(e) Tamp and strike off the concrete with a template or strikeboard moving slowly forward at an even speed;

(f) Keep both ends of the strike-board on the screed at all times during the process;
(g) Maintain a slight excess of concrete in front of the cutting edge across the entire width of the placement operation;
(h) Make enough passes with the strike-board (without bringing excessive amounts of mortar to the surface) to create a surface that is true and ready for final finish; and
(i) Leave a thin, even film of mortar on the concrete surface after the last pass of the strike-board.

Workers shall complete all post screeding operations without walking on the concrete. This may require work bridges spanning the full width of the slab.

After removing the screed supports, the Contractor shall fill the voids with concrete (not mortar).

The Contractor shall refine the surface left by the finishing machine with floats at least 4 feet long. Floating shall remove roughness and minor irregularities and seal the surface of the concrete, leaving a smooth, even surface. Each transverse pass of the float shall overlap the previous pass by at least half the length of the float. The first floating shall be at right angles to the strike-off. The second floating shall be at right angles to the centerline of the span. A smooth riding surface shall be maintained across construction joints.

Expansion joints shall be finished with a 1/2 inch radius edger.

After floating, but while the concrete remains plastic, the Contractor shall test the entire slab for flatness (allowing for crown, camber, and vertical curvature). The testing shall be done with a 10-foot straightedge held on the surface. The straightedge shall be advanced in successive positions parallel to the centerline, moving not more than one-half the length of the straightedge each time it advances. This procedure shall be repeated with the straightedge held perpendicular to the centerline. An acceptable surface shall be one free from deviations of more than 1/8 inch under the 10-foot straightedge.

If the test reveals depressions, the Contractor shall fill them with freshly mixed concrete, strike off, consolidate, and refinish them. High areas shall be cut down and refinished. Retesting and refinishing shall continue until an acceptable, deviation free surface is produced. The hardened concrete shall meet all smoothness requirements of these Specifications even though the tests require corrective work.

The Contractor will texture the bridge deck by combing the final surface perpendicular to the centerline. Made of a single row of metal tines, the comb shall leave striations in the fresh concrete approximately 3/16-inch deep by 1/8-inch wide and spaced approximately 1/2 inch apart. The Engineer will decide actual depths at the site. (If the comb has not been approved, the Contractor shall obtain the Engineer's approval by demonstrating it on a test section.)

The Contractor may operate the combs manually or mechanically, either singly or with several placed end to end. The timing and method used shall produce the required texture without displacing larger particles of aggregate. Texturing shall end 2 feet from curb lines. This 2-foot untextured strip shall be hand finished with a steel trowel.

If the Drawings call for an overlay (to be constructed on the same contract) such as asphalt concrete, latex modified concrete, epoxy concrete, or similar, the Contractor shall produce the final finish by dragging a strip of damp, seamless burlap lengthwise over the full width of the slab or by brooming it lightly. A burlap drag shall equal the slab in width. Approximately 3 feet of the drag shall contact the surface, with the least possible bow in its leading edge. It must be kept wet and free of hardened lumps of concrete. When it fails to produce the required finish, the Contractor shall replace it. When not in use, it shall be lifted clear of the slab.

After the slab has cured, the surface shall not vary more than 1/8-inch under a 10-foot straightedge placed parallel and perpendicular to the centerline.

The Contractor shall cut high spots down with a diamond faced, saw-type cutting machine. This machine shall cut through mortar and aggregate without breaking or dislodging the aggregate or causing spalls.

Low spots shall be built up with portland cement grout that meets the strength requirement of Class AX concrete. This build-up shall be no higher than the surrounding deck surface. An approved epoxy bonding agent shall bind it to the deck.

The surface texture on any area cut down or built up shall match closely that of the surrounding deck. The entire bridge roadway slab must provide a smooth riding surface.

Concrete for sidewalk slabs shall be well compacted, struck off with a strike-board, and floated with a wooden float to achieve a surface that does not vary more than 1/8 inch under a 10-foot straightedge. An edging tool shall be used to finish all sidewalk edges and expansion joints. The final surface shall have a granular texture that will not turn slick when wet.

6-02.3(10)B FINISHING BRIDGE APPROACH SLABS

The reinforced concrete bridge approach slabs shall conform to the requirements of Section 5-06 except that the concrete shall be Class A mix. The finished and cured bridge approach slabs shall be free from any deviation exceeding 1/8 inch under a 10 foot straightedge placed parallel and perpendicular to the centerline of the roadway.

6-02.3(11) CURING CONCRETE

6-02.3(11)A GENERAL

After placement, concrete surfaces shall be cured as follows:

(a) Slabs (roadway, sidewalk, culvert tops, roofs of cut and cover tunnels) –curing compound covered by white, reflective type sheeting.
(b) Retaining walls and sidewalls and floors of culverts–continuous moisture for at least 10 days.
(c) All other concrete surfaces (except traffic barriers and rail bases)–continuous moisture for at least 3 days.

The Contractor may provide continuous moisture by watering a covering of heavy quilted blankets, by watering and covering with a white reflective type sheeting, or by wetting the outside surfaces of wood forms.

On slabs, the Contractor shall apply two coats of an epoxy chlorinated rubber curing compound (that complies with Section 9-23.2) to the fresh concrete. The compound shall be applied immediately after finishing as soon as the visible bleed of water has evaporated or as soon as the Engineer directs. Application of the second coat shall run at right angles to that of the first. The two coats shall total at least 1 gallon per 100 square feet and shall obscure the original color of the concrete. If any curing compound spills on construction joints or reinforcing steel, the Contractor shall clean it off before the next pour.

Normally, the Contractor shall use white, pigmented curing compound, agitating it thoroughly just before and during application. If other materials shall be bonded to the surface, the Contractor shall use clear compound.

The Contractor shall supply back-up spray equipment, enough workers, and a bridge from which they will apply the curing compound. The Engineer may require the Contractor to demonstrate (at least 1 day before the pour) that the crew and equipment can apply the compound in a professional manner.

No later than the morning after applying the curing compound, the Contractor shall cover the top surfaces with white, reflective sheeting, leaving it in place for at least 10 days. Throughout this period, the sheeting shall be kept tightly in place by taping or weighting the edges where they overlap. The Contractor shall not sprinkle or pond the slab, and shall not cover it with any material other than the sheeting described above.

If the Drawings call for an asphalt overlay, the Contractor shall use the clear curing compound, applying at least 1 gallon per 150 square feet to the concrete slab. Membrane curing compounds that leave a waxy film will not be allowed.

6-02.3(11)B CURING AND FINISHING CONCRETE TRAFFIC AND PEDESTRIAN BARRIER

The Contractor shall supply enough water and workers to cure and finish concrete barrier as required in this Section.

Fixed-Form Barrier

After troweling and edging a barrier (while the forms remain in place), the Contractor shall:

(a) Brush the top surface with a fine bristle brush;
(b) Cover the top surface with heavy, quilted blankets; and
(c) Spray water on the blankets and forms at intervals short enough to keep them thoroughly wet for 3 days.

After removing the forms, the Contractor shall:

(a) Remove all lips and edgings with sharp tools or chisels;
(b) Fill all holes with mortar;
(c) True up corners of openings;
(d) Remove concrete projecting beyond the true surface by stoning or grinding;
(e) Cover the barrier with heavy, quilted blankets (not burlap);
(f) Keep the blankets continuously wet for at least 7 days.

The Contractor may do the finishing work described in steps (a) through (d) above during the second (the 7 days) curing period if the entire barrier is kept covered except the immediate work area. Otherwise, no finishing work may be done until at least 10 days after pouring.

After the 10-day curing period, the Contractor shall remove from the barrier all form-release agent, mud, dust, and other foreign substances in either of two ways: (1) by light sandblasting and washing with water, or (2) by spraying with a water jet at a pressure of at least 500 psi.

After cleaning, the Contractor shall use brushes to rub 1:1 mortar into air holes and small crevices on all surfaces except the brushed top. This mortar shall consist of 1 part portland cement (of the same brand used in the concrete) and 1 part clean, fine plaster sand. As soon as the mortar takes its initial set, the Contractor shall rub it off with a piece of sacking or carpet. The barrier shall then be covered with wet blankets for at least 48 houra.

No curing compound shall be used on fixed-form concrete barrier. The completed surface of the concrete shall be even in color and texture.

Slip-Form Barrier

The Contractor shall finish slip-form barrier by: (1) steel troweling to close all surface pockmarks and holes; and (2) for plain surface barrier, lightly brushing the front and back face with vertical strokes and the top surface with crosswise strokes.

After finishing, the Contractor shall cure the slip-form barrier by using either method A (curing compound) or B (wet blankets) described below:

(a) **Method A.** Under the curing compound method, the Contractor shall:

(1) Spray 2 coats of clear, chlorinated rubber curing compound (Type 1) on the concrete surface after the free water has disappeared. (Coverage of combined coats shall equal at least 1 gallon per 150 square feet.)
(2) No later than the morning after applying the curing compound, cover the barrier with white, reflective sheeting for at least 10 days.
(3) Remove the curing compound completely by light sandblasting or by spraying with a high-pressure water jet to produce an even surface appearance.

(b) **Method B.** Under the wet blanket method, the Contractor shall:

(1) Cover the barrier with heavy, quilted blankets as soon as it is strong enough to withstand damage.
(2) Keep the blankets continuously wet for at least 10 days. (No additional finishing is required at the end of the curing period.)

6-02.3(12) CONSTRUCTION JOINTS

If the Engineer approves, the Contractor may add, delete, or relocate construction joints shown in the Drawings. Any request for such changes shall be in writing, accompanied by a drawing that depicts them. The Contractor will bear any added costs that result from such changes.

All construction joints shall be neatly formed as shown on the Drawings by the use of grade strips or other approved methods. Irregular or undulating pour lines will not be allowed. All construction joints shall be either horizontal or vertical, or if the main reinforcement is inclined, the joints shall be normal to the direction of the main reinforcement. Wire mesh of any kind will not be permitted for forming material. An edger shall not be used on the joint, but lips and edgings shall be removed before making the adjacent pour.

If the Drawings require a roughened surface on the joint, the Contractor shall strike it off to leave corrugations at right angles to the length of the member. The grooves shall be at least 1/2 inch wide and at least 1/4 inch but no more than 1/2 inch deep. If the first strike-off does not produce the required roughness, the Contractor shall repeat the process before the concrete reaches initial set. The final surface shall be clean and without laitance or loose material.

Shear keys shall be provided at all construction joints except those where the Drawings call for a roughened surface.

These keys shall provide a positive, mechanical bond. Shear keys shall be formed depressions and the forms shall not be removed until the concrete has been in place at least 12 hours. Forms shall be slightly beveled to ensure ready removal. Raised shear keys are not allowed.

Shear keys for the tops of beams, at tops and bottoms of boxed girder webs, in diaphragms, and in crossbeams shall:

(a) Be formed with 2-inch x 8-inch wood blocks;
(b) Measure 8 inches lengthwise along the beam or girder stem;
(c) Measure 4 inches less than the width of the stem, beam, crossbeam, etc. (measured crosswise of the stem); and
(d) Be spaced at 16 inches center to center.

Unless the Drawings show otherwise, in other locations (not named above), shear keys shall equal approximately one-third of the joint area and shall be approximately 1-1/2 inches deep.

Before placing new concrete against cured concrete, the Contractor shall thoroughly clean and roughen the cured face and wet it with water. Before placing the reinforcing mat for footings on seals, the Contractor shall: (1) remove all scum, laitance, and loose gravel and sediment; (2) clean the construction joint at the top of the seals; and (3) chip off any high spots on the seals that would prevent the footing steel from being placed in the position required by the Drawings.

6-02.3(13) EXPANSION JOINTS (Bridge Decks)

6-02.3(13)A GENERAL

This section outlines the requirements of specific expansion joints shown in the Drawings. The Drawings may require other types of joints, seals, or materials than those described here.

Joints made of a vulcanized, elastomeric compound (with neoprene as the only polymer) shall be installed with an approved lubricant adhesive as recommended by the manufacturer. The length of a seal shall match that required in the Drawings without splicing or stretching.

Open joints shall be formed with a template made of wood, metal, or other suitable material. Insertion and removal of the template shall be done without chipping or breaking the edges or otherwise injuring the concrete.

Any part of an expansion joint running parallel to the direction of expansion shall provide a clearance of at least 1/2 inch (produced by inserting and removing a spacer strip) between the two surfaces. The Contractor shall ensure that the surfaces are precisely parallel to prevent any wedging from expansion and contraction.

All poured rubber joint sealer (and any required primer) shall conform with Section 9-04.2(2).

The expansion joints shall be as shown and noted in the Drawings and shall be installed in accordance with the manufacturer's written recommendations.

The Contractor shall submit Shop Drawings of the expansion joints proposed for use to the Engineer for approval. Submittal of Shop Drawings shall be in accordance with provisions of Section 1-05.3. The Shop Drawings shall show details of the system(s), including materials and dimensions, method of installation, and method of sealing the system to prevent leakage of water through the joint. The Contractor shall submit, with his Shop Drawing submittal, the manufacturer's written installation procedures to the Engineer for approval.

After the joint system(s) is installed, the joint area shall be sand bagged, flooded with 4 inches of water for 24 hours and inspected, from below the joint, for leakage. If leakage is observed, the joint system shall be repaired, as recommended by the manufacturer and approved by the Engineer.

To aid in assuring proper use and installation of the expansion joint system under job conditions, the Contractor shall have available, during installation of the system and at no cost to the Owner, the services of a qualified, full-time field representative of the manufacturer of the expansion joint system to be installed in this project. Recommendations made by the manufacturer's representative, on and/or off the job site, and approved by the Engineer, shall be adhered to by the Contractor at his own expense.

The expansion joints shall seal the roadway deck surface and curbs to prevent water from passing through the joint to portions of the structure below. Installation of the expansion joints and painting of the exposed metal parts shall be in accordance with the manufacturer's recommendation. The sealant recommended by the manufacturer supplying the expansion joint shall be approved by the Engineer before installation. The transition of the expansion joint from the roadway, up the curb face and horizontally to the back of the curb shall be in a continuous factory fabricated curb/gutter unit.

The seats for the expansion joints shall be absolutely parallel to longitudinal and transverse roadway grade and shall match the transverse crown of the final pavement surface. All spalls, low areas or high areas in the expansion joint seat shall be recontoured so that the variation is no more than 1/16 inch from a 10-foot straightedge on a constant cross slope and from a 3-foot straightedge on a parabolic crown. Each successive check with the straightedge device shall lap the previous check by at least 1/2 of the length of the straightedge. All concrete outside corners of the expansion joint slot shall have a radius of rounding no greater than 1/4 inch.

When the expansion joint seat consists of steel plates or steel angles, all high areas shall be ground and all low areas having a depth of less than 1/4 inch from the true seat contour shall be filled with epoxy. Areas with a depth greater than 1/4 inch shall be filled with an epoxy sand grout. The tolerance from a 10-foot or 3-foot straightedge shall be the same as stated above for concrete seats.

The expansion joint material shall have full firm bearing for the entire length and width of the joint.

The expansion joint material shall be placed so that its top surface is recessed 1/8 inch ± 1/16 inch below the driving surface of the pavement on both sides of the expansion joint.

Shims, washers or other devices shall not be used below the expansion joint material to bring the joint into proper elevation and/or tolerance.

All aluminum surfaces which will be in contact with concrete shall be coated with zinc chromate or a bituminous paint as recommended by the manufacturer.

6-02.3(13)B COMPRESSION SEAL

6-02.3(13)B1 GENERAL

The Contractor shall furnish and install compression seals of the size and type specified at the locations shown on the Drawings.

The compression seals shall conform to the minimum requirements for the type of seal specified on the Drawings as manufactured by the D. S. Brown Company and Watson Bowman/Acme Corporation, or approved equal and according to the following provisions:

The seals shall conform to the requirements of ASTM Designation D735 and shall be formed by an extrusion process resulting in a dense neoprene with uniform dimensions and smooth exterior surface.

The cross section of the seal shall be shaped to allow adequate compression of the seal under design conditions. The length of seals shall be as indicated on the Drawings. Stretching of the seals will not be permitted. Details of the seal, including corner joints and type of material to bond joints shall be submitted to the Engineer and approved before submitting samples for lot acceptance. For the purpose of these Specifications, a lot shall be considered all material of one size produced during one production run for use on this project. A sample shall consist of a 3-foot length of actual seal. The supplier of the joint seals will be required to furnish the Engineer with a certified copy of the test results indicating that the material complies with the Specification requirements.

The seal shall be installed with an approved lubricant adhesive in accordance with the manufacturer's recommendations. The lubricant adhesive shall be delivered in containers plainly marked with the manufacturer's name or trademark, lot number and date of manufacture. A one pint sample of lubricant adhesive shall be furnished to the Engineer for approval prior to installation.

6-02.3(13)B2 PREPARATION OF SURFACES FOR INSTALLATION

The groove or recess for compression seals shall have parallel sides and be constructed to the proper depth. The width of the recess shall not vary more than 1/16 inch in a distance of 10 feet. The bottom shall be a true, smooth plane parallel to the surface of the roadway, curb, or sidewalk.

All surfaces to receive elastomeric compression seal shall be free from dirt, water, oil, rust, frost, spalls, cracks, and any other loose foreign debris which may be detrimental to effective joint sealing.

It is imperative that a clean opening with 3/8 inch rounded top edges shall be produced for the specified opening and the full depth of joint required. After the joints are constructed and all foreign materials removed from the joint grooves, all joint grooves shall be inspected for spalling. Any spalling which increases the specified size of the joint groove beyond the following limits shall be repaired by patching with epoxy mortar:

(a) Spalls over 1/4 inch wide and over 1/2 inch below the surface of the pavement.
(b) Spalls over 1/4 inch wide and 2 inches or more in length, regardless of the depth of spall below the surface of the pavement.

6-02.3(13)B3 INSTALLATION

Where indicated on Drawings, the Contractor shall install the proper seals in a neat, workmanlike manner, and to the satisfaction of the Engineer.

For ease of installation, the air temperature should be below 85xF.

At end joints or miter joints as shown on the Drawings, a 1/4 inch thick neoprene sponge shall be bonded to the seal ends with an approved cyanoacrylate adhesive. In order to insure proper fitting, the neoprene sponge shall be cut to the size and shape of the uncompressed seal (nominal dimensions). Further, the seal plus the sponge shall be slightly longer than the gap to be filled so that the sponge is in a state of compression against the ends of the seal. The cyanoacrylate adhesive shall be applied to outer webs and top web of the seal only, to allow entrapped air to escape and the sponge to properly function.

The seal surface to be bonded shall be cleaned with toluene or approved solvent prior to applying adhesive. A continuous coat of adhesive shall be applied to both joint interfaces immediately prior to seal installation. Adhesive shall not be applied below 40° F.

At seal upturn or downturn locations, the installation procedures shall be as follows (see detail on the Drawings):

(a) Locate 1/2 inch diameter hole and drill through seal as shown, using a standard twist drill.
(b) Using a sharp long blade knife or hacksaw, cut lower section of seal to 1/2 inch diameter hole as shown.
(c) Bend seal in desired position and install as shown.
(d) Complete seal installation following normal sealing instructions.

The seal surface to be bonded shall be cleaned with toluene or approved solvent prior to applying adhesive. A continuous coat of adhesive shall be applied to both joint interfaces immediately prior to seal installation. Adhesive shall not be applied below 40 degrees F. The compression seal shall be placed such that the top surface, or surface facing the front of the curb shall be recessed 1/8 inch to 1/4 inch into the adjacent concrete surface.

6-02.3(14) FINISHING CONCRETE SURFACES

6-02.3(14)A GENERAL

All concrete shall show a smooth, dense face after the forms are removed. If it is porous, the Contractor shall bear the cost of removing and replacing it. The Contractor shall clean and refinish any stained or discolored surfaces that may have resulted from his/her work or from construction delays.

Subsections B, C, and D (below) describe three classes of surface finishing. The Contractor shall comply with these subsections unless the Drawings or Project Manual requires otherwise.

6-02.3(14)B CLASS 1 SURFACE FINISH

The Contractor shall apply a Class 1 finish to all rail bases, curbs, traffic barrier, pedestrian barrier, and ornamental concrete members.

Class 1 surface finish requires the same treatment as Class 2 (below) but also includes the finishing steps outlined in Section 6-02.3(11)B.

6-02.3(14)C CLASS 2 SURFACE FINISH

The Contractor shall apply a Class 2 finish to:

(a) All surfaces on the superstructures at highway grade separations and railroad undercrossings (but not under surfaces of slab spans, filled spandrel arches and floor slabs between girders, or near horizontal bottom slabs of box girders, or inside vertical surfaces of girders, or concrete cast in steel forms).
(b) All above finished ground surfaces of bridge piers, columns, abutments, retaining walls, and culvert head walls whenever these surfaces are visible from any walkway or roadway within 150 feet (but not columns cast in steel forms).
(c) All outside surfaces, vertical or sloping, of each superstructure (including the undersurfaces of cantilevered floor slabs that overhang outside girders or box girders).
(d) All surfaces of open spandrel arch rings, spandrel columns, and abutment towers.

The Contractor shall follow steps (a) through (h) below. When steel forms have been used and when the surface of filled holes matches the texture and color of the area around them, the Contractor may omit steps (c) through (h). To create a Class 2 surface, the Contractor shall:

(a) Remove all bolts and all lips and edgings where form members have met;
(b) Fill bolt holes with 1:2 mortar floated to an even, uniform surface;
(c) Thoroughly wash the surface of the concrete with water;
(d) Brush on a 1:1 mortar mix (made of the same brand of cement as was used in the concrete), working it well into the small air holes and other crevices in the face of the concrete;
(e) Brush on no more mortar than can be finished in 1 day;
(f) Rub the mortar off with burlap or a piece of carpet as soon as it takes initial set (before it reaches final set);
(g) Fog-spray water over the finish as soon as the mortar paint has reached final set; and
(h) Keep the surface damp for at least 2 days.

If the mortar becomes too hard to rub off as described in step (f), the Contractor shall remove it with a Carborundum stone and water. Random grinding is not permitted.

The final finish shall satisfy the Engineer.

6-02.3(14)D CLASS 3 SURFACE FINISH

The Contractor shall apply a Class 3 finish to:

(a) All above-ground surfaces not receiving a Class 1 or Class 2 finish as specified above.
(b) All surfaces that will be underground or covered with fill (but the Engineer may waive the requirement for removing tight form ties and filling small air holes).

To produce a Class 3 finish, the Contractor shall:

(a) Remove all bolts and all lips and edgings where form members have met; and
(b) Fill all holes with 1:2 mortar floated to an even, uniform surface.

Nothing further is required if the Engineer decides these 2 steps have produced a satisfactory finish. Otherwise, the Contractor shall follow other Class 2 steps until the Engineer approves the work as a final Class 3 finish.

6-02.3(15) DATE NUMERALS

The Contractor shall place standard date numerals (using the year the structure is completed) as the Drawings require.

6-02.3(16) PLANS FOR FALSEWORK AND FORMS

6-02.3(16)A NON-PREAPPROVED FALSEWORK AND FORMING PLANS

The Contractor shall submit to the Engineer, for approval, 6 copies of Shop Drawings showing details of the falsework and non-preapproved forms intended to be used. The Shop Drawings will be returned from the Engineer to the Contractor. Shop Drawings will not be required for footing or retaining walls 4 feet or less in height. The footing pedestal is not included in the footing height. If a railroad is involved, 4 additional sets are required for each railroad company involved. The Working Drawings shall show the proposed details of construction such as sizes of members, spacing of bents, posts, studs, wales, stringers, collars, bolts, wedges, bracing, rate of pour, and the manufacturer's recommended safe working capacity of all form ties and column wraps.

Falsework and forms shall not be constructed until approval has been given by the Project Engineer. Approval by the Project Engineer will not relieve the Contractor of responsibility for the sufficiency of the falsework and forms. Falsework, form, and other related Shop Drawings which are necessary for the prosecution of the work shall be designed by or under the direction of a Professional Engineer, licensed under the provisions of Title 18 RCW with the State of Washington, and shall bear his signature and seal. All assumptions, dimensions, material properties, and other data used in making the structural analysis shall be noted on the Shop Drawing. Upon request, the Contractor shall furnish copies of the design calculations to the Engineer for examination as a condition for approval. Prints returned for correction shall be resubmitted and shall be approved by the Engineer before the construction of the falsework and forms is undertaken.

All Shop Drawings shall be made on sheets conforming in size to the provisions of Section 1-05.3 and all details shall be made clear, complete and to scale in accordance with standard drafting procedures.

For calculating the strength of falsework, a weight of 160 pounds per cubic foot shall be assumed for green concrete.

6-02.3(16)B FORMING PLANS

Form plans for abutments, wingwalls, diaphragms, retaining walls, columns, girders and beams, box culverts, railings, and bulkheads shall also be submitted to the Engineer for approval. Contractors submitting plans for approval shall submit one reproducible drawing for each plan sheet. The plan will be returned to the Contractor for any necessary modifications, revisions, or special instructions. Upon final approval, the plan will be stamped "Approved", dated, and returned to the Contractor.

Construction shall not proceed until approval has been given by the Engineer. Use of the approved plans for Contracts on or adjacent to railroad right of way will require railroad approval. Four additional copies shall be submitted to the Project Engineer for railroad review and approval.

Falsework plans for supporting the roadway slab for the interior spans between precast prestressed concrete girders shall be submitted for approval. Other falsework plans shall be submitted in accordance with Section 6-02.3(16)A.

6-02.3(17) FALSEWORK AND FORMS

6-02.3(17)A GENERAL

Formwork and falsework are both structural systems. Formwork contains the lateral pressure exerted by concrete placed in the forms. Falsework supports the vertical load of the formwork, reinforcing steel, concrete, and live loads during construction.

The Contractor shall set falsework to allow for shrinkage, settlement, and any structural camber the Drawings or the Engineer requires.

The Contractor shall set all forms true to designated lines. Interior shape and dimensions shall guarantee that the finished concrete will conform with the Drawings.

If the new structure is near or part of an existing one, the Contractor shall not use the existing one to suspend or support falsework (unless the Drawings or Project Manual states otherwise).

On bridge roadway slabs, forms made of precast concrete panels designed to stay in place shall not be allowed.

6-02.3(17)B CAPS, PILING, POSTS, AND MUDSILLS

The Contractor shall support all falsework on either driven piling or mudsills. All piling, post, or mudsill shall be designed to carry the maximum design load plus all construction equipment. If the Drawings call for piling or foundation shafts to support permanent structures, the Contractor may not use mudsills for falsework unless the underlying soil passes the settlement test described in this section. When using piling to support the falsework, the Contractor's falsework shop drawings shall specify the minimum required bearing and penetration for the piling.

To determine the bearing capacity of falsework piling, the Contractor shall use the formulas in Section 6-05.3(2)F. Or, if the Engineer approves, the Contractor may instead demonstrate capacity by loading the piling to twice the falsework design load.

Timber piling (untreated) shall comply with the requirements of Sections 9-10.1(1) and 9-10.1(2). Steel piling shall meet the requirements of Section 9-10.5.

If the Engineer approves, the Contractor may use mudsills in place of driven piling, provided tests show that the soil can support twice the falsework design load and that the mudsill will not settle more than 1/4 inch while loaded. The acceptable tests for various soil types are:

(a) Granular Soil–The Contractor shall conduct on-site tests according to the AASHTO 235 "Standard Method Test for Bearing Capacity of Soil for Static Load on Spread Footings."
(b) Fine Grained or Organic Soil–The Contractor shall employ a Professional Geotechnical Engineer to investigate the foundation soils and certify the falsework design will meet the load-settlement requirements described above.

In building a mudsill, the Contractor shall:

(a) Place it on soil that is either undisturbed or compacted to 95 percent of maximum density, as determined by the compaction control tests in Section 2-03.3(14)E;
(b) Design it to be as unyielding as possible under full design load, according to soil pressures the Engineer determines from conditions at the site (normally not more than 3,000 pounds per square foot);

(c) Place grout or a compacted layer of fine material under the mudsill if it will rest on rock or coarse sand and gravel;
(d) Provide the Engineer with a sample of any off-site material to be used under the mudsill; and
(e) Allow up to 5 working days for the Engineer's approval before using the off-site material.

When using mudsills, the Contractor shall prepare in advance for the possibility of reshoring. After placing concrete, if the falsework settles more than 1/2 inch, the Contractor shall reshore it to raise the bottom slab to Drawing elevation plus any anticipated settlement.

Caps shall be fastened to piling and posts with drift pins or other Engineer-approved fasteners. The Contractor shall install caps at all bents supported by posts or piling unless approved falsework plans specifically permit otherwise. Timber posts shall be fastened to mudsills with drift pins or other Engineer-approved fasteners.

High quality wedges in each support system shall permit forms to be taken up and released uniformly. Wedges shall be placed between stringer and cap–not between post (or pile) and cap. Only one set of wedges shall be used at a location. For more adjustment, the Contractor shall use a single piece of blocking. Stacks of blocks and wedges are not permitted. For arches, the Contractor shall use screw jacks (or other approved devices) in place of wedges so that the falsework may be released in increments.

6-02.3(17)C STRINGERS, BEAMS, AND JOISTS

Deflection of stringers, beams, and joists used to support form work shall not exceed 1/500 of the span under full load (or 1/360 on joists that support the deck slab between girders in girder-type bridges). In setting the falsework, the Contractor shall allow for deflection.

6-02.3(17)D BRACING

The Contractor shall brace falsework lengthwise and crosswise to stiffen it and to keep individual members from buckling. Bracing shall be as rigid as possible. If movement is likely, wedges shall be used with braces to stabilize the falsework. The Contractor shall replace any split or damaged crossbracing.

When timber members brace falsework bents near roadways or railroads, the Contractor shall use bolted connections with bolts 5/8 inch or more in diameter. The connection for any bent shall be designed to resist the horizontal load. This load shall be the sum of potential horizontal loads from equipment, work sequence, wind, and other causes. This load shall never be less than 2 percent of the total dead load.

Bolts at connections shall be at least 5/8 inch in diameter. The sizes of any spikes or nails shall be as required in the plans. The Contractor shall replace all crossbraces split or damaged by connections or for any other reason.

To stabilize steel scaffold falsework, the Contractor shall attach exterior braces to towers taller than 20 feet unless the Engineer allows otherwise. These horizontal and diagonal braces must be fastened securely to the frame legs.

On prestressed girder spans, the Contractor shall install braces between girders to prevent movement or rotation during pouring of the diaphragm and roadway slab.

When deck overhang (the distance from the centerline of the exterior girder to the near edge of the roadway slab) on a prestressed girder span exceeds the distances listed in the table below, the Contractor shall provide extra bracing. This bracing shall include: (1) a cross-tie connecting the top flange of each exterior girder with its counterpart on the other side, and (2) braces between the bottom flanges of all girders. All bracing shall be placed at the midpoint between diaphragms (or at more frequent intervals).

Girder Series	Distance in Inches
6	30
8	42
10	63
14	66

If a concrete finishing machine is supported at the outside edge of the slab, the Contractor shall adjust for its added weight.

Roadway deck forming systems may require bracing, strutting, or ties between girders for the girder to adequately support the form loading. When braces, strutts, or ties are required, they shall be designed and detailed by the Contractor and shall be shown on the falsework/formwork plans submitted to the Engineer for approval. These braces, strutts, and ties shall be furnished and installed by the Contractor at no additional cost to the Owner.

6-02.3(17)E FRICTION COLLARS, BRACKETS, SAND JACKS, AND SIMILAR DEVICES

An independent testing laboratory must establish the load capacity and deflection (or settlement) of all friction collars and clamps, brackets, sand jacks, and similar devices. Laboratory tests shall use the same materials and design that will be used on the project. The Contractor shall provide the Engineer an opportunity to witness these tests and shall provide an outline of the test data and procedures for the Engineer's approval.

The working load for devices named in this section title shall be based on a minimum safety factor of 2. The Contractor must comply with all manufacturer's specifications, including those relating to torque and reuse of material.

6-02.3(17)F FORM TIES

For form ties, the Contractor shall use threaded rods or (if specifically named on an approved form plan) standard manufactured ties. As a condition of approval, the Engineer may require the Contractor to submit test data or specimens for testing. Wire form ties and taper ties are not allowed.

Installation of form ties shall permit removal of all metal to at least 1/2 inch below the concrete surface. During removal of the outer unit, the bond between the concrete and the inner rod shall not be broken.

6-02.3(17)G FACE LUMBER, STUDS, WALES, AND METAL FORMS

Wooden forms shall be faced with smooth sanded, exterior plywood. This plywood shall meet the requirements of the National Bureau of Standards, U.S. Product Standard PS 1, and the Design Specification of the American Plywood Association (APA). Each full sheet shall bear the APA stamp. The Contractor shall list in the form plans the grade and class of plywood. If the Engineer approves the manufacturer's certification of structural properties, the Contractor may use plywood that does not carry the APA stamp.

The grades of plywood for various form applications shall be as follows:

(a) Traffic and Pedestrian Barriers (except those that will receive an architectural surface treatment)–Plywood used for these surfaces shall be APA grade High Density Overlaid (HDO) 60-60 Class I. But if the Contractor coats the form to prevent it from leaving joint and grain marks on the surface, plywood that meets or exceeds APA grades B-B Plyform Class I or B-C (Group I species) may be used. Under this option, the Contractor shall provide for the Engineer's approval a 4-foot square,

test panel of concrete formed with the same plywood and coating as proposed in the form plans. This panel shall include one form joint along its centerline. The Contractor shall apply coating material, according to the manufacturer's instructions, before applying chemical release agents.
(b) Other Exposed Surfaces (all but those on traffic and pedestrian barriers)–Plywood used to form these surfaces shall meet or exceed the requirements of APA grades B-B Plyform Class I or B-C (Group I series). If one face is less than B quality, the B (or better) face shall contact the concrete.
(c) Unexposed Surfaces (such as the undersides of roadway slabs between girders, the interiors of box girders, etc., and traffic and pedestrian barriers where surfaces will receive an architectural treatment)–Plywood used to form these surfaces may be APA grade CDX, provided the Contractor complies with stress and deflection requirements stated elsewhere in these Specifications.

Form joints on an exposed surface shall be in a horizontal or vertical plane. But in wingwalls and box girders, side form joints shall be placed at right angles and parallel to the roadway grade. Joints parallel to studs or joists shall be backed by a stud or joist. Joints at right angles to studs and joists shall be backed by a stud or other backing the Engineer approves. Perpendicular backing is not required if studs or joists are spaced:

(a) Nine inches or less on center and covered with 1/2-inch plywood, or
(b) Twelve inches or less on center and covered with 3/4-inch plywood.

The face grain of plywood shall run perpendicular to studs or joists unless shown otherwise on the Contractor's formwork plans and approved by the Engineer. Proposals to deviate from the perpendicular orientation shall be accompanied by supporting calculations of the stresses and deflections.

On any retaining wall that follows a horizontal circular curve, the wall stems may be a series of short chords if:

(a) The chords within the panel are the same length,
(b) The chords do not vary from a true curve by more than 1/2 inch at any point, and
(c) All panel points are on the true curve.

Where architectural treatment is required, the angle point for chords in wall stems shall fall at vertical rustication joints.

For exposed surfaces of abutments, wingwalls, piers, retaining walls, and columns, the Contractor shall build forms of plywood at least 3/4-inch thick with studs no more than 12 inches on center. The Engineer may approve exceptions, but deflection of the plywood, studs, or wales shall never exceed 1/500 of the span (or 1/360 of the span for unexposed surfaces, including the bottom of the deck slab between girders).

All form plywood shall be at least 1/2-inch thick except on sharply curved surfaces. There, the Contractor may use 1/4-inch plywood if it is backed firmly with heavier material.

The rear faces of forms for retaining walls and sloping faced columns over 12 feet high shall include portholes at least 18 inches square. These portholes shall occur at least every 12 feet horizontally and every 8 feet vertically. The portholes will provide access for vibrating and inspecting the concrete as it is placed.

Round columns or rounded pier shafts shall be formed with a self-supporting metal shell form or form tube that leaves a smooth, nonspiralling surface. Wood forms are not permitted.

Metal forms shall not be used elsewhere unless the Engineer is satisfied with the surface and approves in writing. The Engineer may withdraw approval for metal forms at any time. If permitted to use a combination of wood and metal in forms, the Contractor shall coat the forms so that the texture produced by the wood matches that of the metal. Aluminum shall not be used for metal forms.

For design purposes, the Contractor shall assume that on vertical surfaces concrete exerts 150 pounds of pressure per square foot per foot of depth. However, when the depth is reached where the rate of placement controls the pressure, the following table applies:

FEET PER HOUR RATE OF PLACING	PRESSURE, POUNDS PER SQUARE FOOT FOR TEMPERATURE OF CONCRETE AS SHOWN				
	40°	50°	55°	60°	70° and above
2	725	600	560	470	375
3	900	750	690	640	565
4	1,075	875	800	725	625
5	1,250	1,000	900	815	690
6	1,425	1,125	1,000	900	750
7	1,600	1,250	1,110	990	815
8	1,775	1,375	1,215	1,075	875
9	1,950	1,500	1,320	1,165	935
10	2,125	1,625	1,425	1,250	1,000
15	3,000	2,250	1,950	1,670	1,300

The pressures in the above table have been increased to provide an allowance for the vibration and impact.

Horizontal surfaces shall support a pressure of 160 pounds per square foot for each foot of concrete height.

All exposed corners shall be beveled 3/4 inch. However, traffic barriers shall not be beveled unless the Drawings require it.

All forms shall be watertight as possible with no water standing in them as the concrete is placed.

The Contractor shall apply a parting compound on forms for exposed concrete surfaces. This compound shall be a chemical release agent that permits the forms to separate cleanly from the concrete. The compound shall not penetrate or stain the surface and shall not attract dirt or other foreign matter. After the forms are removed, the concrete surface shall be dust-free and have a uniform appearance. The Contractor shall apply the compound at the manufacturer's recommended rate to produce a surface free of dusting action and yet provide easy removal of the forms.

If an exposed concrete surface will be sealed, the release agent shall not contain silicone resin. Before applying the agent, the Contractor shall provide the Engineer a written statement from the manufacturer stating whether the resin in the base material is silicone or non-silicone.

The Contractor shall submit to the Engineer a sample of the parting compound at least 10 working days before its use. Approval or nonapproval shall be based on laboratory tests results.

The Engineer may reject any forms that will not produce a satisfactory surface.

6-02.3(17)H CONCRETE FORMS ON STEEL SPANS

Concrete forms on all steel structures shall be removable and shall not remain in place. Where needed, the forms shall have openings for truss or girder members. Each opening shall be large enough to leave at least 1-1/2 inches between the concrete and steel on all sides of the steel member after the forms have been removed.

Any form support for a roadway slab that rests on a plate girder flange shall apply the load within 6 inches of the girder web centerline. The Contractor shall not weld any part of the form to any steel member.

If the Engineer permits bolt holes in the web to support form brackets, the Contractor shall fill the holes with fully torqued AASHTO M 164 bolts. Each bolt head shall be placed on the exterior side of the web.

6-02.3(17)I FINISHING MACHINE SUPPORT SYSTEM

Before using any finishing machine, the Contractor shall obtain the Engineer's approval of detailed drawings that show the system proposed to support it. The Contractor shall not attach this (or any other) equipment support system to the sides or suspend it from any girder unless the Engineer permits. The Engineer will not permit such a method if it will unduly alter stress patterns or create too much stress in the girder.

6-02.3(17)J RESTRICTED OVERHEAD CLEARANCE SIGN

When erecting falsework that restricts overhead clearance above a railroad track, the Contractor shall immediately (as soon as the restriction occurs) place restricted overhead clearance signs. Sign details are shown in WSDOT Standard Plan No. G-1.

6-02.3(17)K REMOVAL OF FALSEWORK AND FORMS

The Contractor shall never remove forms or falsework unless the Engineer approves. The Engineer will decide, on the basis of post-placement curing conditions, the exact number of curing days that shall elapse before form removal. If the Engineer does not decide otherwise, the Contractor may remove forms (from the time of the last pour the forms support) as indicated in the table below:

Concrete Placed In	Percent of Design Strength	Curing Days
Columns, wall faces, mass piers and abutments (except pier caps), traffic and pedestrian barriers, and any other side form not supporting the concrete weight (1)	–	3
Pier caps continuously supported. (2)	60	3
Sidewalks not supported on bridge roadway slabs. (2)	70	-
Crossbeams, caps, pier caps not continuously supported, struts and top slabs on concrete box culverts, inclined columns and inclined walls. (2) (3)	80	5
Roadway slabs supported on wood or steel stringers or on steel or prestressed concrete girders. (2)	–	10
Box girders, T-beam girders, and flat-slab superstructure. (2) (3)	80	14
Arches. (2) (3)	–	21

(1) Where forms do not support the load of concrete.
(2) Where forms support the load of concrete.
(3) Where continuous spans are involved, the time for all spans will be determined by the last concrete placed affecting any span.

Before releasing supports from beneath beams and girders, the Contractor shall remove forms from columns to enable the Engineer to inspect the column concrete.

The Contractor may remove the side forms of footings 24 hours after concrete placement if a curing compound is applied immediately. But this compound shall not be applied to that area of the construction joint between the footing and the column or wall.

The Contractor may remove side forms, traffic barrier forms, and pedestrian barrier forms after 24 hours if these forms are made of steel or dense plywood, an approved water reducing additive is used, and the concrete reaches 1,400 psi before form removal. This strength shall be proved by test cylinders made from the last concrete placed into the form. The cylinders shall be cured according to WSDOT Test Method No. 809, Method 2.

Wet curing shall comply with the requirements of Section 6-02.3(11). The concrete surface shall not become dry during form removal or during the entire curing period.

Before placing forms for traffic and pedestrian barriers, the Contractor shall completely release all falsework under spans.

Before releasing forms under concrete cured at temperatures colder than 50 degrees F, the Contractor shall first prove that the concrete is strong enough–regardless of the time that has elapsed.

The Engineer may approve leaving in place forms for footings in cofferdams or cribs. This decision will be based on whether removing them would harm the cofferdam or crib and whether the forms will show in the finished structure.

On concrete box girder structures, the forms supporting the roadway slab shall rest on ledgers or similar supports without being shored to, or supported on, the bottom slab. These form supports shall be fastened as near as possible to the top of the web walls. Unless the Drawings call for their removal, the roadway slab interior forms for concrete box girder structures may be left in place.

All other forms shall be removed whether above or below the level of the ground or water. Sections 6-02.3(7) and 6-02.3(8) govern form removal for concrete exposed to sea water or to alkaline water or soil. The forms inside of hollow piers, girders, abutments, etc. shall be removed through openings provided for that purpose.

6-02.3(18) PLACING ANCHOR BOLTS

The Contractor shall comply with the following requirements in setting anchor bolts in piers, abutments, or pedestals:

(a) If set in the wet concrete, the bolts shall be accurately placed before the concrete is placed. Grouting shall comply with Section 6-02.3(20).
(b) If the bolts are set in drilled holes, hole diameter shall exceed bolt diameter by at least 1 inch.
(c) If the bolts are set in pipe, grouting shall comply with the requirements for grouting shoes in Section 6-02.3(20).
(d) If freezing weather occurs before bolts can be bolted into sleeves, or holes, they shall be filled with an approved antifreeze solution (nonevaporating).

6-02.3(19) BRIDGE BEARINGS

6-02.3(19)A ELASTOMERIC BEARING PADS

The Contractor shall use rubber cement to bond the lower contact surface of elastomeric bearing pads to the structure.

6-02.3(19)B STEEL EXPANSION BEARINGS

For all expansion bearings, sliding or rolling, the Contractor shall:

(a) Machine all sliding and rolling surfaces true, smooth, and parallel to the movement of the bearing;
(b) Polish all sliding surfaces;

(c) Anchor expansion bearings securely, setting them true to line and grade;
(d) Coat all sliding surfaces thoroughly with oil and graphite just before placing them into position; and
(e) Avoid placing concrete in such a way that it might interfere with the free action of any sliding or rolling surface.

Grout placement under steel bearings shall comply with Section 6-02.3(20).

6-02.3(20) GROUT FOR ANCHOR BOLTS AND BRIDGE BEARINGS

Grout shall be a prepackaged grout, mixed, placed, cured as recommended by the manufacturer, or the grout shall be produced using Type II portland cement, fine aggregate Class 1, and water, in accordance with these Specifications.

Grout shall meet the following requirements:

Requirement	Compressive Strength
Test Method	AASHTO T 106
Values	4,000 psi @ 7 days

Grout shall be a workable mix with flowability suitable for the intended application.

If the Contractor elects to use a prepackaged grout, a material sample and laboratory test data from an independent testing laboratory shall be submitted to the Engineer for approval with the request for approval of material sources.

If the Contractor elects to use a grout consisting of Type II portland cement, fine aggregate Class 1, and water, the mix proportions and laboratory test data from an independent test labatory shall be submitted to the Engineer for approval with th request for approval of material sources.

The Contractor shall receive approval from the Engineer before using the grout.

Before placing grout, the concrete on which it is to be placed shall be thoroughly cleaned, roughened, and wetted with water to ensure proper bonding. The grout pad shall be kept continuously wet water until a strength of 2,000 psi is attained.

Before placing grout into anchor bolt sleeves or hole, the cavity shall be thoroghly cleaned, roughened, and wetted to ensure proper bonding.

To grout bridge bearing masonry plates, the Contractor shall:

(a) Build a form approximately 4 inches outside the base of each masonry plate;
(b) Fill each form to the top with grout;
(c) Work grout under all parts of each masonry plate;
(d) Remove each form after the grout has hardened;
(e) Remove the grout outside each masonry plate to the base of the masonry plate;
(f) Bevel off the grout neatly to the top of the masonry; and Place no additional load on the masonry plate until the grot has set at least 72 hours.

After all grout under the masonry plate and in the anchor bolt cavities has attained a minimum strength of 4,000 psi, the anchor bolt nuts shall be tightened to snug-tight. "Snug-tight" mes either the tightness reached by (1) a few blows from an impact wrench, or (2) the full effort of a man using a spud wrench. Once the nut is snug-tight the anchor bolt threads shall be burred just enough to prevent loosening of the nut.

6-02.3(21) DRAINAGE OF BOX GIRDER CELLS

To drain box girder cells, the Contractor shall provide and install, according to details in the Drawings, short lengths of nonmetallic pipe in the bottom slab at the low point of each cell. The pipe shall have a minimum inside diameter of 4 inches. If the difference in plan elevation is 2 inches or less, the Contractor shall install pipe in each end of the box girder cell.

6-02.3(22) DRAINAGE OF SUBSTRUCTURE

The Contractor shall use weep holes and gravel backfill that complies with Section 9-03.12(2) to drain fill material behind retaining walls, abutments, tunnels, and wingwalls. To maintain thorough drainage, weep holes shall be placed as low as possible. Gravel backfill shall be placed and compacted as required in Section 2-09.3(1)E. In addition, if the Drawings require, tiling, French or rock drains, or other drainage devices shall be installed.

If underdrains are not installed behind the wall or abutment, all backfill within 18 inches of weep holes shall comply with Section 9-03.12(4). Unless the Drawings require otherwise, all other backfill behind the wall or abutment shall be gravel backfill for walls.

6-02.3(23) OPENING TO TRAFFIC

Bridges with a roadway slab made of portland cement concrete shall remain closed to all traffic, including construction equipment, until the concrete has attained the minimum ultimate strength. This strength shall be determined with cylinders made of the same concrete as the roadway and cured under the same conditions. A concrete deck bridge shall never be opened to traffic earlier than 10 days after the deck concrete was placed and never before the Engineer has approved.

For load restrictions on bridges under construction, refer to Section 6-01.6.

6-02.3(24) REINFORCEMENT

6-02.3(24)A GENERAL

The Contractor shall furnish a bar list and bending diagram to the Engineer for approval prior to fabrication.

Various steel reinforcing bars, including those in crossbeams, may be shown as straight in the bar list sheets of the plans. The Contractor shall bend these bars as required to conform to the configuration of the structure and as detailed in the Drawings.

6-02.3(24)B FIELD BENDING

If the Drawings call for field bending of steel reinforcing bars, the Contractor shall bend them in keeping with the structure configuration and the Drawings.

Bending steel reinforcing bars partly embedded in concrete shall not be done until the Engineer has given written approval of a field-bending plan from the Contractor. Approval for such bending will be given only for bars smaller than Size No. 14.

Field bending shall not be done:

(a) On bars Size No. 14 or No. 18,
(b) When air temperature is lower than 40 degrees F,
(c) By means of hammer blows or pipe sleeves, or
(d) While bar temperature is in the range of 400 to 700 degrees F.

In field-bending steel reinforcing bars, the Contractor shall:

(a) Make the bend gradually;
(b) Use a bending tool equipped with a bending radius guide of 6 bar diameters for bars Size No. 3 through No. 8 and 8 bar diameters for bars Size No. 9 through No. 11;

(c) Limit any bend to these maximums–135 degrees for bars smaller than Size No. 9, and 90 degrees for bars Size No. 9 through No. 11;
(d) Apply heat as described below in bending bar Sizes No. 7 through No. 11 and in bending bar Sizes Nos. 4, 5, and 6 when the bars have been previously bent. (Previously unbent bars of Sizes Nos. 4, 5, and 6 may be bent without heating.)

In applying heat for field-bending steel reinforcing bars, the Contractor shall:

(a) Use a method that will avoid damages to the concrete;
(b) Insulate any concrete within 6 inches of the heated bar area;
(c) Ensure, by using temperature-indicating crayons or other suitable means, that steel temperature never exceeds the maximum temperatures shown in Table 1 below;
(d) Maintain the steel temperature within the required range shown in Table 1 below during the entire bending process;
(e) Ensure that heating is done uniformly, using two heat-tip sources applied simultaneously at opposite sides of the bar if necessary;
(f) Apply the heat for a long enough time that within the bend area the entire thickness of the bar–including its center–reaches the required temperature;
(g) Heat at least as much of the bar as Table 2 below requires;
(h) Locate the heated section of the bar to include the entire bending length; and
(i) Never cool bars artificially with water, forced air, or other means.

TABLE 1

Preheating Temperatures for Field-Bending Reinforcing Bars

Bar Size	Temperature Min.	Max.
No. 4, No. 5, No. 6	1,100 - 1,200°F	
No. 7, No. 8, No. 9	1,150 - 1,250°F	
No. 10, No. 11	1,200 - 1,300°F	

TABLE 2

Minimum Bar Length to be Heated
(d = nominal diameter of bar in inches)

Bar Size	Bend Angle 45°	90°	135°
No. 3 thru No. 8	6d	9d	12d
No. 9 thru No. 11	8d	12d	Not Permitted

6-02.3(24)C PROTECTION OF MATERIALS

The Contractor shall protect reinforcing steel from all damages. When placed into the structure, the steel shall be free from dirt, loose rust or mill scale, paint, oil, and other foreign matters.

When the Engineer requires protection for reinforcing steel that will remain exposed for a length of time, the Contractor shall protect the reinforcing steel:

(a) By cleaning and applying a coat of paint Formula No. A-9-73 over all exposed surfaces of steel, or
(b) By cleaning and painting paint Formula No. A-9-73 on the first 6 inches of the steel bars protruding from the concrete and covering the bars with polyethylene sleeves.

The paint shall have a minimum dry film thickness of 1 mil.

6-02.3(24)D PLACING AND FASTENING

The Contractor shall position reinforcing steel as the Drawings require and shall ensure that the steel will not be displaced as the concrete is placed.

When spacing between bars is 1 foot or more, they shall be tied at all intersections. When spacing is less than 1 foot, every other intersection shall be tied. If the Drawings require bundled bars, they shall be tied together with wires at least every 6 feet. Wire used for tying epoxy-coated reinforcing steel shall be plastic coated. Tack welding is not permitted on reinforcing steel except as specified in Section 6-02.3(24)F.

Abrupt bends in the steel are permitted only when one steel member bends around another. Vertical stirrups shall pass around main reinforcement or be firmly attached to it.

For slip-formed concrete, the reinforcing steel bars shall be tied at all intersections and crossbraced to keep the cage from moving during concrete placement. Crossbracing shall be with additional reinforcing steel. Crossbracing shall be placed both longitudinally and transversely.

After reinforcing steel bars are placed in a traffic or pedestrian barrier and prior to slip-form concrete placement, the Contractor shall check clearances and reinforcing steel bar placement. This check shall be accomplished by using a template or by operating the slip-form machine over the entire length of the traffic or pedestrian barrier. All clearance and reinforcing steel bar placement deficiencies shall be corrected by the Contractor before slip-form concrete placement.

Mortar blocks (or other approved devices) shall hold all reinforcing steel from the forms so that it does not vary more than 1/4 inch from the positions the Drawings require. These blocks shall:

(a) Measure not more than 2 inches square,
(b) Develop a compressive strength equal to that of the concrete they are embedded in.

In slabs, each mortar cube shall have either: (1) a grooved top that will hold it in place, or (2) an embedded wire that protrudes and is tied to the reinforcing steel. If this wire is used around epoxy-coated bars, it shall be coated with plastic.

Acceptance of mortar blocks shall be based on testing a set of two 2-inch diameter by 4-inch long cylindrical specimens. Each pair of specimens shall represent 2,500 or fewer mortar blocks and shall be made of the same mortar as the blocks and cured under the same conditions. The Contractor may either:

(a) Submit the blocks to the Engineer for preuse testing, or
(b) Submit certification of compliance in keeping with Section 1-06.2.

In lieu of mortar blocks, the Contractor may use metal chair supports to hold the bars. Any surface of a chair support that will not be covered by at least 1/2-inch of concrete shall be either:

(a) Hot-dip galvanized after fabrication in keeping with AASHTO M 232 Class D, or
(b) Coated with plastic firmly bonded to the metal. This plastic shall be at least 3/32-inch thick where it touches the form and shall not react chemically with the concrete when tested in the Materials Laboratory. The plastic shall not shatter or crack at 5 degrees F and shall not deform enough to expose the metal at 200 degrees F.

Stainless steel chair supports that meet the requirements of ASTM A493, Type 302, require neither galvanizing nor plastic coating.

In roadway and sidewalk slabs, the Contractor shall place reinforcing steel mats carefully to provide the required concrete cover. A "mat" is 2 layers of steel. Top and bottom mats shall be supported enough to hold both in their proper positions. If No. 4 bars make up the lower layer of steel in a mat, it shall be blocked at not more than 3-foot intervals (or 4-foot intervals for bars No. 5 and larger). Wire ties to girder stirrups shall not be considered as blocking. To provide a rigid mat, the Contractor shall add other supports and tie wires to the top mat as needed.

If a bar will interfere with a bridge drain, it shall be bent in the field to bypass the drain.

Clearances shall be at least:

(a) 4 inches between: Main bars and the top of any concrete masonry exposed to the action of salt or alkaline water.
(b) 2-1/2 inches between: Adjacent bars in a layer. Slab bars and the top of the roadway slab. Main bars and the surface of concrete deposited against earth (without intervening forms).
(c) 2 inches between: Adjacent layers. Main bars and the surface of concrete (except in walls and slabs). Reinforcing bars and the faces of forms for exposed aggregate finish.
(d) 1-1/2 inches between: Main bars and the surface of concrete in retaining walls. Slab bars and the top of the slab (except roadway slabs). Stirrups and ties and the surface of the concrete.
(e) 1 inch between: Slab bars and the bottom of the slab. Curb or sidewalk bars and the surface of the concrete.

Before placing any concrete, the Contractor shall:

(a) Clean all mortar from reinforcement, and
(b) Obtain the Engineer's permission to place concrete after the Engineer has inspected the placement of the reinforcing steel. (Any concrete placed without the Engineer's permission shall be rejected and removed.)

6-02.3(24)E SPLICING

The Contractor shall supply steel reinforcement bars in the full lengths the Drawings require. Unless the Engineer approves in writing, the Contractor shall not change the number, type, or location of splices.

The Engineer may permit the Contractor to use thermal or mechanical splices in place of the method shown in the Drawings if they are of an approved design. Use of a new design may be granted if:

(a) The Contractor provides technical data and proof from the manufacturer that the design will perform satisfactorily, and
(b) Sample splices and materials from the manufacturer pass the Engineer's tests.

After a design has been approved, any changes in detail or material shall require new approval.

The Contractor shall:

(a) Not lap-splice reinforcing bars Nos. 14 or 18.
(b) Not permit any welded or mechanical splice to deviate in alignment more than 1/4 inch per 3-1/2 feet of bar.
(c) Distribute splices evenly, grouping them together only at points of low tensile stress.
(d) Ensure at least 2 inches clearance between any splice and the nearest bar or the surface of the concrete (or 1-1/2 inches for the length of the sleeve on mechanical splices).
(e) Rigidly clamp or wire all splices in a way the Engineer approves.
(f) Place lap-spliced bars in contact for the length of the splice and tie them together near each end.
(g) Securely fasten the ends and edges of welded-wire-fabric reinforcement, overlapping them enough to maintain even strength.

6-02.3(24)F WELDING REINFORCING STEEL

Welding of steel bars shall comply with the AWS D1.4 Structural Welding Code - Reinforcing Steel, the Drawings, these Specifications, and the Project Manual. In case of conflict, requirements of the latter three shall prevail over the AWS Code.

Welders shall meet the requirements in AWS D1.4 Structural Welding Code - Reinforcing Steel, and shall qualify under the supervision of a WSDOT Materials and Fabrication Inspector.

Steel reinforcing bars to be welded shall be suitable for welding, with a maximum carbon equivalent (C.E.) of 0.65 percent as determined by this formula:

C.E. = %C + %Mn/6 + %Cu/40 + %Ni/20 + %Cr/10 - %Mo/50 - %V/10

In addition, carbon shall not exceed 0.45 percent nor manganese 1.30 percent.

Before any welding begins, the Contractor shall obtain the Engineer's approval of a welding procedure. It shall specify the process, type of equipment, electrode selection, preheat and interpass temperature, any postheat treatment, and any other useful facts. The Contractor may use the form in Appendix A in AWS D1.4 to supply this information.

The Contractor shall not deviate from this approved welding procedure because no practical method exists to test a weld within a structure. To change the approved procedure part way through a project, the Contractor shall submit the revised process to the Engineer for approval. This approval will require test welds. The revised procedure shall not be implemented until the Engineer's written approval is received.

Unless the Engineer approves in writing, the Contractor shall not add to, delete from, or relocate the welds shown in the Drawings.

If back-up plates and runoff plates are tack welded to the reinforcing bar, the tack weld shall be placed so that the final weld consumes it. No other tack welds shall be permitted.

All welding shall be protected from air currents, drafts, and precipitation to prevent loss of heat or arc shielding. Reinforcing bars shall not be field welded while the air is below 32 degrees F.

The ground wire from the welding machine shall be clamped to the bar being welded.

Preheat and interpass temperature shall be at least 400 degrees F for Grade 60 bars. The Contractor shall apply the preheat to the weld area and to the bar or any other splice member within 6 inches of the weld. This distance may be modified if lengths of bars or splice members require.

Postheating of welded splices is required on direct butt-welded splices on Grade 60 bars and sizes No. 9 and larger. These splices shall be postheated immediately after welding, before the splice has cooled to 700 degrees F. The Contractor shall postheat the weld area to between 800 and 1,000 degrees F. The temperature shall remain within this range for at least 10 minutes before the splice is allowed to cool naturally to air temperature.

Weld splices on which postheating is not required shall be allowed to cool naturally to air temperature without accelerated cooling.

6-02.3(24)G MECHANICAL SPLICES

The Contractor shall form mechanical splices with an Engineer-approved system using sleeve filler metal, threaded coupling, or another method that complies with this section.

If necessary to maintain required clearances after the splices are in place, the Contractor shall adjust, relocate, or add stirrups, ties, and bars.

Before splicing, the Contractor shall provide the Engineer with the following information for each shipment of splice material:

(a) The type or series identification (and heat treatment lot number for threaded-sleeve splices),
(b) The grade and size of bars to be spliced,
(c) A manufacturer's catalog with complete data on material and procedures,
(d) A written statement from the manufacturer that the material is identical to that used earlier by the Engineer in testing and approving the system design, and
(e) A written statement from the Contractor that the system and materials will be used according to the manufacturer's instructions and all requirements of this section.

All splices shall meet these criteria:

(a) Tension splices shall develop at least 130 percent of the yield tensile strength specified for the unspliced bar. The ultimate tensile strength of the sleeve shall exceed that of the other parts of the completed splice.
(b) AASHTO M 31 bars within a splice sleeve shall not slip more than 0.045 inch for Grade 60 bars. This slippage shall be measured between gage points clear of the splice sleeve. Measurements shall be taken once after loading to 90 percent of the minimum yield tensile strength specified for the unspliced bar and relaxing to 3,000 psi.
(c) Maximum allowable bar size:

(1) Mechanical butt splice	No. 14 bar
(2) Mechanical lap splice	No. 6 bar

The Engineer will visually inspect the splices and accept all that appear to conform with the test samples. For sleeve-filler splices, the Engineer will allow voids within the limits on file in the design approval. If the Engineer considers any splice defective, it shall be removed and replaced.

In preparing sleeve-filler metal splices, the Contractor shall:

(a) Clean the bar surfaces by: (1) oxyacetylene torch followed by power wire brushing, or (2) abrasive blasting;
(b) Remove all slag, mill scale, rust, and other foreign matter from all surfaces within and 2 inches beyond the sleeve;
(c) Grind down any projection on the bar that would prevent placing the sleeve;
(d) Prepare the ends of the bars as the splice manufacturer recommends and as the approved procedure requires; and
(e) Preheat, just before adding the filler, the entire sleeve and bar ends to 300 degrees F, plus or minus 50 degrees F. (If a gas torch is used, the flame shall not be directed into the sleeve.)

When a metallic, sleeve-filler splice is used (or any other system requiring special equipment), both the system and the operator shall qualify in the following way under the supervision of the City Materials and Fabrication Inspector. The operator shall prepare 6 test splices (3 vertical, 3 horizontal) using bars having the same AASHTO Designation and size (maximum) as those to be used in the work. Each test sample shall be 42 inches long, made up of two 21-inch bars joined end-to-end by the splice. The bar alignment shall not deviate more than 1/8 inch from a straight line over the whole length of the sample. All 6 samples must meet the tensile strength and slip criteria specified in this section.

The Contractor shall provide labor, materials, and equipment for making these test sample splices and the Owner will test the samples.

6-02.3(24)H JOB CONTROL TESTS

As the work progresses, the Engineer may require the Contractor to provide a sample splice (thermal or mechanical) to be used in a job control test. The operator shall create this sample on the job site with the Engineer present using bars of the same size as those being spliced in the work. The sample shall comply with all requirements of these Specifications, and is in addition to all other sample splices required for qualification. The Engineer will require no more than two satisfactory samples on any project with fewer than 200 splices and no more than one satisfactory sample per 100 splices on any project with more than 200 splices.

6-02.3(24)I EPOXY-COATED STEEL REINFORCING BAR

This work is furnishing, fabricating, coating, and placing epoxy-coated steel reinforcing bars as shown in the Drawings, these Specifications, and the Project Manual. Coating material shall be applied electrostatically, by spraying, or by the fluidized-bed method.

All epoxy-coated bars shall comply with the requirements of Section 9-07. Fabrication may occur before or after coating.

The Contractor shall protect epoxy-coated bars from damage using padded or nonmetallic slings and straps free from dirt or grit. To prevent abrasion from bending or sagging, the Contractor shall lift bundled bars with a strongback, multiple supports, or a platform bridge. Bundled bars shall not be dropped or dragged. During shop or field storage, bars shall rest on wooden or padded cribbing. The Contractor may substitute other methods for protecting the bars if the Engineer approves. If the Engineer determines the coated bars have been badly damaged, they will be rejected.

Metal chairs and supports shall be coated with epoxy (or another inert coating if the Engineer approves). The Contractor may use other support devices with the Engineer's approval. Plastic coated tie wires (approved by the Engineer) shall be used to protect the coated bars from being damaged during placement.

The bars shall be placed as the Drawings require and held firmly in place during placing and setting of the concrete. All epoxy-coated bars in the top mat of the roadway slab shall be tied at all intersections. Other epoxy-coated bars shall also be tied at all intersections except when spacing is less than 1 foot in each direction, they shall be tied at alternate intersections.

In the interval between installing coated bars and concreting the deck, the Contractor shall protect the coating from damage that might result from other construction work.

The Engineer will inspect the coated bars after they are placed and again before the deck concrete is placed. The Contractor shall patch any areas that show significant damage (as defined below).

Significant damage means any opening in the coating that exposes the steel in an area that exceeds:

(a) 0.05 square inch (approximately 1/4 inch square or 1/4 inch in diameter or the equivalent).
(b) 0.012 square inch (approximately 1/8 inch square or 1/8 inch in diameter) when the opening is within 1/4 inch of another opening of equal or larger size.
(c) 6 inches long, any width.
(d) 0.50 square inch aggregate area in any 1-foot length of bar.

The Contractor shall patch significantly damaged areas with Engineer-approved patching material obtained from the epoxy resin manufacturer. This material shall be compatible with the coating and inert in concrete. Areas to be patched shall be clean and free of surface contaminants. Patching shall be done before oxidation occurs and according to the resin manufacturer's instructions.

6-02.3(25) PRESTRESSED CONCRETE GIRDERS

6-02.3(25)A GENERAL

The concrete in piers and crossbeams shall have reached at least 80 percent of design strength before girders are placed on them. The Contractor shall hoist girders only by the lifting strands at the ends, always keeping the girders plumb and upright.

Instead of the oak block wedges shown in the Drawings, the Contractor may use Douglas fir blocks if the grain is vertical.

Before the grout pads are placed, the concrete beneath them shall be thoroughly cleaned, roughened, and wetted with water to ensure proper bonding. Pads shall be kept wet continuously until they reach a compressive strength of at least 2,000 psi. Grout pads shall have reached this strength before girders are set on them. Grout compressive strength will be determined by fabricating cubes in accordance with WSDOT Test Method 813 and testing in accordance with AASHTO T 106.

All plants fabricating prestressed concrete products for City of Seattle projects shall be currently certified under the "Prestressed Concrete Institute Certification Program". Proof of plant certification by PCI shall be submitted along with the shop drawings by the Contractor to the Engineer.

6-02.3(25)B BULB TEE GIRDER FLANGE CONNECTION

On bulb tee girders, camber shall be equalized before adjacent girders are weld-tied and before keyways are filled. Keyways between tee girders shall be filled flush with the surrounding surfaces with grout. This grout shall have reached a compressive strength of 3,000 psi before the equalizing equipment is removed. Compressive strength will be determined by fabricating cubes in accordance with WSDOT Test Method 813 and testing in accordance with AASHTO Test T 106.

Welding grounds shall be attached directly to the steel plates being welded when welding the weld-ties on prestressed concrete bulb tee girders.

Only after the grout in the keyways has reached 3,000 psi and after girders have been weld-tied will construction equipment (other than equalizing apparatus) be allowed on the deck.

6-02.3(25)C PROTECTION OF EXPOSED REINFORCEMENT

From manufacture to encasement in concrete, all reinforcement used in girders shall be protected against dirt, grease, damage, rust, and all corrosives. If the steel has been damaged, it will be rejected. The Engineer may reject the steel if it shows rust or corrosion.

When a girder is removed from its casting bed, all bars and strands projecting from the girder shall be cleaned and painted with a minimum dry film thickness of 1 mil of paint Formula No. A-9-73. During shipping and handling, projecting reinforcement shall be protected from bending or breaking. Just before placing concrete around the painted projecting bars or strands, the Contractor shall remove from them all dirt, oil, and other foreign matter.

6-02.3(25)D CASTING AND SHOP DRAWINGS

The Drawings show design conditions for prestressed girders. Deviations from prestressing details shown in the Drawings will not be permitted, except as specified.

For Series 14 girder, if reinforcing steel is adjusted in the end block area to provide the clearance the Drawings require, the Contractor may change the width of the end block to 1 foot 4 inches.

Before casting girders, the Contractor shall provide 4 copies of the fabrication drawings to the Engineer for approval. If hold down devices have not been approved earlier, these must also be approved before fabrication. Only steel side forms will be approved, but plywood forms on the bottom and end bulkheads are acceptable. Approval of Shop Drawings means only that the Engineer accepts the methods and materials. Approval does not imply correct dimensions.

Unless the Drawings permit, no welds will be permitted on steel bars within prestressed girders. Once the prestressing steel has been installed, no welds or welding grounds shall be made on the forms or the steel in the girder.

The Contractor may form circular blockouts in the top girder flanges to receive falsework hanger rods. These blockouts shall:

(a) Not exceed 1 inch in diameter,
(b) Be spaced no more than 72 inches apart lengthwise on the girder,
(c) Be located more than 3 inches from the outside edge of the top flange on Series 4 through 10 girders (more than 6 inches for Series 14 girders).

The circular blockouts are also allowed in the webs of the prestressed concrete girders to support brackets for roadway slab falsework. The blockouts in the webs shall be not more than 1 inch in diameter, spaced at 6 feet-0 inches maximum longitudinally and positioned so as to clear the girder reinforcing and prestressing steel.

The Contractor, at his option, may furnish prestressed concrete girders Series 14 with minor dimension differences from those shown in the Drawings.

The dimensions that may be changed are the 2-5/8 inch top flange taper which may be reduced to 1-5/8 inch and the 5-inch web width may be increased to 6 inches. The overall height and width of the girder shall remain unchanged. Other dimensions of the girder shall be adjusted as necessary to accommodate the above mentioned changes.

If the Contractor elects to provide a Series 14 girder with minor dimension differences as specified, shop drawings along with supporting design calculations shall be submitted to the Engineer for approval prior to girder fabrication. The girder shall be designed for at least the same load carrying capacity as the girder shown in the Drawings. The amount of mild steel reinforcement shall be the same as that shown in the Drawings.

6-02.3(25)E CURING

While side forms remain in place, the top of the girder shall be kept continuously wet. The Contractor may strip side forms once the concrete has reached a compressive strength of 3,000 psi. Any damage from stripping is the Contractor's responsibility. From form stripping until the concrete reaches the required release strength, the entire surface of the girder shall be covered with a curing pad and kept continuously wet.

If the Engineer approves, the Contractor may shorten curing time by heating the outside of impervious forms. Heat may be radiant, convection, conduction, steam, or hot air. With steam, the arrangement shall envelop the entire surface with saturated steam. The Engineer will not permit hot air curing until after approving the Contractor's proposed method to envelop and maintain the girder in a saturated atmosphere. "Saturated atmosphere" means heated air admitted at either end of the girder always remains at a relative humidity of at least 90 percent. The Contractor shall never allow dry heat to touch the girder surface at any point.

Under any heat curing method, the Contractor shall:

(a) Keep any unformed girder surface in a water saturated atmosphere throughout the curing time;

(b) Embed a thermocouple (linked with a thermometer accurate to plus or minus 5 degrees F) 6 to 8 inches from the top or bottom of the girder on its centerline and near its midpoint;
(c) Monitor with a recording sensor (accurate to plus or minus 5 degrees F) arranged and calibrated to continuously record, date, and identify concrete temperature throughout the heating cycle;
(d) Make this temperature record available for the Engineer to inspect;
(e) Heat concrete to no more than 100 degrees F during the first 2 hours after pouring the concrete;
(f) Raise concrete temperature no more than 25 degrees F per hour to a maximum of 175 degrees F after the first 2-hour period;
(g) Cool concrete, after curing is complete, at a rate no more than 25 degrees F per hour to 100 degrees F; and
(h) Keep the temperature under the enclosure above 60 degrees F until the girder reaches release strength.

If, based upon the Contractor's monitoring record, the Engineer believes the girder will cool to 100 degrees F at a rate no more than 25 degrees F per hour, monitoring may end when prestressed strands are released. But if the windchill factor is below 32 degrees F, monitoring must continue until the concrete has cooled to 100 degrees. Should the cooling rate exceed 25 degrees per hour, the Contractor shall protect the girder so that the rate returns to 25 degrees per hour or less.

6-02.3(25)F PRESTRESSING

If the Drawings require 1/2-inch strands, each strand shall have an initial tensile force of 28,900 pounds.

Each tendon-stressing jack shall have a pressure gauge or load cell that will measure jacking force. Any gauge shall display pressure accurately and readably with a dial at least 6 inches in diameter or with a digital display. Each jack and its gauge shall be calibrated as a unit and shall be accompanied by a certified calibration chart. The Contractor shall provide one copy of this chart to the Engineer for use in monitoring. The cylinder extension during calibration shall be in approximately the position it will occupy at final jacking force.

Any jack and gauge must be recalibrated and recertified: (1) at least every 180 days, and (2) after any repair or adjustment. The Engineer may use pressure cells to check jacks, gauges, and calibration charts before and during tensioning.

Any load cell shall be calibrated and shall have an indicator that shows prestressing force in the tendon. The range of this cell must be broad enough that the lowest 10 percent of its manufacturer's rated capacity will not be used to measure jacking force.

If tendons in the stressing bed will be exposed to outdoor weather for more than 36 hours before they are encased in concrete, the Contractor shall protect them from contamination or corrosion. Any protection method will require the Engineer's approval.

Side and flange forms that restrain deflection shall be removed before release of any pretensioning reinforcement.

All harped and straight strands shall be released in a way that will produce the least possible tension in the concrete. This release shall not occur until tests show each girder has reached the minimum compressive strength the Drawings require. These tests shall be carried out on concrete cylinders made of the same concrete as the girders and cured under the same conditions.

6-02.3(25)G FINISHING

The Contractor shall apply a Class 2 finish, as defined in Section 6-02.3(14), to: (1) the vertical, outside surfaces of the outside girders; (2) the bottoms, sides, and tops of the lower flanges on all girders; and (3) the bottom of the roadway flange of each outside bulb tee girder section. All other girders surfaces shall receive a Class 3 finish.

The interface on I-girders and others that will support a composite, cast-in-place deck shall have a finish of dense, screeded concrete without any smooth sheen from excess laitance. After vibrating and screeding and just before the concrete reaches initial set, the Contractor shall texture the interface. This texture shall be applied with a steel brooming tool that scratches the surface crosswise leaving grooves between 1/8- and 1/4-inch deep spaced 1/4- to 1/2-inch apart.

On the bulb tee girder section, the Contractor shall test the roadway flange deck surface for flatness. This test shall occur after floating but while the concrete remains plastic. Testing shall be done with a 10-foot straightedge both parallel and at right angles to the girder centerline. The Contractor shall fill depressions, cut down high spots, and refinish to correct any deviation of more than 1/8-inch within the 10 feet. This section of the roadway surface shall be finished to meet the requirements for finishing roadway slabs.

The Contractor may, while the Engineer observes, repair rock pockets and other minor, nonstructural defects in the girders. But any girder repaired without the Engineer's approval and surveillance will be rejected, no matter how large or small the repair.

If no overlay will be placed on the bulb tee girder section, the Contractor shall add an air-entraining mixture to the top 2 inches of the roadway deck flange. Enough mixture shall be added to induce 5 percent (plus or minus 1-1/2 percent) air. No air-entraining admixture is needed in bulb tee girders that will receive overlays.

6-02.3(25)H HANDLING AND STORAGE

During handling, each girder shall always be kept plumb and upright. It shall be lifted only by the lifting strands at both ends.

Before moving a long girder, the Contractor shall check it for any tendency to buckle sideways. Each girder that may buckle shall be braced on the sides to prevent bending as it is hauled and put in place. This bracing shall be attached securely to the top flanges of the girder. Girders shall be braced laterally to prevent tipping or buckling as specified in the Drawings. The lateral bracing shall be in place during all lifting or handling necessary for transportation from the fabricating plant to the job site and erection of the girder at the job site. The Contractor is cautioned that for some delivery routes more conservative guidelines for lateral bracing may be required. Before removing the bracing to cast diaphragms, the Contractor shall fasten all girders in place by other means.

If the Contractor wishes to deviate from these handling and bracing requirements, the vertical pickup, or the pickup location, the proposed method shall be analyzed by the Contractor's engineers and submitted with the supporting calculations to the Engineer for approval. The Contractor's analysis shall conform to Articles 5.2 and 5.3 of the P.C.I. Design Handbook (Precast and Prestressed Concrete), Third Edition, or other approved methods. The Contractor's calculations must verify that the concrete stresses in the prestressed girder do not exceed those listed in Section 6-02.3(25)K and shall be submitted to the Engineer for approval.

If girders are to be stored, the Contractor shall place them on a stable foundation that will keep them in a vertical position. Stored girders shall be supported at the bearing recesses or, if there are no recesses, approximately 18 inches from the girder

ends. For long-term storage of girders with initial horizontal curvature, the Contractor may wedge one side of the bottom flange, tilting the girders to control deflection. If the Contractor elects to set girders out of plumb during storage, the Contractor shall have the proposed method analyzed by his/her engineers to ensure against damaging the girder.

6-02.3(25)I TOLERANCES

The Engineer may reject any girder not fabricated within the tolerances listed below. Actual acceptance or rejection will depend on how the Engineer believes a defect outside these tolerances will affect the structure's strength or appearance:

(a) Length (overall): ± 1/4 inch per 25 feet of beam length, up to a maximum of ± 1 inch.
(b) Width (flanges): +3/8 inch, - 1/4 inch.
(c) Width (narrow web section): + 3/8 inch, - 1/4 inch.
(d) Girder Depth (overall): + 1/2 inch, - 1/4 inch.
(e) Flange Depth: ± 1/8 inch.
(f) Strand Position: ± 1/4 inch from center of gravity of the strand group and individual strands.
(g) Longitudinal Position of Deflection Points for Deflected Strands: ± 12 inches.
(h) Bearing Recess (center recess to end beam): ± 1/4 inch.
(i) Beam Ends (deviation from square or designated skew)
Horizontal: ±1/2 inch from web centerline to flange edge
Vertical: ± 1/8 inch per foot of beam depth.
(j) Bearing Area Deviation from Plane (in length or width of bearing): 1/16 inch.
(k) Stirrup Reinforcing Spacing: ± 1 inch.
(l) Stirrup Projection from Top of Beam: ± 3/4 inch.
(m) Mild Steel Concrete Cover: - 1/8 inch, + 3/8 inch.
(n) Offset at Form Joints (deviation from a straight line extending 5 feet on each side of joint): ± 1/4 inch.
(o) Differential Camber Between Girders in a Span (measured in place at the job site)
For I-girders: 1/8 inch per 10 feet of beam length (series 4, 6, 8, 10, and 14)
For bulb tee girders: Cambers shall be equalized by an approved method when the difference in cambers between adjacent girders or stages measured at mid-span exceeds 1/4 inch (for girders with asphalt overlay) and 1/8 inch (for girders without asphalt overlay).
(p) Position of Inserts for Structural Connections: ± 1/2 inch.
(q) Position of Lifting Loops: ± 3 inches lengthwise, ± 1 inch crosswise.

6-02.3(25)J HORIZONTAL ALIGNMENT

At four separate times, the Contractor shall check the horizontal alignment of both top and bottom flanges of each girder: (1) just after removing the girder from the casting bed, (2) during storage, (3) the day before the girder is shipped to the job site, and (4) just before placing concrete into the structural diaphragms. Each check shall be made by measuring the distance between each flange and a chord that extends from one end of the girder to the other. The Contractor shall perform and record each check in the presence of the Engineer at a time when the alignment of the girder is not affected by temporary differences in surface temperature.

Immediately after the girder is removed from the casting bed, neither flange shall be offset more than 1/8 inch per 10 feet of girder. The offset shall be measured from a chord that extends end to end of the girder. (For example, on a 100-foot girder, 10 times 1/8 inch would yield a maximum allowable offset of 1-1/4 inches.)

During storage and prior to shipping, the offset (with girder ends plumb and upright and with no external force) shall not exceed 1/4 inch per 10 feet of girder length. Any girder within this tolerance may be shipped, but must be corrected at the job site before concrete is placed into the diaphragms. Correction must restore the girder to the 1/8 inch per 10 feet maximum offset.

The Engineer may permit the use of external force to correct alignment at the plant or job site if the Contractor provides stress calculations and a proposed procedure. If external force is permitted, it shall not be released until after the roadway slab has been placed and cured 10 days.

The Engineer may reject any girder that does not meet the requirements of this Section.

6-02.3(25)K SHIPPING

No prestressed girders shall be shipped until cylinder tests show that the girder has reached the compressive strength required in its design (f'c). These test cylinders shall be made of the same concrete and cured under the same conditions as the girder being shipped. No bulb tee girder shall be shipped for at least 7 days after concrete placement. No other girder shall be shipped for at least 10 days after concrete placement.

Girder support during shipping shall meet these requirements:

Type of Girder	Supported Within This Distance From Either End
Series 4, 6, and 8 and all bulb tee girders	3 feet
Series 10	4 feet
Series 14	5 feet

If the Contractor wishes to use other support locations, they shall be proposed to the Engineer in accordance with Section 6-02.3(16)A. The Contractor's proposal must include calculations showing concrete stresses in the girders will not exceed those listed below:

CRITERIA FOR CHECKING GIRDER STRESSES AT THE TIME OF LIFTING OR TRANSPORTING AND ERECTING

Stresses at both support and harping points must be satisfied based on these criteria:

(a) Concrete strength at time of lifting or transporting, f'cm.
f'cm = compressive strength at time of lifting or transporting verified by test but shall not exceed design compressive strength (f'c) at 28 days in psi + 1,000 psi.
(b) Allowable compression stress, fc = 0.60 f'cm.
(c) Allowable tension stress, ft.
(1) With no bonded reinforcement = 3 times the square root of f'cm.
(2) With bonded reinforcement to resist total tension force in the concrete computed on the basis of an uncracked section = 7.5 times the square root of f'cm. The allowable tensile stress in reinforcement is 30 ksi (ASTM A615 Gr. 60).
(d) Prestress losses
1 day to 1 month = 20,000 psi
1 month to 1 year = 35,000 psi
1 year or more = 45,000 psi (max.)
(e) Impact on dead load
Lifting from casting beds = 0%
Transporting and erecting = 20%

6-02.3(25)L STRENGTH

Concrete strength shall be measured on test cylinders cast from the same concrete as that in the girder. These cylinders shall be cured under time-temperature relationships and conditions that simulate those of the girder. If the forms are heated by steam or hot air, test cylinders will remain in the coolest zone throughout curing. If forms are heated another way, the Contractor shall provide a record of the curing time-temperature relationship for the cylinders for each girder to the Engineer. When two or more girders are cast in a continuous line and in a continuous pour, a single set of test cylinders may represent all girders provided the fabricator demonstrates uniformity of casting and curing to the satisfaction of the Engineer.

Under the surveillance of the Inspector, the Contractor shall mold, cure, and test enough of these cylinders to satisfy specification requirements for measuring concrete strength. The Contractor shall follow procedures required by the Materials Laboratory. If heat is used to shorten curing time, the Contractor shall let cylinders cool for at least 1/2 hour before capping. Sulphur caps shall be allowed to cure 1/2 hour before testing. If the Headquarters Materials Engineer approves, the Contractor may use other capping methods.

To measure concrete strength in the girder, the Contractor shall randomly select two test cylinders and average their compressive strengths. If the fabricator casts cylinders to represent more than one girder, all girders in that line shall be cored. The compressive strength in either cylinder shall not fall more than 5 percent below the requirement. If these two cylinders do not pass the test, two other cylinders shall be selected and tested.

If too few cylinders were molded to carry out all required tests on any girder, the Contractor shall remove and test cores from the girder under the surveillance of the Engineer. If the fabricator casts cylinders to represent more than one girder, all girders in that line shall be cored. These cores shall measure 4 inches in diameter x 5 inches high and shall be removed from just below the top flange, one approximately 3 feet to the left and the other approximately 3 feet to the right of the midpoints of the girders. After capping these cores (without any other conditioning), the Contractor shall test them using the same methods as for testing cylinders. The Engineer may accept the girder if these cores have the required compressive strength.

The Contractor shall coat any coring hole with an approved epoxy and patch it, before release of prestress, with the same concrete as that in the girder. The girder shall not be shipped until tests show the patches have reached the required strength.

6-02.3(25)M BULB TEE GIRDER DIMENSIONS

The Contractor may alter bulb tee girder dimensions as specified, from that shown in the Drawings if:

(a) The girder has the same or higher load carrying capacity (using current AASHTO Design Specification);
(b) The Engineer approves, before the girder is made, complete design calculations for the girder by a Professional Engineer licensed in the State of Washington and shall bear his/her signature and seal.
(c) The depth of the girder is not increased by more than 2 inches with minimum clearance provided for railroads or highways below, and is not decreased;
(d) The Contractor adjusts substructures to yield the same top of roadway elevation shown in the Drawings.
(e) The web thickness is not increased by more than 1 inch and is not decreased;
(f) The top flange minimum thickness of the girder is not increased by more than 2 inches, providing the top flange taper depth is decreased a corresponding amount;
(g) The top flange taper depth is not increased by more than 1 inch.
(h) The bottom flange width is not increased by more than 2 inches.

6-02.3(25)N GIRDER DEFLECTION

The "D" dimensions shown in the Drawings are computed girder deflections at mid-span based on a time elapse of 90 days after release of the prestressing strands. A positive (+) "D" dimension indicates an upward deflection. The "A" dimensions shown in the Drawings are based on the girder deflection at 90 days.

The Contractor shall control the deflection of prestressed concrete girders that are to receive a cast-in-place slab by scheduling fabrication or other means. The actual girder deflection at the mid-span may vary from the "D" dimension by a maximum of plus 1/2 inch for girder lengths up to 80 feet and plus 1 inch for girder lengths over 80 feet at the time of slab forming. The method used by the Contractor to control the girder deflection shall not cause damage to the girders or any overstress when checked in accordance with the AASHTO Specifications. Any girder which does not meet the preceding requirements is subject to rejection.

6-02.3(26) CAST-IN-PLACE PRESTRESSED CONCRETE

6-02.3(26)A GENERAL

Cast-in-place prestressed concrete shall be Class AX mix (unless the Drawings show otherwise). It shall be air-entrained, but shall not contain air-entraining cement.

The Contractor shall construct supporting falsework in a way that leaves the superstructure free to contract and lift off the falsework during post-tensioning. Forms that will remain inside box girders to support the roadway slab shall, by design, resist girder contraction as little as possible.

Before tensioning, the Contractor shall remove all side forms from girders. Construction loads and other live loads shall not be allowed on the superstructure nor shall the falsework supporting the superstructure be released until the job-cured 2-inch cubes of grout reach a minimum compressive strength of 800 psi nor until other conditions of the Specifications have been met.

Once the prestressing steel is installed, no welds or welding grounds shall be attached to metal forms, structural steel, or reinforcing bars of the structural member.

The Contractor shall not stress the strands until all concrete has reached a compressive strength of at least 4,000 psi (or the strength shown in the Drawings). This strength shall be measured on concrete test cylinders made of the same concrete cured under the same conditions as the cast-in-place unit.

All post-tensioning shall be completed before sidewalks and barriers are placed.

6-02.3(26)B SHOP DRAWINGS

Before casting the structural elements, the Contractor shall submit for approval, in accordance with Section 6-02.3(16)A, complete details of the method, materials, and equipment he proposes to use in the prestressing operations.

In addition, the Contractor shall provide the Engineer with Shop Drawings which shall show:

(a) The method and sequence of stressing.
(b) Technical data on tendons and steel reinforcement, anchoring devices, anchoring stresses, types of tendon conduit, and all other data on prestressing operations.

(c) Separate stress and elongation calculations for each tendon if the difference in tendon elongations exceeds 2 percent.
(d) That tendons in the bridge will be arranged to locate their center of gravity as the plans require.
(e) Details of additional or modified reinforcing steel required by the stressing system.

Approval of these Shop Drawings will mean only that the Engineer considers them to show a reasonable approach in enough detail. Approval will not indicate a check on dimensions.

Couplings or splices will not be permitted in prestressing strands. Couplings or splices in bar tendons are subject to the Engineer's approval.

Friction losses in post-tensioning steel shall be based on wobble and curvature coefficients determined by the post-tensioning system supplier and shall be verified during the stressing operations at the job site. The values of these coefficients assumed for design are shown in the Drawings.

The Contractor shall determine all points of interference between the mild steel reinforcement and the paths of the post-tensioning tendons. Details to resolve interferences shall be submitted with the shop plans for approval. Where reinforcing bar placement conflicts with post-tensioning tendon placement, the tendon profile shown in the Drawings shall be maintained. Mild steel reinforcement for post-tensioning anchorage zones shall not be fabricated until after the post-tensioning shop drawings have been approved by the Engineer.

The Contractor may deviate from the approved Shop Drawings only after obtaining the Engineer's approval of a written request that describes the proposed changes. Approval of a change in method, material, or equipment shall not relieve the Contractor of any responsibility for completing the work successfully.

Before completion of the project, the Contractor shall provide the Engineer with reproducible originals of the Shop Drawings (and any approved changes). These shall be clear, suitable for microfilming, and on permanent sheets that conform with the size requirements of Section 1-05.3.

6-02.3(26)C ANCHORAGES

Post-tensioning reinforcement shall be secured at each end by means of an approved anchorage device which shall be of such a nature that it will not kink, neck down, or otherwise damage the post-tensioning reinforcement. The anchorage assembly shall be grouted to the Engineer's satisfaction.

Anchorage zone grid reinforcement required shall be calculated by the post-tensioning system supplier and shall be shown in the shop plans. The anchorage zone grid reinforcement shall be furnished and installed by the contractor, in addition to the structural reinforcement required by the Drawings at no additional cost to the State. The calculation for the required anchorage zone grid reinforcement shall be in accordance with the bursting stress formula and procedure outlined in the Post-Tensioning Institute publication titled "Post-Tensioned Box Girder Bridge Manual," 1978 Edition.

The Contractor shall submit details, certified tests reports and/or supporting calculations as specified below, which verify the structural adequacy of the anchorage devices for approval by the Engineer. This requirement does not apply where the anchorage devices have been previously approved by WSDOT for the same structure configuration. The Contractor shall also submit any necessary changes to the contract Plans. The test report shall specify all pertinent test data. Dead ended anchorages will not be permitted. Dead ended anchorages are defined as anchorages that cannot be accessed during the stressing operations.

The Contractor's proposed anchorage devices shall meet the requirements listed in (a) or (b) below:

(a) Bearing Type Anchorage:

(1) The computed average bearing stress on the concrete directly beneath bearing plates shall not exceed either of the following:
a. At service load (after all losses)
$f_{cp} = 0.6\, f'_c \sqrt{A'_b/A_b}$ but not greater than $1.25\, f'_c$.
b. At jacking load (before seating)
$f_{cp} = 0.8\, f'_{ci} \sqrt{A'_b/A_b - 0.2}$ but not greater than $1.25\, f'_{ci}$ for longitudinal tendons anchored in the webs and not greater than $1.00\, f'_{ci}$ for transverse tendons anchored in the deck slab, where:

f_{cp} = permissible compressive concrete stress,

f'_c = compressive strength of concrete,

f'_{ci} = compressive strength of concrete at time of initial prestress,

A'_b = Maximum area of the portion of the concrete anchorage surface that is geometrically similar to and concentric with the area of the anchorage (excluding openings),

A_b = bearing area of the anchorage excluding openings.

(2) The computed bending stresses in the distribution plate induced by the pull of the prestressing steel shall not exceed 90 percent of the yield point of the material when 95 percent of the ultimate strength of the post-tensioning reinforcement is applied. The bending stresses in the distribution plate shall be computed in accordance with the procedure describe din the article title "Simplified Bearing Plate Computations for Post-Tensioning Anchorages" published in the July-August 1975 edition of the PCI Journal, and these calculations shall be submitted with the shop drawings for approval.
(3) Materials and workmanship shall conform to the applicable requirements of Sections 6-03 and 9-06.

(b) Other Anchorage Assemblies:

Other anchorage assemblies shall be defined as an assembly that does not meet the requirements of item (a) above for bearing type anchorages. The adequacy of other anchorage assemblies shall be demonstrated by tests representing actual job site conditions. The tests shall be certified and meet the following requirements:

(1) The concrete test block shall have a cross-section equal to twice the minimum edge distance of center line of tendon to the face of concrete in the actual structure in one direction and equal to the minimum spacing of the anchorages plus 3 inches in the other direction. The length of the concrete test block shall be at least three times the largest cross-section dimension.
(2) The reinforcement in the test block behind the anchorage for a distance equal to the largest of the two cross-sectional dimensions of the anchorage shall simulate the actual reinforcement used in the structure. For the remaining length of the test block, the reinforcement may be increased as required to prevent failure in that portion.
(3) Concrete strength at the time of testing shall not exceed 85 percent of the minimum concrete strength at the time of post-tensioning as specified in the

Drawings. The concrete strength shall be determined in accordance with procedures as outlined in ASTM C 1074, Estimating Concrete Strength by the Maturity Method.

(4) The test shall be comprised of three anchorages separately tested or tested together in one test block.

(5) Anchorages shall be capable of developing 95 percent of the ultimate strength of the post-tensioning reinforcement without measurable permanent distortion of the assembly and without concrete failure in the test block. Measurable permanent distortion is defined as a distortion across the face of the assembly of 0.01 inch or more using the original plane as a reference and is measured after the test loading is released. The test block shall be acceptable with regard to concrete failure if the following criteria are satisfied.

a. No concrete cracks with a load of 40 percent of the ultimate strength of the post-tensioning reinforcement.
b. Width of concrete cracks with a test load of 70 percent of the ultimate strength of the post-tensioning reinforcement does not exceed 0.005 inch.
c. After loading to 95 percent of the ultimate strength of the post-tensioning reinforcement and releasing the test load, the width of concrete cracks does not exceed 0.015 inch.

(6) Materials and workmanship shall conform to the applicable requirements of Sections 6-03 and 9-06.

Before installing the anchorage device, the Contractor shall submit a Manufacturer's Certificate of Compliance for the anchorage device in accordance with Section 1-06.3.

6-02.3(26)D METAL CONDUIT

The Contractor shall encase each tendon in a galvanized, ferrous metal conduit that is rigid and spiral. This conduit shall maintain the required profile within a placement tolerance of ± 1/4 inch for longitudinal tendons and ± 1/8 inch for transverse slab tendons, during all phases of the work. The conduit shall be completely sealed to keep out all mortar.

Each conduit shall be located to place the tendon at the center of gravity the Drawings require. To keep friction losses to a minimum, the Contractor shall install conduits to the exact lines and grades shown in the Drawings. Once in place, the conduits shall be tied firmly in position before they are covered with concrete. During concrete placement, the conduits shall not be displaced or damaged.

The ends of the conduits shall:

(a) Permit free movement of anchorage devices, and
(b) Remain covered after installation in the forms to keep out all water or debris.

The Contractor shall install vents at high points and drains at low points of the tendon profile (and at other places if the Drawings require). Vents and drains shall be 1/2 inch minimum diameter standard steel or polyethylene pipe. Vents shall point upward and remain closed until grouting begins. Drains shall point downward and remain open until grouting begins. Ends of steel vents and drains shall be removed 1 inch inside the concrete surface after grouting has been completed: polyethylene vents and drains may be left flush to the surface unless otherwise directed by the Engineer. Conduit vents are not required for transverse post-tensioning ducts in the roadway slab unless specified in the Drawings.

Immediately after any concrete placement, the Contractor shall force blasts of oil-free, compressed air through the conduit to break up and remove any mortar inside before it hardens. Before deck concrete is placed, the Contractor shall satisfy the Engineer that conduits are unobstructed and contain nothing that could interfere with grouting or harm the tendons. If the tendons are in place, the Contractor shall show that they are free in the duct.

In temperatures below 32 degrees F, ducts shall be kept free from water to avoid damage from freezing.

6-02.3(26)E PRESTRESSING REINFORCEMENT

All prestressing reinforcement shall comply with Section 9-07.10. They shall not be coupled or spliced. Tendon locations shown in the Drawings indicate final positions after stressing (unless the Drawings say otherwise). No tendon made of 7-wire strands shall contain more than 31 strands of 1/2-inch diameter, or more than 24 strands of 0.6-inch diameter.

From the time prestressing reinforcement is made until it is grouted or encased in concrete, the Contractor shall protect it from dirt, grease, rust, corrosives, and all physical damage. The Engineer will reject prestressing reinforcement that shows any sign of damage, rust, or corrosion. If the prestressing reinforcement will not be stressed and grouted within 10 calendar days after it is placed in the conduits, the Contractor shall place an approved corrosion inhibitor in the conduits.

6-02.3(26)F TENSIONING

The Contractor shall not begin to tension the tendons until:

(a) All concrete has reached a minimum compressive strength of 4,000 psi or the strength the Drawings require (demonstrated on test cylinders made of the same concrete cured under the same conditions as that in the bridge), and
(b) The Engineer is satisfied that all strands are free in the conduits.

Tendons shall be tensioned to the values shown in the Drawings (or approved Shop Drawings) with hydraulic jacks. When stressing from both ends of a tendon is specified, it need not be simultaneous unless the Drawings require. The jacking sequence shall follow the approved Shop Drawings.

Each jack shall have a pressure gauge that will determine the load applied to the tendon. The gauge shall display pressure accurately and readably with a dial at least 6 inches in diameter or with a digital display. Each jack and its gauge shall be calibrated as a unit and shall be accompanied by a certified calibration chart. The Contractor shall provide one copy of this chart to the Engineer for use in monitoring. The cylinder extension during calibration shall be in approximately the position it will occupy at final jacking force.

All jacks and gauges must be recalibrated and recertified: (1) at least every 180 days, and (2) after any repair or adjustment. The Engineer may use pressure cells to check jacks, gauges, and calibration charts before and during tensioning.

These stress limits apply to all tendons (unless the Drawings set other limits):

(a) Maximum service load after all losses: 80 percent of the specified yield point stress of the steel.
(b) Maximum tensile stress during jacking: 75 percent of the specified minimum ultimate tensile strength of the steel.
(c) Maximum initial stress at anchoring: 70 percent of the specified minimum ultimate tensile strength of the steel at any point along the entire length of the tendon.

Tendons shall be anchored at initial stresses that will ultimately maintain service loads at least as great as the Drawings require.

As tensioning proceeds, the Engineer will be recording the applied load, tendon elongation, and anchorage seating valves.

When removing the jacks, the Contractor shall relieve stresses gradually before cutting the prestressing reinforcement. The prestressing strands shall be cut a minimum of 1 inch from the face of the anchorage device.

6-02.3(26)G GROUTING

After tensioning the tendons, the Contractor shall again blow oil-free, compressed air through each conduit. All drains shall then be closed and the vents opened. After completely filling the conduit with grout, the Contractor shall pump the grout from the low end at a pressure of not more than 250 psig. Grout shall be continuously wasted through the vent until no more air or water pockets show. At this point, all vents shall be closed and grouting pressure at the injector held between 100 and 200 psig for at least 10 seconds. The Contractor shall leave all plugs, caps, and valves in place and closed for at least 24 hours after grouting.

Grouting equipment shall:

(a) Include a pressure gauge with an upper end readout of between 275 and 325 psig;
(b) Screen the grout before it enters the pump with an easily reached screen that has clear openings of no more than 0.125 inch;
(c) Be gravity fed from an attached, overhead hopper kept partly full during pumping; and
(d) Be able to complete the largest tendon on the project in no more than 20 minutes of continuous grouting.

In addition, the Contractor shall have standby equipment (with a separate power source) available for flushing when the regular equipment cannot maintain a one-way flow of grout. This standby equipment shall be able to pump at 250 psig.

The grout shall be mixed in this proportion:

Type II portland cement	1 sack
Water	5.5 gallons (approximately)
Sika Intraplast-N	6 ounces

The Contractor shall adjust the amount of water to produce a grout flow of 15 to 20 seconds (determined by ASTM C 939 tests). An expansion agent other than Sika Intraplast-N is permitted if it is used according to the manufacturer's instructions and if it does not contain ingredients that corrode steel (that is, chlorides, fluorides, sulfates, or nitrates) and approved by the Engineer. Fly ash may make up no more than 20 percent of the portland cement and shall comply with Section 9-23.9.

The grout shall be injected within 30 minutes after the Sika Intraplast-N (or other approved expansion agent) is added. Surrounding concrete shall be at least 35 degrees F from time of grouting until 2-inch cubes of job-cured grout reach a compressive strength of at least 800 psi. Grout temperature shall not exceed 90 degrees F during mixing or pumping. This may require that the water be cooled.

6-02.3(27) SUPERSTRUCTURE

The superstructure for bridges shall include all materials (except those noted below) above the top of the cross beams or pedestals as the case may be, and between the abutment expansion joints, including concrete Class AX, reinforcing steel, prestressed concrete girders, deck slab, diaphragms, sidewalks, curb/parapets, earthquake restrainers, railing anchorage, concrete for precast and prestressed components, prestressing steel, expansion joints, inserts, compression seals, elastometric pads, bridge drains with reducers, and electrical conduits/expansion fittings encased in concrete.

EXCEPTIONS: Items excluded under "Superstructure" are the following:

(a) Metal traffic and pedestrian railings and posts.
(b) Steel bridge bearings, steel and reinforced concrete transverse stops.
(c) Downspouts.
(d) Painting.
(e) Light poles (standards) luminaires and other electrical-related items specified elsewhere herein except as otherwise noted above.

The Superstructure contains the approximate quantities of materials as listed in the Project Manual. The quantities listed are for major items only and are not intended to be a complete list of all items required for construction of the superstructure. The quantities are approximate and are for the convenience of the Contractor in determining the volume of work involved and are not guaranteed to be accurate. The prospective bidders shall verify these quantities before submitting a bid. No adjustments other than for approved changes will be made in the lump sum contract price for "Superstructure," even though the actual quantities required may deviate from those listed.

6-02.3(28) BRIDGE DRAINS

The Contractor shall furnish and install drains in the roadway slab, of the type specified in the Drawings and at the locations shown therein.

Bridge drains shall be furnished with vaned grates as shown on Standard Plan No.'s 265 or 266, WSDOT Standard Plan No. B-2b or as shown on the Drawings. Grating covers shall be fitted to the individual drain casting with which they are to be used and shall be ground to rest evenly and without rocking.

To each drain casting there shall be shop welded a piece of either standard galvanized steel or galvanized wrought iron pipe of the size, length and type as shown in the Drawings.

The length of steel pipe shall be galvanized in accordance with the provisions of ASTM Designation A 120, Black and Hot-Dipped Zinc-Coated Welded and Seamless Steel Pipe for Ordinary Uses. Galvanizing shall be done after cutting to length, grooving, threading or other fabrication.

After welding, the drain castings and grating covers shall be coated inside and outside with an asphaltum base, black dipping paint, approved by the Engineer. This coating shall extend over that portion of the galvanized steel pipe adjacent to the casting far enough to cover the welds.

Bridge drains shall meet the requirements of Section 9-06.19.

6-02.3(29) DOWNSPOUTS

The Contractor shall furnish and install 4 or 6 inches standard weight steel pipe downspouts at the locations shown and as detailed in the Drawings.

The downspouts shall be full length pipe sections in all straight runs. If approved by the Engineer, the Contractor may use other types of couplings and fittings in lieu of the grooved couplings and fittings shown in the Drawings, provided they are equal and are approved by the Engineer.

The portion of downspouts and/or drain pipe constructed within concrete shall be fully encased in a sponge rubber compound 1/2 inch thick and meeting the requirements of ASTM Designation D 1752 Type No. 1, except the color requirement is waived.

The downspouts shall be constructed along a minimum slope of 10% and with minimum radius of 4 feet. The Contractor shall submit Shop Drawings showing typical downspout pipe layout including size, spacing and type of pipe hangers and concrete inserts for approval of the Engineer. The Contractor shall determine the exact lengths of pipe and

hangers required for each location. The Contractor shall verify all downspout lengths by field measurements prior to fabrication.

6-02.3(30 DRILLING HOLES IN CONCRETE

The Contractor shall drill holes in the existing concrete facilities as shown and noted on the Drawings. The diameter of holes shall be as follows:

Diameter Holes for #18 Bars	2-3/4"
Diameter Holes for #14 Bars	2-1/4"
Diameter Holes for #11 Bars	1-7/8"
Diameter Holes for #10 Bars	1-3/4"
Diameter Holes for # 9 Bars	1-1/2"
Diameter Holes for # 8 Bars	1-3/8"
Diameter Holes for # 7 Bars	1-1/4"
Diameter Holes for # 6 Bars	1-1/8"
Diameter Holes for # 5 Bars	1"
Diameter Holes for # 4 Bars	7/8"
Diameter Holes for # 3 Bars	3/4"

For threaded rod, 1/4" larger than the outside diameter of the rod.

The holes to be drilled in the existing concrete shall be drilled with equipment that will not fracture or damage the existing concrete which is to remain, or fracture the aggregate that surrounds the hole. Jackhammers shall not be used to drill holes. The method used to drill the holes shall provide a fracture free surface in which to epoxy bond the bars and/or threaded rods.

The Contractor shall submit his proposed method or methods of drilling the holes to the Engineer for approval. If the Engineer rejects the Contractor's proposed methods, the Contractor shall use other means, as approved by the Engineer, of drilling the holes which will give the required results.

Tools classified as demolition tools shall not be used.

6-02.3(31) EPOXY IN DRILLED HOLES

Reinforcing bars or threaded rods shall be secured in drilled holes in the existing concrete where indicated on the Drawings with a high strength, creep resistant epoxy resin such as Adhesive Engineers Concresive 1463-G for vertical bars or rods, or Concresive 1441 for horizontal bars or rods. For epoxy resins other than those specified above, the Contractor shall submit a test report from a testing laboratory approved by the Engineer verifying that application temperature range, cure time, heat deflection temperature (ASTM D648), and slant shear strength (AASHTO T237) are equal to or better than the epoxy resins specified.

The Contractor shall place the reinforcing steel and/or threaded rods scheduled to be embedded in the existing concrete, in the following manner:

(a) Core drilled holes shall be sandblasted full depth to roughen sides of hole.
(b) Sandblast the section of reinforcing steel and/or threaded rods, scheduled to be embedded in the existing concrete to white metal (see note below).
(c) Prime with epoxy the part of the reinforcing bar and/or threaded rod which has been sandblasted to white metal (see note below).
(d) Dry the drilled hole thoroughly immediately before placing the epoxy by clean, hot air, or by flame. If flame is used, only that produced with propane gas will be allowed.
(e) Place the epoxy in the drilled hole in such a manner as to prevent the formation of air pockets.
(f) Clean the primed epoxy surface of the reinforcing bar and/or threaded rod with a clean rag dipped in a solution of methyl/ethyl ketone or acetone.
(g) Insert the reinforcing bar and/or threaded rod into the drilled holes. In the horizontal drilled holes, caulk the annular space between the entrance of the hole and the bar and/or threaded rod with lead wool or approved equal.

NOTE: For factory coated epoxy bars, Steps (b) and (c) shall be omitted.

6-02.3(32) REPAIR OF SPALLED AND DELAMINATED CONCRETE

6-02.3(32)A DESCRIPTION

This work shall consist of cleaning and repairing loose, spalled, and delaminated concrete at locations indicated on the Drawings and in accordance with the following Sections.

6-02.3(32)B CLEANING AND PREPARATION

The Contractor shall remove all loose, defective and delaminated concrete by chipping with pneumatic chipping hammers, hand tools, or high pressure water jets. All cracks and cavities shall be chipped to such formation that their sides are approximately perpendicular to the exposed surface forming a mechanical shoulder for at least 1/2 inch in depth. In addition to chipping, all concrete to be repaired shall be cleaned by flushing with water and compressed air jets. The nozzle shall have sufficient air pressure to assure removal of all dirt, grease, oil, moss and loose particles.

Cleaned surfaces shall be free of all dirt, grease, oil, moss scale, and rust before repairs are made.

Care shall be taken in removing concrete to prevent overbreakage. Concrete shall be carefully broken away from reinforcing bars where applicable, to prevent damage to steel reinforcement.

6-02.3(32)C REPAIRS

The Contractor shall have the option of making the concrete repairs with the best methods available subject to the approval of the Engineer. Two proposed methods are outlined below:

(a) Hand placed sand and cement grout with approved epoxy bonding agent.
(b) Quick-set concrete as approved by the Engineer.

Hand placed sand and cement grout shall be used only on the smaller spalled areas with a depth of 1/2 inch or less. All repairs shall be finished to the original size and contour of the member being repaired.

Spall depths over 1 inch shall be reinforced with 4 X 4 WO.5 welded wire fabric secured to the existing concrete with 1/4 inch tie wire anchors and 16 gauge wire ties. Welded wire fabric shall clear the new surface by no less than 1/2 inch, preferably 3/4 inch. Location, spacing and type of anchor will be subject to approval of the Engineer.

6-02.3(33) EPOXY INJECTION OF CONCRETE CRACK

6-02.3(33)A GENERAL

Cracks in existing concrete shall be repaired by epoxy injection where indicated on the Drawings or where directed by the Engineer in accordance with the following specifications. The Contractor shall submit his procedure for epoxy injection to the Engineer for approval 2 weeks prior to performing this portion of the work.

The material used as a surface seal must have adequate strength and adhesion to hold injection ports firmly in place

and to resist injection pressures adequately to prevent leakage during injection.

The epoxy resin system for crack injection shall be a Type I, Grade 1 system conforming to ASTM C881 except for the following requirements:

(a) Gel Time[1]	20 Minutes Minimum
(b) Viscosity	700 Centipoises Maximum
(c) Shrinkage	Not Required
(d) Heat Deflection Temperature	130xF. Minimum

[1]Gel time shall not apply if continuous flow nozzle mixing injection equipment is used.

The injection equipment shall have the capability of discharging the mixed adhesive at pressures up to 200 psi and maintaining that pressure.

6-02.3(33)B GUIDELINES

Concrete cracks over 0.006 inch thick and as designated and marked by the Engineer for injection shall be repaired as follows:

(a) Before repair work begins, cracks shall be free from loose or foreign matter such as dirt, efflorescence laitance, oil, grease, salt or any other contaminants. Acids and corrosives shall not be used as cleaning agents.
(b) Entry ports shall consist of tubes, tees, or other valve devices suitable for accepting epoxy injection resins under pressure and shall be provided along the crack at intervals of not less than the thickness of the concrete at that location. For thick sections (2 feet plus), entry ports may be spaced at distances as recommended by the manufacturer or directed by the Engineer. The holes for the entry ports shall be drilled with a hollow bit with an attached vacuum chuck to prevent dust from becoming embedded in the crack.
(c) Prior to injection of the crack, the surface sealing system shall be applied to the face of the crack and areas around entry ports to attain a seal capable of withstanding the applied injection pressures. For through cracks, the surface seal shall be applied to all accessible faces.
(d) The surface seal shall be allowed to gain adequate strength before proceeding with the injection. However, prior to epoxy injection, crack should be air injected to determine if the crack is capable of epoxy injection (air detected coming out of adjacent ports means that crack is injectible). If not injectible, entry port should be temporarily abandoned and procedure repeated at adjacent ports. At a later time, previously non-injectible cracks should be given a second air injection test.
(e) The injection of the adhesive into each crack shall begin at the entry port at the lowest elevation. Injection of deck cracks shall be done from the top side; through cracks may require sealing crack on bottom with epoxy paste. Injection shall continue at the first port until the injection adhesive begins to flow out of the port at the next higher elevation. The first port shall be plugged and injection started at the second port until adhesive flows from the next port. The entire crack shall be injected with the same sequence. If port to port travel of epoxy adhesive is not indicated, the work shall immediately be stopped and the Engineer notified. On wide cracks where resin travel between ports will be rapid, two or more ports may be pumped simultaneously. On exceptionally large cracks, a formulation (dependent upon crack width, ambient temperature, modulus requirements and other variables) of epoxy resin and fine sands shall be used as approved by the Engineer.
(f) After the injection adhesive has cured, the surface seal shall be removed. The face of the crack shall be finished flush with the adjacent concrete. There shall be no indentations or protrusions caused by placement of entry ports.
(g) Supervision of this process by the manufacturer's representative shall be required until the Contractor is familiar with the products and the operations.
(h) The sealing and injection procedures outlined herein is an approved method for accomplishing the work. However, the Contractor may, upon written approval of the Engineer, use other equipment and/or procedures.

The Contractor shall obtain three 2-inch diameter core samples in the first 100 linear feet of crack repaired and one core sample for each 100 linear feet thereafter at his expense. The cores shall be for full crack depth and taken from locations selected by the Engineer. If less than 90% of the visible crack is not filled with cured epoxy adhesive, the crack from which the cores were taken shall be deemed not to have been repaired in accordance with this Specification and no payment will be made until satisfactory repairs are completed by the Contractor. The Contractor shall reinject crack and the repair will again be subject to the approval of the Engineer.

Upon approval of the repair by the Engineer, the Contractor shall fill the core holes using an epoxy bonding agent and portland cement mortar ($f'c$ = 4,000 psi) and finish the surface to blend with the adjacent concrete.

6-02.3(33)C SUBMITTALS

The Contractor shall submit the following documentation for approval along with the Bid:

(a) Applicator's Qualifications: a list of projects, dates, locations, contacts, and contact's telephone number for successful epoxy resin repairs on concrete structures.
(b) Epoxy Injection Adhesive: After award of contract, the epoxy manufacturer shall provide material certifications and test report.

6-02.3(34) BONDING NEW CONCRETE TO EXISTING CONCRETE

Surfaces to which new concrete is to be bonded shall be rough and clean. Loose particles, dust and dirt shall be removed by vigorous brushing with wire brushes followed by a thorough washing with high pressure water jet prior to application of new materials. Oil or film of any sort that may reduce the bond of the new material to the old concrete will not be permitted.

Bonding surfaces between old and new concrete shall be treated in the following manner after the free water has dried from the area.

The surface shall be coated with epoxy resin forming a 10-15 mil thickness. The epoxy surface shall appear shiny and shall be tacky just before new concrete is placed. If the concrete has absorbed the adhesive, as evidenced by a dull appearance, apply another coat. The new concrete shall then be placed while the epoxy remains tacky.

Epoxy resin shall conform to the requirements of ASTM C881 for Type II, Grade 2, Class A, B or C depending on the temperature of the existing concrete. The shrinkage test in ASTM C881 is not required. Refer to Section 9-26 of these Specifications.

6-02.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Concrete (Class) (Use)" will be by the cubic yard in place. Measurements will be to the neat lines of the structure as shown in the Drawings unless authorized otherwise in writing by the Engineer, except in the case of concrete in cofferdam seals. No measurement will be made for concrete below the established elevation of the bottom of the footing or seal. No deduction will be made for pile heads, reinforcing steel, structural steel, bolts, weep holes, rustications, chamfers, edgers, bridge drains, joint filler, junction boxes, miscellaneous hardware and conduit and drain pipes under 6 inches diameter.

Class D or DX concrete, when used in the seals of underwater cofferdams, will be paid for on the basis of the actual volume deposited as determined by the average cross-sectional area of the inside of the cofferdam except that no measurement will be made for the volume so determined which is outside of an area which is bounded by vertical planes 1 foot outside of the neat lines of the seal. The limiting vertical planes shall be parallel to the location of the neat lines based upon the traverse and longitudinal centerlines of the seal as shown on the Drawings.

Measurement for "Steel Reinforcing Bar, (Grade)" will be by the pound in place as calculated from the Drawings, unless ordered otherwise in writing by the Engineer. No allowance will be made for spreaders, form blocks, wire clips or other fastenings, which must be furnished by the Contractor. When splices are made other than those shown in the Drawings, no allowance will be made for the extra steel required. When shear steel is required at construction joints which are not shown in the Drawings, and which are permitted for the Contractor's convenience, no allowance will be made for the additional steel required.

Measurement for "Steel Reinforcing Bar, (Grade), Epoxy Coated" will be by the pound before epoxy coating is applied, as set forth above for uncoated steel reinforcing bars.

Measurement for "Wire Mesh, (Gage), (Mesh Size)" will be by the square yard for the area covered as calculated from the Drawings. No extra allowance will be made for required overlap of mesh.

Measurement for "Expansion Joint (Type)" or "Compression Seal (Type)" will not be made at or between the abutment expansion joints when there is a bid item for "Superstructure". Otherwise, measurement for "Expansion Joint (Type)" or "Compression Seal (Type)" will be per linear foot along the slope including length along miter joints.

Measurement for "Downspout, Galvanized Steel Pipe, (Diameter)" will be by the linear foot along the center line of the pipe through fittings.

Measurement for "Superstructure" will be by lump sum. Separate measurement will not be made for those quantities described in Section 6-02.3(27) as being included with the "Superstructure."

When a bid item for "Superstructure" is included on the Bid Form, no measurement will be made for concrete or reinforcing steel placed in the area defined as superstructure.

When the Bid Form includes the bid item "Superstructure", no separate measurement will be made for "Bridge Drain" that are to be installed within the area defined as superstructure.

Measurement for gravel backfill for drains will be by the cubic yard as Mineral Aggregate (Type) per Section 1-09.1.

6-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-02 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Concrete (Class) (Use)," per cubic yard.
(2) "Steel Reinforcing Bar, (Grade)," per pound.
(3) "Steel Reinforcing Bar, (Grade), Epoxy Coated," per pound.
(4) "Wire Mesh, (Gage), (Mesh Size)," per square yard.
(5) "Expansion Joint (Type)," per linear foot.
(6) "Compression Seal (Type)," per linear foot.
(7) "Downspout, Galvanized Steel Pipe, (Diameter)," per linear foot.
(8) "Superstructure," per lump sum.
(9) "Drill Hole (Size)," per linear foot.
(10) "Repair of Spalled and Delaminated Concrete," per square foot.
(11) "Epoxy Injection of Crack," per linear foot.
(12) "Bridge Drains," per each.

The unit contract price for "Concrete (Class) (Use)" shall include all costs for the work required to furnish and install structural concrete in place including falsework, forms, expansion joint material, and construction of weep holes including gravel backfill for drains surrounding the weep holes. The contract price shall exclude concrete in the superstructure when this is covered by a separate bid item.

The unit contract price for "Steel Reinforcing Bar, (Grade)" or "Steel Reinforcing Bar, (Grade), Epoxy Coated" shall include all costs for the work required to furnish, fabricate, coat, and place the steel reinforcement as specified, and to provide a bar list/bending diagram. The unit contract price shall also include all costs for any required threading of reinforcing bars. In structures of reinforced concrete where there are no structural steel bid items, such minor metal parts as expansion joints, bearing assemblies, and bolts will be paid for at the unit contract price for reinforcing steel unless otherwise specified. When a bid item for "Superstructure" is included in the Bid Form, all reinforcing steel in the superstructure shall be considered incidental to the bid item "Superstructure".

All costs related to test weld as required in Section 6-02.3(24)F shall be included in the unit contract price for "Steel Reinforcing Bar, (Grade)".

The unit contract price for "Wire Mesh, (Gage), (Mesh Size)" shall include all costs required to furnish and place the mesh as specified.

The unit contract price for "Expansion Joint (Type)" shall inlcude all costs to furnish and install the complete expansion joint system as specified, including hardware and miter joints. Refer to Section 6-02.4 and Section 6-02.5, paragraph 3 herein.

The unit contract price for "Compression Seal (Type)" shall include all costs for the work required to furnish and install the compression seal in place. All costs in connection with the compression seals in the deck, sidewalk slabs, concrete overlay, curbs and abutment backwalls, including mitre joints, lubricant adhesive, samples and all necessary items to make a complete installation shall be included in the unit contract price for "Compression Seal (Type)". Refer to Section 6-02.4 herein.

The unit contract price for "Downspout, Galvanized Steel Pipe", shall be full compensation for all costs in connection with furnishing and installing the downspouts, including field measuring, galvanizing, and other items necessary to make a complete construction as specified.

The lump sum contract price for "Superstructure" shall include all costs for the work required to furnish and install all items described in Section 6-02.3(27) to be complete as specified. No separate payment will be made for these items described in Section 6-02.3(27) as being included with the "Superstructure".

All costs for furnishing and placing the date numerals as specified in Section 6-02.3(15) shall be included in the lump sum contract price for the bid item "Superstructure".

All costs related to the work for the overhead clearance signs as specified in Section 6-02.3(17)J shall be considered incidental to the bid item "Superstructure".

All costs in connection with lifting, transporting, and erecting girders including inserts, shims for leveling, grout, field cutting and bending, rebar for drains, welding, blockouts

in girders and slabs, and special construction features shall be included in the lump sum contract price for "Superstructure."

The unit contract price for "Drill Hole" shall include all costs for the work required to perform the drilling as specified.

The unit contract price for "Repair of Spalled and Delaminated Concrete" shall include all costs for the work specified in Section 6-02.3(32).

The unit contract price for "Epoxy Injection of Crack" shall include all costs for the work specified in Section 6-02.3(33).

The unit contract price for "Bridge Drain" shall be full compensation for all work necessary to install drain, reducer, and grate to structure as specified in Section 6-02.3(28). All costs in connection with maintaining and cleaning of bridge drains as specified in 6-01.16 shall be considered incidental to the construction of the bridge drain.

All necessary items not specifically listed as a contract bid item in the Bid Form, and payment is not otherwise provided, shall be considered to be included in the various items comprising this improvement. No separate payment will be made.

Structure excavation, shoring, cribbing, and cofferdams will be paid in accordance with Section 2-09.5.

Gravel backfill for walls and gravel backfill for drains will be paid as Mineral Aggregate, (Type) in accordance with Section 4-01.5.

Structural removals will be paid in accordance with Section 2-02.5.

Any section of concrete placed that are found or deemed defective by the Engineer shall be removed and replaced by the Contractor and all costs incurred thereof shall be borne by the Contractor.

For concrete placed in water as specified in Section 6-02.3(6)C and testing as required by the Engineer reveals void(s) or joint(s), the Contractor shall repair the void(s) or joint(s), or replace the seal at his own cost.

All costs for curing and finishing concrete shall be considered incidental to the various bid items comprising the work.

When test indicate leakage in the expansion joint system(s) on the bridge deck, the Contractor shall make good the system(s) and all costs incurred thereof shall be borne by the Contractor.

All costs related to the provision of openings as specified in Section 6-02.3(17)H shall be considered incidental to the various bid items comprising the Contract.

The Contractor shall provide labor, materials, and equipment for making the test sample splices as specified in Section 6-02.3(24)G at no cost to the Owner. The Owner will test the samples at no cost to the Contractor.

All costs in connection with the provision and installation of special anchorage reinforcement as specified in Section 6-02.3(26)C shall be borne by the Contractor.

All costs, including any additional Owner's engineering expenses, in connection with controlling the girder deflection shall be borne by the Contractor.

All costs in connection with using air-entraining and/or water-reducing admixture(s) in concrete for the bridge decks, traffic barrier, and pedestrian barrier shall be included in the unit contract prices for the various bid items involved.

All costs in connection with providing holes for vents, for furnishing and installing cell drainage pipes for box girder structures, and furnishing and placing grout and shims under steel shoes shall be included in the unit contract prices for the various bid items involved.

Payment for fly ash shall be included in the bid price of various items as specified in Section 5-05.5.

SECTION 6-03 STEEL STRUCTURES

6-03.1 DESCRIPTION

This work includes furnishing, fabricating, erecting, cleaning, and painting steel structures and the structural steel parts of nonsteel structures.

6-03.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Structural Steel and Related Materials	9-06
Paints	9-08
Bolts	AASHTO M 164
Nuts	AASHTO M 291
Hardened Washers	AASHTO M 293
Direct Tension Indicators	ASTM F 959

Structural steel shall be classified as:

(a) Structural carbon steel (to be used whenever the Drawings do not specify another classification),
(b) Structural low alloy steel, and
(c) Structural high strength steel.

Unless the Drawings or Project Manual states otherwise, the following shall be classified as structural carbon steel: shims; ladders; stairways; anchor bolts and sleeves; pipe, fittings and fastenings used in handrails; and other metal parts, even if made of other materials, for which payment is not specified.

The following table specifies longitudinal Charpy V-notch requirements. All material used in what the Drawings show as main load-carrying tension members or as tension components of flexural members shall meet these requirements.

TABLE 1

AASHTO Specification Designation	Thickness t (in.)	Absorbed Energy (ft-lb.)	Test Temperature (Deg. F)	Frequency of Testing
M 183	t≤4	15	40	Heat
M 222 & M 223(1)	t≤4	15	40	Heat
M 222 & M 223	t≤2	15	40	Heat
M 222 & M 223	2<t≤4	20	40	Heat
M 244	t≤2-1/2	25	0	Piece
M 244	2-1/2<t≤4	35	0	Piece

(1) Mechanically fastened.

Sampling and testing shall comply with AASHTO T 243.

The test temperature listed in Table 1 shall be reduced for AASHTO M 222 or M 223 material when the yield strength shown in the certified mill test report exceeds 65 ksi. For each 10 ksi (or fraction thereof) above 65 ksi, the temperature shall be reduced by 15 degrees from that shown in the table.

The Contractor shall submit for the Engineer's approval a written plan for visibly marking the material so that it can be traced. These marks shall remain visible at least through the fit-up of the main load-carrying tension members. The marking method shall permit the Engineer to verify: (1) material specification designation, (2) heat number, and (3) material test reports to meet any special requirements.

For steel in main load-carrying tension members and in tension components of flexural members, the Contractor shall include the heat numbers on the reproducible copies of the as-built Shop Drawings.

6-03.3 CONSTRUCTION REQUIREMENTS

6-03.3(1) NOTICE OF ROLLING

Five working days before rolling work begins, the Contractor shall notify the Engineer so that he may arrange to inspect it. The Contractor shall inform the Engineer of who will do the work and where it will be done. No material shall be rolled until the Engineer gives written notice to proceed.

6-03.3(2) FACILITIES FOR INSPECTION

The Contractor shall provide all facilities the Inspector requires to inspect material and workmanship. Inspectors shall be given safe and free access to all areas in the mill and shop.

6-03.3(3) INSPECTOR'S AUTHORITY

The Inspector may reject materials or workmanship that does not comply with these Specifications. In any dispute, the Contractor may appeal to the Engineer whose decision shall be final.

By its inspection at the mill and shop, the Owner intends only to facilitate the work and prevent errors. This inspection shall not relieve the Contractor of any responsibility for identifying and replacing defective material or workmanship.

6-03.3(4) REJECTIONS

Even if the Inspector accepts materials or finished members, the Owner may later reject them if defective. The Contractor shall promptly replace or make good any rejected materials or workmanship.

6-03.3(5) MILL ORDERS AND SHIPPING STATEMENTS

The Contractor shall furnish as many copies of mill orders and shipping statements as the Engineer requires.

6-03.3(6) WEIGHING

Structural steel need not be weighed unless the Drawings or Project Manual requires it. When weight is required, it may either be calculated or obtained by scales. The Contractor shall furnish as many copies of the calculations or weight slips as the Engineer requires. If scale weights are used, the Contractor shall record separately the weights of all tools, erection material, and dunnage.

6-03.3(7) SUBMITTALS

6-03.3(7)A SHOP DRAWINGS

The Contractor shall submit for approval all shop detail drawings for fabricating the steel.

The Contractor shall submit shop detail drawings in accordance with Section 1-05.3, except that for grade separation structures which carry a railroad over a highway, 4 additional sets are required for each railroad company involved. Sheets returned for correction shall be corrected, and the required number of corrected sheets shall be submitted for approval. No material shall be fabricated until the shop detail drawings have been approved by the Engineer.

In approving Shop Drawings, the Owner accepts only the nature and scope of the details without validating any dimensions.

Unless the Engineer permits it in writing, no changes shall be made in any drawing after its approval.

Before project completion, the Contractor shall furnish the Project Engineer one set of reproducible copies of the as-built Shop Drawings. (One more set is required for each affected railroad company on any grade separation structure that carries a railroad over a highway.) The reproducible copies shall be clear, suitable for microfilming, and on permanent material.

Sheets for all Shop Drawings shall conform to the size requirements of Section 1-05.3 of these Specifications.

6-03.3(8) SUBSTITUTIONS

The Contractor shall not substitute sections that differ from Drawings dimensions unless the Engineer approves in writing. If the Contractor requests and receives approval to substitute heavier members, such substitution shall be at no additional cost to the Owner.

6-03.3(9) HANDLING, STORING, AND SHIPPING OF MATERIALS

Markings applied at the mill shall distinguish structural low alloy steel from structural carbon steel. The fabricator shall keep the 2 classes of steel carefully separated.

Before fabrication, all material stored at the fabricating plant shall be protected from rust, dirt, oil, and other foreign matter. The Owner will accept no rust-pitted material.

After fabrication, all material awaiting shipment shall be subject to the same storage requirements as unfabricated material.

All structural steel shall arrive at the job in good condition. As the Engineer requires, steel damaged by salt water shipment shall be thoroughly cleaned by high pressure water flushing, chemical cleaning, or sandblasting, and repainted with the specified shop coat.

All material shall be stored so as to prevent rust and loss of small parts. Piled material shall not rest on the ground or in water but on skids or platforms.

The loading, transporting, unloading, and piling of the structural steel material shall be so conducted that the metal will be kept clean and free from injury from rough handling.

In field assembly of structural parts, the Contractor shall use methods and equipment not likely to twist, bend, deform, or otherwise injure the metal. Any member slightly bent or twisted shall be corrected before it is placed. The Owner will reject any member with serious handling damage.

Girder sections shall be handled so as to prevent damage to the girders. If necessary, the Contractor shall provide temporary stiffeners to prevent buckling during erection.

6-03.3(10) STRAIGHTENING BENT MATERIAL

If the Engineer permits in writing, plates, angles, other shapes, and built-up members may be straightened. Straightening methods shall not fracture or injure the metal. Distorted members shall be straightened mechanically. A limited amount of localized heat may be applied only if carefully planned and supervised, and only if the Engineer has approved a heat-straightening procedure in writing.

Parts to be heat-straightened shall be nearly free from all stress and external forces except those that result from the mechanical pressure used with the heat.

After straightening, the Contractor will inspect the member for fractures using a method determined by the Owner.

The Owner will reject metal showing sharp kinks and bends.

The procedure for heat straightening of universal mill (UM) plates by the mill or the fabricator shall be submitted to the Engineer for approval.

6-03.3(11) WORKMANSHIP AND FINISH

Workmanship and finish shall be first-class, equaling the best practice in modern bridge fabrication shops. Welding, shearing, burning, chipping, and grinding shall be done neatly and accurately. All parts of the work exposed to view shall be neatly finished.

Wherever the Drawings show a surface finish symbol, the surface shall be machined.

6-03.3(12) FALSEWORK

All falsework and forms shall conform to the requirements specified in Section 6-02.

6-03.3(13) FABRICATING TENSION MEMBERS

Plates for main load-carrying tension members or tension components of flexural members shall be:

(a) Blast cleaned entirely or blast cleaned on all areas within 2 inches of welds to SSPC-SP6, Commercial Blast Cleaning, and
(b) Fabricated from plate stock with the primary rolling direction of the stock parallel to the length of the member.

6-03.3(14) EDGE FINISHING

All rolled, sheared, and flame-cut edges shall be true to line and free of rough corners and projections. Corners along exposed edges shall be rounded to a radius of 1/16 inch or greater. Sheared edges on material more than 5/8-inch thick shall be planed back by at least 1/8 inch.

The following standards for surface roughness and edge hardness shall apply to the named parts of main load-carrying tension members or tension components of flexural members:

(a) Surface roughness of flange components–rolled, sheared, and flame-cut –shall not exceed 250 micro inches as defined by ANSI specifications. On flame-cut edges, this roughness may be obtained after cutting by grinding or other approved means.
(b) Surface roughness of other rolled, sheared, and flame-cut edges shall not exceed 1,000 micro inches.
(c) Edge hardness of AASHTO M 222 and M 223 plates after flame-cutting shall meet the requirements outlined in Appendix A, "Testing Rockwell Hardness of Flame-Cut Edges" (a part of the contract). The Contractor shall prevent excessive hardening of plate edges through preheating, postheating, or control of the burning process as the steel manufacturer recommends and the Engineer approves.

6-03.3(15) PLANING OF BEARING SURFACES

Ends of columns that bear on base and cap plates shall be milled to true surfaces and accurate bevels.

When assembled, caps and base plates of columns and the sole plates of girders and trusses shall have full contact. If warped or deformed, the plates shall be heat straightened, planed, or corrected in some other way to produce accurate, even contact. If necessary for proper contact, bearing surfaces that will contact other metal surfaces shall be planed or milled. Surfaces of warped or deformed base and sole plates that will contact masonry shall be rough finished.

On the surface of expansion bearings, the cut of the planer shall be in the direction of expansion.

6-03.3(16) ABUTTING JOINTS

Abutting ends of compression members shall be faced accurately so that they bear evenly when in the structure. On built-up members, the ends shall be faced or milled after fabrication.

Ends of tension members at splices shall be rough finished to produce neat, close joints. A contact fit is not required.

6-03.3(17) END CONNECTION ANGLES

On floorbeams and stringers, end connection angles shall be flush with each other and set accurately in relationship to the position and length of the member. Unless the Drawings require it, end connection angles shall not be finished. If, however, faulty assembly requires them to be milled, milling shall not reduce thickness by more than 1/16 inch.

6-03.3(18) BUILT MEMBERS

The various pieces forming one built member shall be straight and close-fitting, true to detailed dimensions, and free from twists, bends, open joints, or other defects.

When fabricating curved girders, localized heat or the use of mechanical force shall not be used to bend the girder flanges about an axis parallel to the girder webs.

6-03.3(19) HAND HOLES

Hand holes, whether punched or cut with burning torches, shall be true to sizes and shapes shown in the Drawings. Edges shall be true to line and ground smooth.

6-03.3(20) LACING BARS

Unless the Drawings state otherwise, ends of lacing bars shall be neatly rounded.

6-03.3(21) PLATE GIRDERS

6-03.3(21)A WEB PLATES

If web plates are spliced, clearance between plate ends shall not exceed 3/8 inch.

6-03.3(21)B VACANT

6-03.3(21)C WEB SPLICES AND FILLERS

Web splice plates and fillers under stiffeners shall fit within 1/8 inch at each end.

6-03.3(22) EYEBARS

Eyebars shall be straight, true to size, and free from twists or folds in the neck or head and from any other defect that would reduce their strength. Heads shall be formed by upsetting, rolling, or forging. Dies in use by the manufacturer may determine the shape of bar heads if the Engineer approves. Head and neck thickness shall not overrun by more than 1/16 inch. Welds shall not be made in the body or head of any bar.

Each eyebar shall be properly annealed and carefully straightened before it is bored. Pinholes shall be located on the centerline of each bar and in the center of its head. Holes in bar ends shall be so precisely located that in a pile of bars for the same truss panel the pins may be inserted completely without driving. All eyebars made for the same locations in trusses shall be interchangeable.

6-03.3(23) ANNEALING

All eyebars shall be annealed by being heated uniformly to the proper temperature, then cooled slowly and evenly in the furnace. At all stages, the temperature of the bars shall be under full control.

Slight bends on secondary steel members may be made without heat. Crimped web stiffeners need no annealing.

6-03.3(24) PINS AND ROLLERS

6-03.3(24)A GENERAL

Pins and rollers shall be made of the class of forged steel the Drawings specify. They shall be turned accurately to detailed dimensions, smooth, straight, and flawless. The final surface shall be produced by a finishing cut.

Pins and rollers 9 inches or less in diameter may either be forged and annealed or made of cold-finished carbon steel shafting.

Pins more than 9 inches in diameter shall have holes at least 2 inches in diameter bored longitudinally through their centers. Pins with inner defects will be rejected.

The Contractor shall provide pilot and driving nuts for each size of pin unless the Drawings state otherwise.

6-03.3(24)B BORING PIN HOLES

Pin holes shall be bored true to detailed dimensions, smooth and straight, and at right angles to the axis of the member. Holes shall be parallel with each other unless the Drawings state otherwise. A finishing cut shall always be made.

The distance between holes shall not vary from detailed dimensions by more than 1/32 inch. In tension members, this distance shall be measured from outside to outside of holes; in compression members, inside to inside.

6-03.3(24)C PIN CLEARANCES

Each pin shall be 1/50-inch smaller in diameter than its hole. All pins shall be numbered after being fitted into their holes in the assembled member.

6-03.3(25) WELDING AND REPAIR WELDING

6-03.3(25)A GENERAL

All welding and repair welding shall comply with:

(a) The AWS Structural Welding Code D1.1-80,
(b) The Third Edition (1981) of the AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges, and
(c) The requirements described in the remainder of this section which shall prevail wherever they differ from (a) or (b) above.

Welding of structural steel will be permitted only to the extent shown in the Drawings. No welding, including tack and temporary welds shall be done in the shop or field unless the location of the welds is shown on the approved Shop Drawings or approved by the Engineer in writing.

Welding procedures shall be submitted for approval with Shop Drawings. The procedures shall specify the type of equipment to be used, electrode selection, preheat requirements, base materials, and joint details. When the procedures are not prequalified by AWS or AASHTO, evidence of qualification tests shall be submitted.

Welding shall not begin until after the Contractor has received the Engineer's approval of Shop Drawings as required in Section 6-03.3(7). These Shop Drawings shall include procedures for welding, assembly, and any heat-straightening or heat-curving.

Any welded shear connector longer than 8 inches may be made of two shorter shear connectors joined with full-penetration welds.

If using AASHTO M 222 Grade D or E steel, the Contractor shall provide proof of weldability to the Engineer before fabrication.

In shielded metal-arc welding, the Contractor shall use low-hydrogen electrodes.

In submerged-arc welding, flux shall be oven-dried at 550 degrees F for at least 2 hours, then stored in ovens held at 250 degrees F or more. If not used within 4 hours after removal from a drying or storage oven, flux shall be redried before use.

Preheat and interpass temperatures shall comply with the minimums in Table 2 below:

TABLE 2

Thickness (t) of Thickest Part at Point of Welding (Inches)	Temperature (Degrees F)
t≤3/4	100
3/4<t≤1-1/2	150
1-1/2<t≤2-1/2	200
t>2-1/2	250

All web and flange plates, bearing stiffeners, bearing plates, and heavy sections (restrained when welded) shall be preheated to at least 250 degrees F.

If groove welds (web-to-web or flange-to-flange) have been rejected, they may be repaired no more than twice. If a third failure occurs, the Contractor shall:

(a) Trim the members, if the Engineer approves, at least 1/2 inch; or
(b) Replace the members at no expense to the Owner.

By using extension bars and runoff plates, the Contractor shall terminate groove welds in a way that ensures the soundness of each weld to its ends. The bars and plates shall be removed after the weld is finished and cooled. The weld ends shall then be ground smooth and flush with the edges of abutting parts.

The Contractor shall not:

(a) Weld with electrogas or electroslag methods,
(b) Weld or flame cut when ambient temperature is below 20 degrees F, or
(c) Use coped holes in the web for welding butt splices in the flanges unless the Drawings show them.

6-03.3(25)B WELDING INSPECTION

The Contractor's welding inspection procedures, techniques, and inspector qualification shall comply with:

(a) The AWS Structural Welding Code D1.1-80, and
(b) The Third Edition (1981) of the AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges.

Inspection of welds shall be as follows:

(a) **Visual Inspection:**
Every weld shall be given a 100 percent visual inspection.

(b) **Radiographic Inspection:**
Full-penetration tension groove welds shall be given a 100 percent radiographic inspection. These welds include those in the tension area of webs, where inspection shall cover the greater of these two distances: (a) 15 inches from the tension flange, or (b) one-third of the web depth.

(c) **Magnetic Particle Inspection:**
Fillet welds and longitudinal butt welds in webs shall be given a magnetic particle inspection.

(1) Flange-to-Web Connections:
Until the Engineer accepts the Contractor's record of quality control, 100 percent of all fillet welds in flange-to-web connections of built-up members shall be inspected. After such acceptance, 30 percent of each weld shall be inspected. Ten percent of this

inspection shall occur at each end of the weld length. The remaining 10 percent shall occur randomly at points selected by the Engineer.

(2) Boxed Members of Trusses:
Each fillet weld in boxed members of trusses shall be given a 100 percent inspection.

(3) End and Intermediate Pier Diaphragms:
Each fillet weld in end and intermediate pier diaphragms shall be given a 100 percent inspection.

(4) Longitudinal Butt Weld in Web:
Each longitudinal butt weld in the web shall be inspected under the same requirements as flange-to-web connections (see above).

(5) Stiffeners and Connection Plates:
Thirty percent of each fillet weld in transverse and longitudinal web stiffeners and connection plates shall be inspected. Ten percent of this inspection shall occur at each end of the weld. The remaining 10 percent shall occur randomly at points selected by the Engineer.

(6) Miscellaneous Weldments:
Each fillet weld in miscellaneous weldments (such as bridge bearing assemblies) shall be given a 100 percent inspection.

(d) **Ultrasonic Inspection:**
All full-penetration groove welds shall be ultrasonically inspected.

(1) Transverse Flange and Web Splices:
Each transverse groove weld on flange and web splices shall be given a 100 percent inspection.

(2) End and Intermediate Pier Diaphragms:
Each groove weld on end and intermediate pier diaphragms shall be given a 100 percent inspection.

(3) Other Weldments:
Each groove welds in other weldments shall be given a 100 percent inspection, unless the Drawings state otherwise.

(e) **Dye-Penetrant Or Magnetic-Particle Inspection:**
The end of each groove weld at plate edges shall be given a 100 percent dye-penetrant or magnetic-particle inspection.

After the Contractor has completed his welding inspection, the Contractor shall allow the Engineer sufficient time to perform quality assurance ultrasonic welding inspection.

The Contractor shall maintain the radiographs and the radiographic inspection report in the shop until the last joint to be radiographed in that member is accepted by the radiographer representing the Contractor. Within two days following this acceptance, the Contractor shall mail the film and two copies of the radiographic inspection report to the Engineer.

6-03.3(26) SCREW THREADS

Screw threads shall be U.S. Standard and shall fit closely in the nuts.

6-03.3(27) HIGH STRENGTH BOLT HOLES

6-03.3(27)A GENERAL

At the Contractor's option under the conditions described in this Section, holes may be punched or subpunched and reamed, drilled or subdrilled and reamed, or formed by numerically controlled drilling operations.

The hole for each high strength bolt shall be 1/16-inch larger than the nominal diameter of the bolt.

In forming any connection, the fabricator may drill holes full size from the solid with all thicknesses of material assembled in proper position. If the fabricator chooses not to use this method, then these methods apply:

(a) Holes shall be subpunched or subdrilled, then reamed full size after assembly in all connections and splices in the main members of trusses, arches, continuous beam spans, bents, towers, plate girders, box girders, and rigid frames.
(b) Holes may be drilled full size unassembled to a steel template for splices of rolled beam stringers that continue over floorbeams or crossframes.
(c) Holes shall be subpunched and reamed full size to a steel template or reamed full size while assembled for end connections of rolled beam stringers and floorbeams or crossframes.

If steel templates are used to ream or drill full-size connection holes, the templates shall be positioned and angled with extreme care and bolted firmly in place. Templates for reaming matching members or the opposite faces of one member shall be duplicates. Templates for connections on like parts or members shall be located with such accuracy that match-marks are not needed.

Bolt holes in crossframes, gussets, lateral braces, and other secondary members may be punched or drilled full size from the solid while assembled.

6-03.3(27)B PUNCHED HOLES

For punched holes, die diameter shall not exceed punch diameter by more than 1/16 inch. Any hole requiring enlargement to admit the bolt shall be reamed. All holes shall be cut clean with no torn or ragged edges. The Owner will reject components having poorly matched holes.

6-03.3(27)C REAMED AND DRILLED HOLES

Reaming and drilling shall be done with twist drills, or with short taper reamers, producing cylindrical holes perpendicular to the member. Reamers and drills shall be directed mechanically, not hand-held. Connecting parts that require reamed or drilled holes shall be assembled and held securely as the holes are formed, then match-marked before disassembly. The Contractor shall provide the Engineer a diagram showing these match-marks. The Owner will reject components having poorly matched holes.

Burrs on outside surfaces shall be removed. If the Engineer requires, the Contractor shall disassemble parts to remove burrs.

6-03.3(27)D NUMERICALLY CONTROLLED DRILLED CONNECTIONS

In forming any hole described in Section 6-03.3(27), the fabricator may use numerically controlled (N/C) drilling or punching equipment if it meets the requirements in this Section.

The Contractor shall submit for approval a detailed outline of proposed N/C procedures. This outline shall:

(a) Cover all steps from initial drilling or punching through check assembly;

(b) Include the specific members of the structure to be drilled or punched, hole sizes, locations of the common index and other reference points, makeup of check assemblies, and all other information needed to describe the process fully.

N/C holes may be drilled or punched to size through individual pieces, or may be drilled through any combination of tightly clamped pieces.

When the Engineer requires, the Contractor shall demonstrate that the N/C procedures consistently produces holes and connections meeting the requirements of these Specifications.

6-03.3(27)E ACCURACY OF PUNCHED, SUBPUNCHED AND SUBDRILLED HOLES

After shop assembly and before reaming, all punched, subpunched, and subdrilled holes shall meet the following standard of accuracy. At least 75 percent of the holes in each connection shall permit the passage of a cylindrical pin 1/8-inch smaller in diameter than nominal hole size. This pin shall pass through at right angles to the face of the member without drifting. All holes shall permit passage of a pin 3/16-inch smaller in diameter than nominal hole size. The Owner will reject any piece that fail to meet these standards.

6-03.3(27)F ACCURACY OF REAMED AND DRILLED HOLES

At least 85 percent of all holes in a connection of reamed or drilled holes shall show no offset greater than 1/32 inch between adjacent thicknesses of metal. No hole shall have an offset greater than 1/16 inch.

Centerlines from the connection shall be inscribed on the template and holes shall be located from these centerlines. Centerlines shall also be used for accurately locating the template relative to the milled or scribed ends of the members.

Templates shall have hardened steel bushing inserted into each hole. These bushings may be omitted, however, if the fabricator satisfies the Engineer (1) that the template will be used no more than 5 times, and (2) that use will produce no template wear.

Each template shall be at least 1/2-inch thick. If necessary, thicker templates shall be used to prevent buckling and misalignment as holes are formed.

6-03.3(27)G FITTING FOR BOLTING

Before drilling, reaming, and bolting begins, all parts of a member shall be assembled, well pinned, and drawn firmly together. If necessary, assembled pieces shall be taken apart to permit removal of any burrs or shavings produced as the holes are formed. The member shall be free from twists, bends, and other deformation.

In shop-bolted connections, contacting metal surfaces shall be sandblasted clean before assembly. Sandblasting shall meet the requirements of the SSPC Specifications for Commercial Blast Cleaning (SSPC-SP 6).

Any drifting done during assembly shall be no more than enough to bring the parts into place. Drifting shall not enlarge the holes or distort the metal.

6-03.3(28) SHOP ASSEMBLY

6-03.3(28)A METHOD OF SHOP ASSEMBLY

Unless the Contract states otherwise, the Contractor shall choose from the 5 shop assembly methods described below one that will best fit the proposed erection method. The Contractor shall obtain the Engineer's approval of both the shop assembly and the erection methods before work begins.

(a) Full Truss or Girder Assembly: Each truss or girder is completely assembled over the full length of the superstructure.

(b) Progressive Truss or Girder Assembly: Each truss or girder is assembled in stages over the full length of the superstructure.

(1) For trusses: The first stage shall include at least three adjacent panels

(2) For girders: The first stage shall include at least three adjacent shop sections.

After stage one has been completed, each next stage shall be assembled to include: two panels or shop sections of the previous stage, repositioned if necessary, and pinned to ensure accurate alignment, and one or more panels or shop sections added at the advancing end.

If the bridge is longer than 150 feet, each stage shall be at least 150 feet long, regardless of the length of individual continuous panels or shop sections.

The Contractor may begin the assembly sequence at any point on the bridge and proceed in either or both directions from that point.

Unless the Engineer approves otherwise, no assembly shall have less than three panels or shop sections.

(c) Full Chord Assembly: The full length of each chord for each truss is assembled with geometric angles at the joints. Chord connection bolt holes are drilled/reamed while members are assembled. The truss web member connections are drilled/reamed to steel templates set by relating geometric angles to the chord lines.

At least one end of each web member shall be milled or scribed at right angles to its long axis. The templates at both ends of the member shall be positioned accurately from the milled end or scribed line.

(d) Progressive Chord Assembly: Adjacent chord sections are assembled in the same way as specified for Full Chord Assembly, using the procedure specified for Progressive Truss or Girder Assembly.

(e) Special Complete Structure Assembly: All structural steel members (superstructure and substructure, including all secondary members) are assembled at one time.

6-03.3(28)B CHECK OF SHOP ASSEMBLY

The Contractor shall check each assembly for alignment, accuracy of holes, fit of milled joints, and other assembly techniques. Drilling or reaming shall not begin until the Engineer has given approval. If the Contractor uses N/C drilling, this approval must be obtained before the assembly or stage is dismantled.

6-03.3(29) SANDBLASTING

After fabrication, the Contractor shall sandblast all structural steel (except machine-finished surfaces) in accordance with the SSPC-SP10 specification for near-white blast cleaning. After sandblasting and before painting, the Contractor shall remove all loose dust and dirt that remains on the steel. Acid shall not be used to remove scale or stains in the field.

6-03.3(30) SHOP PAINTING

6-03.3(30)A GENERAL

Within 8 hours after the sandblasting required in Section 6-03.3(29), all structural steel shall be painted with one shop coat as the Drawings specify. The Contractor shall not add more volatile thinner to the paint than the formula permits.

The Contractor shall not load structural steel for shipment until the shop coat of paint has dried thoroughly. No painting shall be done after the steel has been loaded for shipment.

Contact surfaces of field bolted connections shall be:

(a) Painted with the shop coat when the structure is to be coated with inorganic zinc silicate paint, but

(b) Painted with one shop coat of vinyl pretreatment, Formula No. A-5-61, when the structure is to be coated with a paint other than inorganic zinc silicate.

If the contact surfaces of a bolted connection coated with inorganic zinc silicate paint has been kept free from dirt, oil, grease, and other foreign matter, it may be field bolted without further preparation. If it is contaminated, the surface shall be sandblasted just before final bolting.

All contact surfaces of bolted connections coated with other than inorganic zinc silicate paint shall be cleaned by sandblasting just before final field bolting.

Any sandblasting done before final field bolting shall comply with SSPC Specifications for Commercial Blast Cleaning (SSPC-SP6).

6-03.3(30)B WEATHER CONDITIONS

The Contractor shall apply paint only when air and metal are 40 degrees F or warmer. Major painting on a structure shall not begin unless the weather is forecast to remain above 40 degrees F for at least 48 hours after painting starts. Minor painting of spots and small areas may be done any time the air and metal meet temperature requirements.

In open yards or on erected structures, the metal shall not be painted while hot enough to blister the paint.

Paint shall never be applied on damp metal. Any metal painted under cover in damp or cold weather shall remain covered until dry or until weather conditions permit open exposure.

6-03.3(30)C APPLICATION

All paint shall be brushed on unless the Project Manual call for another method. Painting shall be done in a professional manner by competent painters. The paint film shall meet the minimum thickness requirements stated in Section 6-07.3(5).

6-03.3(30)D ERECTION MARKS

Erection marks to permit identification of members in the field shall be painted on previously painted surfaces.

6-03.3(30)E MACHINE FINISHED SURFACES

As soon as possible and before they leave the shop, machine-finished surfaces on abutting chord splices, column splices, and column bases shall be covered with grease. After erection, the steel shall be cleaned and painted as specified.

All surfaces of iron and steel castings milled to smooth the surface shall be painted with the primer called for in the specified paint system.

While still in the shop, machine-finished surfaces and inaccessible surfaces of rocker or pin-type bearings shall receive the full paint system. Surfaces of pins and holes machine-finished to specific tolerances shall not be painted. But as soon as possible and before they leave the shop, they shall be coated with grease.

6-03.3(31) ALIGNMENT AND CAMBER

6-03.3(31)A GENERAL

Before beginning field bolting, the Contractor shall:

(a) Adjust the structure to correct grade and alignment,

(b) Regulate elevations of panel points (ends of floorbeams), and

(c) Delay bolting at compression joints until adjusting the blocking to provide full and even bearing over the whole joint.

On truss spans, a slight excess camber will be permitted as the bottom chords are bolted. But camber and relative elevations of panel points shall be corrected before the top chord joints, top lateral system, and sway braces are bolted.

6-03.3(31)B MEASURING CAMBER

The Contractor shall provide the Engineer with a diagram for each truss that shows camber at each panel point. This diagram shall display actual measurements taken as the truss is being assembled.

6-03.3(32) ASSEMBLING AND BOLTING

As erection proceeds, all field connections and splices for each member shall be securely drift pinned and bolted before the weight of the next member is added. Field erection drawings shall specify pinning and bolting requirements that meet or exceed these minimums:

(a) Joints in normal structures: field bolted and pinned to 50 percent of full strength, with at least 30 percent of the holes pinned in any single joint.

(b) Joints in cantilevered structures: field bolted and pinned to 75 percent of full strength, with at least 50 percent of the holes pinned in any single joint.

Pins shall be placed throughout each joint, with the greatest concentration in the outer gage lines.

All bolts shall be placed with heads toward the outside and underside of the bridge. All high-strength bolts shall be installed and tightened before the falsework is removed.

The Contractor may erect metal railings as erection proceeds. But railings shall not be bolted or adjusted permanently until the falsework is released and the deck placed.

The Contractor shall not begin painting until the Engineer has inspected and accepted field bolting.

Where bolted connections are shown in the Drawings or specifically authorized, all bolts, nuts, and washers shall conform to the specifications for material and assembly of structural joints using high strength steel bolts as provided in Division I, Design, Article 10.32.3, and Division II, Construction, Articles 10.3 and 10.17 of the current AASHTO Standard Specifications for Highway Bridges.

6-03.3(33) BOLTED CONNECTIONS

6-03.3(33)A GENERAL

All bolted connections are friction type. Painted structures require Type 1 or Type 2 bolts. Unpainted structures require Type 3 bolts. Direct tension indicators, if used, shall be galvanized on painted structures and epoxy-coated on unpainted structures.

The Contractor shall supply for the Engineer's approval test reports and compliance certificates for all direct tension indicators.

After assembly, bolted parts shall fit solidly together. They shall not be separated by washers, gaskets, or any other material. Assembled joint surfaces, including those next to bolt heads, nuts, and washers, shall be free of loose mill scale, burrs, dirt, and other foreign material that would prevent solid seating.

When all bolts in a joint are tight, each bolt shall carry at least the proof load shown in Table 3 below:

TABLE 3

Bolt Tension

Bolt Size (In.)	Minimum Bolt Tension (lbs.)
1/2	12,050
5/8	19,200
3/4	28,400
7/8	39,250
1	51,500

Tightening may be done by either the turn-of-nut or the direct-tension-indicator method (each described in detail below). In either method, the nut shall be turned tight while the bolt is prevented from rotating. Each bolt shall have a hardened washer under the nut. However, the Contractor may omit the washer when the turn-of-nut method is used on any AASHTO M 164 bolt. If the Engineer approves, the Contractor may reuse any bolt one time. Retightening a bolt loosened by the tightening of nearby bolts will not be considered reuse.

To begin bolting any connection, the Contractor shall install and tighten to snug-tight enough bolts to bring all parts into full contact with each other. "Snug-tight" means either the tightness reached by (1) a few blows from an impact wrench, or (2) the full effort of a man using a spud wrench.

After this initial tightening, bolts shall be installed and brought to snug-tight in all holes that remain in the connection. Then, beginning with bolts in the most rigid part of the joint and working out to its free edges, the Contractor shall systematically tighten all bolts to specified tension.

(a) Turn-of-Nut Method:

After all bolts in the joint have been brought to snug tightness, the nuts shall be further tightened by the amount of rotation shown in Table 4.

After snug tightening, but before final tightening, the Contractor shall match-mark with crayon or paint the outer face of each nut and the protruding part of the bolt. To ensure that this tightening method is followed, the Engineer will (1) observe as the Contractor installs and tightens all bolts, and (2) inspect each match-mark.

TABLE 4

TURN-OF-NUT TIGHTENING METHOD

Nut Rotation[1] from Snug-Tight Condition

Bolt Length	Disposition of Outer Faces of Bolted Parts		
(measured from underside of head to extreme end of point)	(both faces at right angles to bolt axis)	(one face at right angle to bolt axis, one face sloped no more than 1:20, without bevel washer)	(both faces sloped no more than 1:20 from right angle to bolt axis, without bevel washer)
1≤4D[2]	1/3 turn	1/2 turn	2/3 turn
4D<1≤8D	1/2 turn	2/3 turn	5/6 turn
8D<1≤12D[3]	2/3 turn	5/6 turn	1 turn

[1]Nut rotation is relative to the bolt regardless of which element (nut or bolt) is being turned. Tolerances permitted: plus or minus 30 degrees for final turns of 1/2 turn or less; plus or minus 45 degrees for final turns of 2/3 turn or more.

[2]D = nominal bolt diameter of bolt being tightened.

[3]When bolt length exceeds 12D, the rotation shall be determined by actual tests in which a suitable tension device simulates actual conditions.

(b) Direct-Tension-Indicator Method:

The load indicator shall be placed under the nut with the protrusions facing the nut and with a hardened flat washer placed between the load indicator and the nut. After all bolts in the joint have been brought to snug tightness, the nuts shall be further tightened until all gap openings are 0.015 inch or less and more than 50 percent of the gap openings in the load indicator measure 0.005 inch or less. Gap openings shall be 0.000 inch for unpainted structures. When tightening the nut, hold the bolt head with a hand wrench to prevent turning.

To ensure that this tightening method is followed, the Engineer will observe as the Contractor installs and tightens all bolts. In the presence of the Engineer, the Contractor shall inspect all bolts with a feeler gauge.

6-03.3(33)B BOLTING INSPECTION

The Contractor, in the presence of the Engineer, shall inspect the tightened bolt using an inspection torque wrench.

Three bolts of the same grade, size, and condition as those under inspection shall be placed individually in a device calibrated to measure bolt tension. This calibration operation shall be done at least once each inspection day. There shall be a washer under the part turned in tightening each bolt if washers are used on the structure. If washers are not used on the structure, the material abutting the part turned shall be of the same specification as that used on the structure. In the calibrated device, each bolt shall be tightened by any convenient means to the specified tension. The inspecting wrench shall then be applied to the tightened bolt to determine the torque required to turn the nut or head 5 degrees (approximately 1 inch at a 12-inch radius) in the tightening direction. The average of the torque required for all three bolts shall be taken as the job-inspection torque.

Ten percent (minimum 2 bolts) of the tightened bolts on the structure represented by the test bolts shall be selected at random in each connection. The job-inspection torque shall then be applied to each with the inspecting wrench turned in the tightening direction. If this torque turns no bolt head or nut, the Owner will accept the connection as being properly tightened. But if the torque turns one or more bolt heads or nuts, the job-inspection torque shall then be applied to all bolts in the connection. Any bolt whose head or nut turns at this stage shall be tightened and reinspected. The Contractor may, however, retighten all the bolts in the connection and resubmit it for inspection.

6-03.3(34) ADJUSTING PIN NUTS

All pin nuts shall be tightened thoroughly. The pins shall be placed so that members bear fully and evenly on the nuts. The pins shall have enough thread to allow burring after the nuts are tightened.

6-03.3(35) SETTING ANCHOR BOLTS

Anchor bolts shall be set in masonry as required in Section 6-02.3(18). Anchor bolts shall be grouted in after the shoes, masonry plates, and keeper plates have been set and the span or series of continuous spans are completely erected and adjusted to line and camber.

6-03.3(36) SETTING AND GROUTING SHOES

The following procedure applies to masonry plates for all steel spans, including shoes, keeper plates, and turning racks on movable bridges. To set masonry plates, the Contractor shall:

(a) Set masonry plates on the anchor bolts;
(b) Place steel shims under the masonry plates to position pin centers to line and grade and in relationship to each other. Steel shims shall be no more than 2-1/2 inches square and placed under masonry plates webs;
(c) Level the bases of all masonry plates;
(d) Draw anchor bolt nuts down tight;
(e) Recheck pin centers for alignment; and
(f) Leave at least 3/4 inch of space under each shoe for grout.

After the masonry plates have been set and the span or series of continuous spans are completely erected, the space between the top of the masonry and the bottom of the masonry plates shall be filled with grout. Main masonry plates for cantilever spans shall be set and grouted in before any steel work is erected.

Grout shall consist of equal parts of portland cement and clean, fine-grained sand, well mixed with enough water to produce a flowing mix. For each sack of cement, 1 teaspoonful of unpolished aluminum powder shall be added. To grout shoes, the Contractor shall:

(a) Build a form approximately 4 inches high with sides 4 inches outside the base of each shoe;
(b) Fill each form to the top with grout;
(c) Work grout under all parts of each shoe;
(d) Remove each form after the grout has hardened;
(e) Remove the grout outside each shoe to the base of the shoe;
(f) Bevel off the grout neatly to the top of the masonry; and
(g) Place no additional load on the shoe until the grout has set at least 72 hours.

6-03.3(37) SETTING EXPANSION BEARING BED PLATES

Masonry plates, shoes, and keeper plates of expansion bearings shall be set and adjusted to center the expansion shoe at a normal temperature of 64 degrees F. Adjustment for any inaccuracy in fabricated length shall be made after dead-load camber is out.

6-03.3(38) PLACING SUPERSTRUCTURE

The Contractor shall place no superstructure load on finished piers or abutments until the Engineer allows. Normally, this concrete-hardening interval requires at least 12 days.

6-03.3(39) SWINGING THE SPAN

No forms, steel reinforcing bars, or concrete roadway slabs shall be placed on steel spans until the spans swing free on their supports and elevations recorded. No simple span or any series of continuous spans will be considered as swinging free until all temporary supports have been released. Forms, reinforcing steel, or concrete roadway slabs shall not be placed on any simple or continuous span steel girder bridge until all its spans are adjusted and its masonry plates, shoes, and keeper plates grouted. For this Specification, the structure shall be considered as continuous across hinged joints.

After the falsework is released (spans swung free) the masonry plates, shoes, and keeper plates are grouted, and before any load is applied, the Engineer will:

(a) Measure elevations at proper points along the tops of girders or floorbeams,
(b) Compare steel weight camber elevations with the elevations measured in step (a), and
(c) Furnish the Contractor with new dead-load camber dimension. The Contractor shall adjust the top-of-web to top-of-deck dimensions, varying from plan camber as necessary and as determined by the Engineer.

6-03.3(40) FILLING AND DRAINING POCKETS

The Contractor shall provide enough holes to dain all water from pockets in trusses, girders, and other members.

All costs related to providing drain holes shall be included in the unit prices for structural or cast steel.

6-03.3(41) FLOORBEAM PROTECTION

Each floorbeam that supports a concrete slab joint shall be coated on its top and flange edges with a heavy mop of roofing grade asphalt, applied hot. This asphalt shall conform to ASTM D 312 (not mineral stabilized). A protective covering of 3-ply, asphalt-saturated, roofing felt shall be added to the hot coat of asphalt. This combination coating shall be applied over the shop paint. It shall take the place of the 2 field coats of paint specified for other parts of the structural steel.

6-03.3(42) SURFACE CONDITION

As the structure is erected, the Contractor shall keep all steel surfaces clean and free from dirt, concrete, mortar, oil, paint, grease, and other stain-producing foreign matter. Any surfaces that become stained shall be cleaned as follows:

(a) Painted steel surfaces shall be cleaned by methods required for the type of staining. The method shall be submitted to the Engineer for approval. Unpainted steel surfaces shall be cleaned by sandblasting.
(b) Sandblasting to remove stains on publicly visible surfaces shall be done to the extent that, in the Engineer's opinion, the uniform weathering characteristics of the structure are preserved.

6-03.3(43) CASTINGS, STEEL FORGINGS, AND MISCELLANEOUS METALS

6-03.3(43)A GENERAL

Castings, steel forgings, and miscellaneous metals shall be built to comply with Section 9-06.

6-03.3(43)B SHOP CONSTRUCTION, CASTINGS, STEEL FORGINGS, AND MISCELLANEOUS METALS

This section's requirements for structural steel (including painting requirements) shall also apply to castings, steel forgings, and miscellaneous metals.

Castings shall be:

(a) True to pattern in form and dimensions;
(b) Free from pouring faults, sponginess, cracks, blow holes, and other defects in places that would affect strength, appearance, or value;
(c) Clean and uniform in appearance;
(d) Filleted boldly at angles; and
(e) Formed with sharp and perfect arrises.

Iron and steel castings and forgings shall be annealed before any machining, unless the Drawings state otherwise.

6-03.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Cast or forged metal (kind) or copper seals shown in the Drawings will be measured by the pound or will be paid for on a lump sum basis, whichever is shown on the Bid Form.

In computing pay weight on the basis of scale weights, the pay quantity of structural steel will be the shop scale weight of the fabricated members, which shall be weighed on satisfactory scales in the presence of the Inspector. If the shop paint has been applied to the completed member when

weighed, 0.4 of 1 percent of the weight of the member shall be deducted from the scale weights to compensate for weight of shop paint.

6-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-03 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Structural Carbon Steel," per pound.
(2) "Structural Low Alloy Steel," per pound.
(3) "Structural High Strength Steel," per pound.
(4) "(Cast or Forged) Steel," lump sum or per pound.
(5) "(Cast, Malleable, or Ductile) Iron," lump sum or per pound.
(6) "Cast Bronze," lump sum or per pound.

The contract bid price for the items "Structural Carbon Steel", "Structural Low Alloy Steel", and "Structural High Strength Steel" shall be full compensation for all costs necessary for manufacture, fabrication, transportation, erection and painting of all structural steel used in the completed structure, including protective coating or treatment as may be called for on the Drawings or in the Project Manual.

Payment for "(Cast or Forged) Steel", "(Cast, Malleable or Ductile) Iron", and "Cast Bronze" will be made at the lump sum or per pound contract prices as included in the Bid Form.

For the purpose of payment, such minor items as bearing plates, pedestals, forged steel pins, anchor bolts, field bolts, shear connectors, etc., unless otherwise provided for elsewhere, shall be considered as structural carbon steel even though it is made of other materials. Reinforcing bars which are threaded will be paid as "Steel Reinforcing Bar, (Grade)" or "Steel Reinforcing Bar, (Grade), Epoxy Coated" in accordance with Section 6-02.5.

When no bid item is included in the Bid Form and payment is not otherwise provided, the castings, forgings, and miscellaneous metal shall be considered as incidental to the construction, and all costs therefore shall be included in the unit contract prices for the payment items involved and shown.

Prospective bidders shall verify the estimated weight of structural steel before submitting the bid.

All costs related to filling pockets and providing drain holes shall be included in the unit contract prices for structural or cast steel.

The weight of field bolts shall be based on the approved shipping list. No payment will be made for any weight in excess of 1-1/2 percent above the computed net weight of the whole item.

SECTION 6-04 TIMBER STRUCTURES

6-04.1 DESCRIPTION

This work shall consist of building of any structure or parts of structures (except piling) made of treated timber, untreated timber, or both. The Contractor shall erect timber structures on prepared foundations. The structures shall conform to the dimensions, lines, and grades required by the Drawings, the Engineer, and these Specifications.

Any part of a timber structure made of nontimber materials shall comply with the Sections of these Specifications that govern those materials.

6-04.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Structural Steel and Related Material	9-06
Bolts, Washers, Other Hardware	9-06.22
Paints	9-08
Timber and Lumber	9-09

6-04.3 CONSTRUCTION REQUIREMENTS

6-04.3(1) STORING AND HANDLING MATERIAL

At the work site, the Contractor shall store all timber and lumber in piles. Weeds and rubbish under and around these piles shall have been removed before the lumber is stacked.

Untreated lumber shall be open stacked at least 12 inches above the ground. It shall be piled to shed water and prevent warping.

Treated timber shall be:

(a) Cut, framed, and bored (whenever possible) before treatment;
(b) Close stacked and piled to prevent warping;
(c) Covered against the weather if the Engineer requires it;
(d) Handled carefully to avoid sudden drops, broken outer fibers, and surface penetration or bruising with tools; and
(e) Lifted and moved with rope or chain slings (without use of cant dogs, peaveys, hooks, or pike poles).

6-04.3(2) WORKMANSHIP

The Contractor shall employ only competent bridge carpenters. All their work shall be true and exact. Nails and spikes shall be driven with just enough force to leave heads flush with wood surfaces. The Contractor shall discharge any worker who displays poor workmanship by leaving deep hammer marks in wood surfaces. Workmanship on metal parts shall comply with requirements for steel structures.

6-04.3(3) SHOP DETAILS

The Contractor shall provide the Engineer with: 6 sets of shop detail drawings for all treated timber. These Shop Drawings shall show dimensions for all cut, framed, or bored timbers. The Engineer will return to the Contractor 1 set of approved or corrected Shop Drawings. No material shall be framed or bored until the Engineer approves the Shop Drawings. Shop Drawings shall be drawn on sheets that conform to the sizes required in Section 1-05.3.

6-04.3(4) FIELD TREATMENT OF CUT SURFACES, BOLT HOLES, AND CONTACT SURFACES

All cuts and abrasions in treated piles or timbers shall be trimmed carefully, coated with 2 coats of hot creosote, and covered with hot roofing pitch or asphalt-asbestos roofing cement. Application of cresote treatment shall be only performed by experienced person.

All bolt holes drilled in the field shall be treated with hot creosote oil from a pressured, bolt-hole treater. If the material will be painted, the holes shall be pressure treated with the same preservative as was used on the timber. Any unfilled holes shall be plugged with wood plugs treated with the same preservative used in the holes.

On structures of untreated timber, 2 thorough coats of hot creosote oil shall be applied to the heads of all piles; the ends, tops, and all contact surfaces of sills, caps, floorbeams, stringers, and wheel guards; all end joints; all contact surfaces of bracing and truss members; the back faces of bulkheads; and all other timber that will contact the earth.

In addition, all depressions or openings around bolt holes, joints, or daps that may retain moisture shall be sealed with hot pitch of an approved quality.

6-04.3(5) HOLES FOR BOLTS, DOWELS, RODS, AND LAG SCREWS

Holes shall be bored:

(a) For drift pins and dowels–with a bit 1/16-inch smaller in diameter than the pins and dowels.

(b) For truss rods or bolts–with a bit 1/16-inch larger in diameter than the rods or bolts.
(c) For lag screws–in two parts: (1) with the shank lead hole the same diameter as the shank and as deep as the length of the unthreaded portion of the shank; and (2) with the lead hole for the threaded part approximately two-thirds of the shank diameter.

6-04.3(6) BOLTS, WASHERS, AND OTHER HARDWARE

Bolts, flat-head bolts, dowels, washers, and other hardware, including nails, shall be black or galvanized as specified in the Plans, but if not so specified shall be galvanized when used in treated timber structures. Flat-head bolts are detailed in WSDOT Standard Plan No. E-2.

Washers of the size and type specified shall be used under all bolt heads and nuts that would otherwise contact wood. Flat-head bolts require washers under the nuts only.

All bolts shall be checked by burring the threads after the nuts have been finally tightened. Vertical bolts shall have nuts on the lower ends.

Wherever bolts fasten timber to timber, to concrete, or to steel, the members shall be bolted tightly together at installation and retightened just before the Owner accepts the work. These bolts shall have surplus threading of at least 3/8 inch per foot of timber thickness to permit future tightening.

Where flat head bolts are specified, washers shall be used under the nuts only. Details for flat head bolts shall be as shown on the Drawings.

6-04.3(7) COUNTERSINKING

Countersinking shall be done wherever smooth faces are required. Each recess shall be painted with hot creosote oil. After the bolt or screw is in place, the recess shall be filled with hot pitch.

6-04.3(8) FRAMING

The Contractor shall cut and frame lumber and timber to produce close-fitting, full-contact joints. Each mortise shall be true to size for its full depth, and its tenon shall fit it snugly. Neither shimmed nor open joints are permitted.

6-04.3(9) FRAMED BENTS

Mudsills shall be of pressure-treated timber, firmly and evenly bedded to solid bearing, and tamped in place.

Concrete pedestals that support framed bents shall be finished so that sills will bear evenly on them. To anchor the sills, the Contractor shall set dowels in the pedestals when they are cast. The dowels shall be at least 3/4 inch in diameter and protrude at least 6 inches above the pedestal tops. Pedestal concrete shall comply with Section 6-02.

Each sill shall rest squarely on mudsills, piles, or pedestals. It shall be drift-bolted to mudsills or piles with 3/4-inch diameter or larger bolts that extend at least 6 inches into them. When possible, the Contractor shall remove any earth touching the sills to permit free air circulation around them.

Each post shall be fastened to sills with 3/4-inch diameter or larger dowels that extend at least 6 inches into the post.

6-04.3(10) CAPS

Timber caps shall rest uniformly across the tops of posts or piles and cap ends shall be aligned evenly. Each cap shall be fastened with a drift bolt 3/4 inch in diameter or larger that penetrates the post or pile at least 9 inches. The bolt shall be approximately in the center of the pile or post.

If the roadway grade exceeds 2 percent, each cap shall be beveled to match the grade.

6-04.3(11) BRACING

When pile bents are taller than 10 feet, each shall be braced crosswise and every other pair shall be braced lengthwise. No single cross-bracing shall brace more than 20 feet of vertical distance on the piles. If the vertical distance exceeds 20 feet, more than one cross-bracing shall be used. Each brace end shall be bolted through the pile, post, or cap with a bolt 3/4 inch in diameter or larger. Other brace/pile intersections shall be bolted or boat-spiked as the Drawings require. Cross-bracing shall lap both upper or lower caps and shall be bolted to the caps or sills at each end.

6-04.3(12) STRINGERS

All stringers that carry laminated decking or vary more than 1/8 inch in depth shall be sized to an even depth at bearing points. Outside stringers shall be butt jointed and spliced. Interior stringers shall be lapped so that each rests over the full width of the cap or floorbeam at each end. Except on sharp horizontal and vertical curves, stringers may cover 2 spans. In this case, joints shall be staggered and the stringers either toenailed or drift bolted as the Drawings require. To permit air circulation on untreated timber structures, the ends of lapped stringers shall be separated. This separation shall be done by fastening across the lapping face a 1-inch x 3-inch wood strip cut 2 inches shorter than the depth of the stringer.

Any cross-bridging or solid bridging shall be neatly and accurately framed, then securely toenailed at each end (with 2 nails for cross-bridging and 4 nails for solid bridging). The Drawings show bridging size and spacing.

6-04.3(13) WHEEL GUARDS AND RAILINGS

Wheel guards and railings shall be built as Section 6-06.3(1) requires.

6-04.3(14) SINGLE-PLANK FLOORS

Single-plank floors shall be made of a single thickness of plank on stringers or joists. Unless the Engineer directs otherwise, the planks shall be:

(a) Laid heart side down with tight joints,
(b) Spiked to each joist or nailing strip with at least 2 spikes that are at least 4 inches longer than the plank thickness,
(c) Spiked at least 2-1/2 inches from the edges,
(d) Cut off on a straight line parallel to the centerline of the roadway,
(e) Arranged so that no adjacent planks vary in thickness by more than 1/16 inch, and
(f) Surfaced on one side and one edge (S1S1E) unless otherwise specified.

6-04.3(15) LAMINATED FLOORS

The strips shall be placed on edge and shall be drawn down tightly against the stringer or nailing strip and the adjacent strip and, while held in place, shall be spiked. Each strip shall extend the full width of the deck, unless some other arrangement is shown in the Drawings or permitted by the Engineer.

Each strip shall be spiked to the adjacent strip at intervals of not more than 2 feet and staggered 8 inches in adjacent strips. The spikes shall be of sufficient length to pass through 2 strips and at least halfway through the third. In addition, unless bolting is specified in the Drawings, each strip shall be toenailed to alternate stringers with 40d common nails and adjacent strips shall be nailed to every alternate stringer. The ends of all pieces shall be toenailed to the outside stringer. The ends of the strips shall be cut off on a true line parallel to the centerline of the roadway. When bolts are used to fasten laminated floors to stringers, the bolts shall be placed at the spacing shown in the Drawings, and the pieces shall be drawn

down tightly to the bolting strips. The bolt heads shall be driven flush with the surface of the deck. Double nuts or single nuts and lock nuts shall be used on all bolts. The strips shall be spiked together in the same manner as specified above.

6-04.3(16) PLANK SUBFLOORS FOR CONCRETE DECKS

Any plank subfloor shall be laid surfaced side down with close joints at right angles to the centerline of the roadway. Planks shall be spiked in place as required in Section 6-04.3(14).

Floor planks shall be pressure treated with creosote as Section 9-09.3(2) requires. The Drawings govern the amount of creosote oil.

6-04.3(17) TRUSSES

Completed trusses shall show no irregularities of line. From end to end, chords shall be straight and true in horizontal projection. In vertical projection they shall show a smooth curve through panel points that conforms to the correct camber. The Engineer will reject any piece cut unevenly or roughly at bearing points. Before the Contractor places the hand railing,he shall complete all trusses, swing them free of their falsework, and adjust them for line and camber (unless the Engineer directs otherwise).

6-04.3(18) PAINTING

Section 6-07.3(3) governs painting of timber structures.

6-04.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

"Timber and Lumber (Untreated or Name Treatment)" will be measured by the 1,000 board feet measure (MBM), using nominal thicknesses and widths. Lengths will be actual lengths of individual pieces in the finished structure with no deduction for daps, cuts, or splices. To measure laminated timber decking, the Owner will use the number and after-dressing sizes of pieces required in the Drawings. The length of each lamination shall be the length remaining in the finished structure.

6-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-04 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Timber and Lumber (Untreated or Name Treatment)", per MBM.

The unit contract price for "Timber and Lumber (Untreated or Name Treatment)" shall be full pay including hardware, and all works necessary for the manufacture, fabrication, preservative treatment, seasoning, transportation, erection, and painting of the timber and lumber used in the completed structure.

Payment for Structural Metal shall be in accordance with Section 6-03.5. Where no item for structural metal is included in the Bid Form, full pay for furnishing and placing metal parts shall be included in the unit contract price for "Timber and Lumber (Untreated or Name Treatment)."

SECTION 6-05 PILING

6-05.1 DESCRIPTION

This work consists of furnishing and driving piles (timber, precast concrete, cast-in-place concrete, and steel) of the sizes and types the Drawings or the Engineer require. This work shall also includes cutting off or building up piles when required. In providing and driving piles, the Contractor shall comply with the requirements of this Section, the Drawings, and the Engineer.

This work shall also include furnishing and driving test piles and preparation of data derived from these procedures in conformance with these Specifications to assist the Engineer in ascertaining pile lengths and driving criteria.

6-05.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Timber Piling	9-10.1
Concrete Piling	9-10.2
Cast-in-Place Concrete Piling	9-10.3
Prestressed Hollow Concrete Piling	9-10.4
Steel Piling	9-10.5

6-05.3 CONSTRUCTION REQUIREMENTS

6-05.3(1) PILES

6-05.3(1)A GENERAL

Concrete piling may be precast, precast-prestressed, or cast-in-place driven to the minimum load-bearing capacity called for in the Drawings.

6-05.3(1)B ORDERING PILING

The length of piling given in the Bid Form is for estimating purposes only and is not to be used as an order list.

No order list for piling will be furnished by the Engineer.

All piling shall be ordered by the Contractor and he shall determine the length required from the results obtained by the driving of the test piles called for in the Drawings and subsurface exploration data. The Contractor shall increase the lengths, at his own expense, the necessary amount to provide for fresh heading and to reach from the cutoff elevation up to the position of his driving equipment.

6-05.3(1)C DRIVING PILES

The Contractor shall completely dig all foundation pits (and build any required cofferdams or cribs) before he begins driving foundation piles. He shall adjust pit depths to allow for upheaval caused by pile-driving, judging the amount of adjustment by the nature of the soil. Before constructing the footing or pile cap, the Contractor shall restore the pit bottom to correct elevation by removing material or by backfilling with granular material.

The Contractor shall not drive piling from an existing structure.

Piles shall be driven deep enough to obtain the load-bearing capacity shown in the Drawings. If the Drawings specified a minimum tip elevation, piles shall be driven to that elevation unless the Engineer directs otherwise. If the piles do not develop the required load-bearing capacity at the specified tip elevation, the Contractor shall continue driving them until they reach bearing capacity. If no tip elevation is specified, piles shall extend at least 10 feet below the bottom of the concrete footing and 15 feet below the bottom of the concrete seal.

In embankments, if piling is driven through previously placed material, its bearing capacity shall be based on resistance found only in the underlying foundation material

unless otherwise specified. Embankment material includes all that placed above the natural ground line or the new ground line formed by excavation or removal of unsuitable soils.

If the embankment or an intermediate hard zone produces undue friction on the piling, prebored holes larger than the piling diameter may be required. Jetting may be used in lieu of boring these holes only upon approval of the Engineer. The Contractor shall ensure that it will not damage the embankment or foundation soils. After the pile is driven, the Contractor shall fill the open space left by the oversized hole with dry sand or pea gravel approved by the Engineer.

So long as the pile is not injured and the embankment not permanently damaged, the Contractor shall use any means necessary to:

(a) Secure the minimum depth specified,
(b) Penetrate hard material that lies under a soft upper layer,
(c) Obtain the specified minimum tip elevation, or
(d) Penetrate through a previously placed embankment.

If the Engineer requires, the Contractor shall overdrive the pile beyond the minimum load-bearing capacity and penetration shown in the Drawings. In this case, the Contractor will not be required to: (1) use any special means, such as jetting or preboring, to achieve the additional penetration; or (2) bear the expense of removing or replacing any pile damaged by overdriving.

In driving piles for footings with seals, the Contractor shall use no method (such as jetting or preboring) that might reduce friction capacity. The Engineer may require the Contractor to increase seal thickness if it proves impossible to drive piles adequately. Unit bid prices shall cover all costs related to increasing seal thickness for this reason.

Piles shall be driven accurately in true line and position. Unless the Drawings show otherwise, all piles shall be driven vertically. The Contractor shall trim the tops of all piles to the true plane shown in the Drawings and to the elevation the Engineer requires. Any piles under timber caps or grillages shall be sawed to the exact plane of the structure above them and fit it exactly. The Contractor shall remove and replace any broken, split, or misplaced piles.

When driving piles, the Contractor shall protect all adjacent structures and utilities from damage by whatever means necessary. In complying with the requirements of Section 1-07, it shall be the Contractor's responsibility to use a type of pile driving equipment and method of driving which will present the least possibility of damage to adjacent property. The Contractor shall provide and use vibration recording devices to monitor the vibration of existing utilities and structures due to pile driving. To prevent damage to existing structures and utilities and concrete being placed and cured ("green" concrete), safe vibration levels shall not exceed those as recommended in "Highway Research Record No. 155" by the Highway Research Board.

Several methods are available to advance the piles past any obstructions, including spudding, preboring and jetting. These methods should be limited to the upper 10 to 15 feet of pile penetration.

Jetting and preboring for pile installation shall be accomplished when necessary to reduce the magnitude of vibrations for safeguarding adjacent structures and utilities. Jettings shall be permitted where necessary to prevent damage to piles: jetting shall be subject to the approval of the Engineer and shall be closely monitored by the Engineer. Where more than 20 percent of the piles in a pile group are jetted, the capacity of the pile group shall be reevaluated by the Engineer.

Prebore holes shall be monitored as to depth and diameter to prevent oversized holes. The diameter of the preboring shall be adjusted to provide for full contact between the pile and the surrounding soil. It is estimated that the required diameter for preboring will be approximately 2 inches less than the pile diameter; however, the diameter shall be adjusted by the Contractor as directed by the Engineer.

Precast concrete piles shall not be driven until a test cylinder, made from the concrete pour for the piles involved and cured with the piles, shows a strength at least equal to the specified 28-day compressive strength of 7000 psi for the 14-inch pile and 8000 psi for the 16 1/2-inch pile.

Piles should be driven in true alignment at the locations shown on the Drawings and shall be plumb or battered as indicated thereon; the final placement location of the piles shall be within 3 inches from the true alignment position. Piles shall be driven such that the flat side of concrete piles is parallel to the side of the footing.

Any hole developing around a driven pile during driving shall be filled with dry sand or pea gravel as approved by the Engineer, after the pile is driven. Similarly, voids remaining from extracted piles shall be filled with dry sand or pea gravel.

All piles shall be clearly marked at 1-foot intervals for the entire length of the pile. Provisions shall be made to enable the Engineer to make a continuous record of hammer energy and blow counts.

If, without the Engineer's approval, a pile is driven below cutoff elevation, the Contractor shall remove and replace it (and bear the costs of doing so), even if this requires a longer pile. Any pile that rises as nearby piles are driven, shall be driven down again if the Engineer requires.

6-05.3(1)D EQUIPMENT FOR DRIVING

For each drop hammer used, the Contractor shall weigh it in the Engineer's presence or provide the Engineer with a certificate of its weight. The exact weight shall be stamped on the hammer. Drop hammers shall weigh not less than:

(a) Three thousand pounds for piles under 50 feet long that have a maximum load bearing capacity of 20 tons, and
(b) Four thousand pounds for piles 50 feet and longer or that have a load bearing capacity of 20 to 30 tons.

If a drop hammer is used for timber piles, it is preferable to use a heavy hammer and operate with a short drop.

For each diesel, steam, or air-driven hammer used, the Contractor shall provide the Engineer with the manufacturer's specifications and catalog. These shall show all data needed to calculate the bearing value of the piles driven.

Underwater hammers may be used only with approval of the Engineer.

Timber piles shall be driven with drop, diesel, steam, or air-driven hammers.

Drop hammers on timber piles shall have a maximum drop of 10 feet. Drop hammers shall not be used to drive timber piles that have load bearing capacities of more than 30 tons.

When used on timber piles, diesel, steam, or air-driven hammers shall develop at least 13,000 foot-pounds per blow. The ram of any diesel hammer shall weigh at least 2,700 pounds.

Steel casings for cast-in-place concrete piles shall be driven with diesel, steam, or air hammers. These shall develop at least:

(a) Thirteen thousand foot-pounds per blow (and the ram of any diesel hammer weighing at least 2,700 pounds) for piles of 55-ton bearing capacities, and
(b) Twenty-four thousand foot-pounds per blow (and the ram of any diesel hammer weighing at least 4,000 pounds) for piles of 70-ton bearing capacities.

Steel H-piles shall be driven with diesel, steam, or air hammers. Unless the Drawings or Project Manual states otherwise, these shall develop at least:

(a) Thirteen thousand foot-pounds per blow (and the ram of any diesel hammer weighing at least 2,700 pounds) for piles of 55-ton bearing capacities or less, and
(b) Twenty-four thousand foot-pounds per blow (and the ram of any diesel hammer weighing at least 4,000 pounds) for piles with bearing capacities greater than 55 tons.

When using a diesel hammer, the Contractor shall increase ram weight to a point that produces satisfactory results if the weights shown above do not do so.

Precast concrete piles (13, 16, and 18 inches in diameter) shall be driven with a single-acting steam, air, or diesel hammer. The ram shall weigh at least half as much as the pile. The ratio of foot-pounds to ram weight shall not exceed 6. The hammer shall develop at least:

(a) Thirteen thousand foot-pounds per blow for 13-inch piles, and
(b) Twenty-four thousand foot-pounds per blow for 16- and 18-inch piles.

All piles shall be driven with fixed-lead drivers. The Contractor shall not use hanging or swinging leads unless they can be fixed in position during driving. Leads shall be long enough to eliminate the need for any follower (except for timber piles as specified in Section 6-05.3(2)B). To avoid bruising or breaking the surface of treated timber piles, the Contractor shall use spuds and chocks as little as possible. In building a trestle or foundation with inclined piles, leads shall be adapted for driving batter piles.

The Contractor shall not use water jets unless the Engineer approves. If they are used, the number of jets and water volume and pressure shall be enough to erode the material next to the pile. The equipment shall include a minimum of two water-jet pipes and two 3/4-inch jet nozzles. The pump shall produce a constant pressure of at least 100 psi at each nozzle. The jets shall be withdrawn before the pile reaches its final penetration, and the pile shall then be driven to its final penetration and bearing value. If the water jets loosen a pile previously driven, it shall be redriven in place or pulled and replaced by a new pile. To check on pile loosening, the Contractor shall attempt to redrive at least 1 in every 5 piles.

All piles shall be driven with a hammer of the same size, type and energy as used to drive the test piles. If the Contractor elects to change the size or type of hammer after the test piles are driven, the Contractor will drive additional test piles at his own expense to establish the driving criteria for production piles. The cost of performing the wave equation analysis for a new hammer will be at the Contractor's own expense.

The Contractor shall complete the "Pile and Driving Equipment Data" form included in the Appendix and submit this form to the Engineer for approval prior to pile driving.

All pile-driving equipment shall be designed, constructed, and maintained in a manner suitable for the work to be performed in this Contract. If, in the opinion of the Engineer, the driving equipment is inadequate or deficient, the Engineer may direct that it be removed from the job site. All costs for remobilizing, removing, or replacing such equipment shall be at the Contractor's expense.

A driving helmet or cap including a cushion block or cap block shall be used between the top of the pile and the ram to prevent impact damage to the pile.

The driving helmet or cap and cushion block combination shall be capable of protecting the head of the pile, minimizing energy absorption or dissipation and transmitting hammer energy uniformly and consistently during the entire driving period. The driving helmet or cap shall fit loosely around the top of the pile so that the pile may rotate slightly without binding within the driving head.

The cushion block shall consist of a combination aluminum-micarta laminate or "Fosterlon" between the ram and helmet and at least 8 inches of Douglas Fir plywood between the helmet and pile or other approved cushion block. The cushion block shall be replaced if it has been damaged, split, compressed to 67% of its original thickness, charred or burned, or has become spongy or deteriorated in any manner. Under no circumstances will the use of small wood blocks, wood chips, rope, or other material be permitted since this will result in loss of excessive hammer energy.

6-05.3(1)E TEST PILES

The Contractor shall furnish and drive test piles at the locations shown on the Drawings or at the locations designated by the Engineer. They shall be driven to determine the pile driving resistance and to evaluate the load carrying capacity of the pile from the driving record by the Engineer. The driving criteria for production piles shall then be established by the Engineer. Test piles shall be:

(a) Made of the same material and have the same tip diameter as the permanent piles (although test piles for treated timber piles may be either treated or untreated),
(b) Driven with pile tips if the permanent piles will have tips,
(c) Prebored when preboring is specified for the permanent piles,
(d) Identical in cross-section and other characteristics to the permanent piles when the test piles are steel shells or casings for cast-in-place concrete piles or precast concrete and steel,
(e) Long enough to accommodate any soil condition,
(f) Driven with equipment and methods identical to those to be used for the permanent piles,
(g) Located as the Engineer directs, and
(h) Driven before permanent piles.

Timber piles shall be driven outside the footing and cut off 1 foot below the finished ground line. Timber test piles shall not be used in place of permanent piles.

Steel and all types of concrete test piles shall become permanent piles. Accordingly, in the Drawings, the Owner has reduced the number of permanent piles by the number of test piles.

The Contractor shall base test pile length on test-hole data in the Contract. Any test piles that prove to be too short shall be replaced at the Contractor's cost.

In foundations and trestles, test piles shall be driven to at least 15 tons more than the bearing value required for the permanent piles. Test piles shall penetrate at least to any tip elevation specified in the Drawings. If no tip elevation is specified, test piles shall extend at least 10 feet below the bottom of the concrete footing and 15 feet below the bottom of the concrete seal.

When any test pile to be left as a permanent pile has been so damaged by handling or driving that the Engineer believes it unfit for use, the Contractor shall remove and replace it. The Engineer may direct the Contractor to drive the test pile to more than 15 tons over the minimum bearing value for permanent piles. In this case, the overdriving shall be at the Contractor's expense. But if damage results from this overdriving, any removal and replacement will be at the Owner's expense.

6-05.3(2) TIMBER PILING

6-05.3(2)A STORAGE AND HANDLING

The Contractor shall store and handle piles in ways that protect them from injury. Treated piling shall be stacked closely and piled to prevent warping. The ground beneath and around stored piles shall be cleared of weeds, brush, and

rubbish. Piling shall be covered against the weather if the Engineer requires it.

The Contractor shall take special care to avoid breaking the surface of treated piles. They shall be lifted and moved with rope or chain slings (without the use of cant dogs, peaveys, hooks, or pike poles). If timber piles are rafted, any attachments shall be within 3 feet of the butts or tips. Any surface cut or break shall be brushed with 3 coats of hot creosote oil of a quality the Engineer approves. The Engineer may reject any pile because of a cut or break.

6-05.3(2)B DRIVING

Treated and untreated timber piles shall be freshly cut on the butt ends just before they are driven. If piles will be driven into hard material, caps, collars, or bands shall be placed on the butt ends to prevent crushing or brooming. If the head area of the pile is larger than that of the hammer face, the head shall be snipped or chamfered to fit the hammer. On treated piles, the heads shall be snipped or chamfered to at least the depth of the sapwood to avoid splitting the sapwood from the pile body.

On timber piles, the Contractor may use steel (not wooden) followers if the driving head and cap fit snugly over the pile head. The Owner prefers, however, that the hammer strike the pile head directly without any cushion, block, or follower. If a follower is used, the Contractor shall, in every group of 10 piles, drive 1 long pile without a follower. This long pile shall be used to test the bearing power of the group.

The Owner prefers that timber piles be driven with squared ends. But if conditions require, they may be shod with metal shoes of an Engineer-approved design.

The Contractor shall use full length timber piles. Treated timber piles shall have pressure treated tips.

In timber pile bents, stakes set to true line and position shall locate all piles. The piles shall be driven accurately in the correct location and to the vertical or batter lines the Drawings require. If a pile is driven out of line, it shall be straightened without injury before it is cut off or braced. The Contractor shall remove and replace any pile damaged in driving or straightening, or any pile driven below grade. No shimming on top of piles will be permitted.

The Contractor shall match pile sizes in any single bent to prevent sway braces from undue bending or distorting.

6-05.3(2)C SPLICING COMPOSITE PILES

If the Drawings call for a composite pile (made of treated and untreated timber), the untreated pile shall be driven first. It shall be driven to approximately the ground or water line before the treated pile is spliced to it.

Unless the Drawings show otherwise, a splice shall be made of steel pipes bolted or spiked both to the treated and untreated piles. Enough of the butt end of the untreated pile shall be rounded so that a tight driving fit is obtained with the pipe splice. After splicing, the composite pile shall be driven to the required penetration and bearing value in the same manner as other timber piles. After driving, the splice shall be below the level of permanent ground water and deep enough into the ground to obtain lateral support.

When ordering material for composite piles, the Engineer will calculate pile lengths in light of the relative positions of the ground line and the permanent water table. If the Contractor buys splice material before receiving the pile order list, and if the number of composite piles is later reduced, the oversupply will be at the Contractor's expense.

6-05.3(2)D TREATMENT OF PILE HEADS

After cutting piles to correct elevation, the Contractor shall thoroughly coat the heads of all untreated piles with 2 coats of hot creosote oil (except concrete-encased piles).

After cutting treated piles to correct elevation, the Contractor shall brush 3 coats of hot creosote oil on all pile heads (except those to be covered with concrete footings or concrete caps). The pile heads shall then be capped with alternate layers of hot pitch (or approved roofing asphalt) and a waterproofing fabric that conforms to Section 9-11.2. The cap shall be made of 4 layers of pitch and 3 layers of fabric. The fabric shall be cut large enough to cover the pile top and fold down at least 6 inches along all sides of the pile. After the fabric cover is bent down over the pile, its edges shall be fastened with large-head galvanized nails or with three turns of galvanized wire. The edges of the cover shall be neatly trimmed.

On any treated pile encased in concrete, the cut end shall receive 2 coats of hot creosote oil and then a heavy coat of coal tar, pitch, or some other sealer.

6-05.3(2)E STRAPPING

Section 9-10.1 governs strapping for timber piles.

6-05.3(2)F DETERMINATION OF BEARING VALUES

The following formulas shall determine safe-bearing values:

$$P = \frac{2WH}{S+1.0}$$ for all gravity hammers

$$P = \frac{2WH}{S+0.1}$$ for all single-acting hammers and closed-end (double-acting) diesel hammers*

$$P = \frac{2H(W+Ap)}{S+0.1}$$ for double-acting steam or air hammers

Where: P = Safe bearing capacity in pounds
W = weight, in pounds, of hammer striking parts
H = drop of hammer or stroke of ram, in feet
A = area of piston in square inches
P = steam pressure in psi at the hammer
S = the average penetration in inches per blow for the last 5 to 10 blows for gravity hammers and the last 10 to 20 blows for steam, air, or diesel hammers

*For closed-end diesel hammers (double-acting), the energy (WH) is to be determined from the bounce chamber reading. The bounce chamber gauge is to be calibrated for each project.

The formulas above apply only when:

(a) The hammer has a free fall;
(b) The pile head is free from broomed or crushed wood fiber;
(c) The penetration occurs at a reasonably quick, uniform rate; and
(d) There is no perceptible bounce after the blow. Twice the height of the bounce shall be deducted from "H" to determine its true value in the formula.

The Engineer may require the Contractor to install a pressure gauge on the inboard end of the hose to check pressure at the hammer.

For timber piles, bearing power calculated by the formulas above shall be considered effective only when it is less than the crushing strength of the piles. Unless the Drawings state otherwise, timber piles shall have these minimum bearing values (determined by the formulas above):

(a) In foundations: 40 tons
(b) In trestle bents: 20 tons

If water jets are used in driving, bearing capacity shall be determined either: (1) by calculating it with the driving data and the formulas above after the jets have been withdrawn, or (2) by applying a test load.

6-05.3(3) PRECAST CONCRETE PILING

6-05.3(3)A GENERAL

Precast concrete piles shall consist of concrete sections reinforced to withstand handling and driving stresses. These may be reinforced with deformed steel bars or prestressed with steel strands. Reinforcement shall conform to Section 9-07. The Drawings show dimensions and details. If the Drawings require piles with square cross-sections, the corners shall be chamfered 1 inch.

Fifty-five ton precast or prestressed piles shall be at least 13 inches in diameter and shall meet the requirements of WSDOT Standard Plan No. E-4.

Seventy-ton precast-prestressed piles shall be at least 16 inches in diameter and shall meet the requirements of WSDOT Standard Plan No. E-4a.

If only one type of cross-section is furnished for any single pier or retaining wall, the Contractor may substitute approved precast or prestressed piles of sizes and cross-sections other than the 13-, 16-, or 18-inch octagonal piles shown on WSDOT Standard Plan No's. E-4 and E-4a and these Specifications. The substitute piles shall be as strong as or stronger than those they replace in axial and bending capacity to carry vertical and horizontal loads. In addition, they shall meet all other requirements specified in the Standard Plans and these Specifications for 13-, 16-, or 18-inch diameter piles.

The designs for pile top connection, pile "pick-up" diagram and pile capacity shall be subject to the approval of the Engineer. The Contractor shall submit all pile design calculations including shop plans of the piles to be used to the Engineer for approval. The drawings shall include details of piles and pick up points and support locations. The Contractor's design shall be by and under the direction of a licensed Professional Engineer and shall bear his signature and seal.

Temporary stress in the prestressing reinforcement of prestressed piles (before loss from creep and shrinkage) shall be 70 percent of the minimum ultimate tensile strength. (For short periods, the reinforcement may be overstressed to 80 percent of ultimate tensile strength if stress after transfer to concrete does not exceed 70 percent of that strength.)

Prestressed concrete piles shall have a final (effective) prestress of at least 1,000 psi.

When driven, pile faces shall be turned as shown in the Drawings or as the Engineer directs.

The Contractor shall submit for the Engineer's approval drawings of the piles to be used. These drawings (similar to WSDOT Standard Plan No. E-4 for 13-inch, and to WSDOT Standard Plan No. E-4a for 16- or 18-inch octagonal piles) shall include pile details, extension splicing, build-ups, pick-up points, and support locations.

All that these Specifications require for 13-, 16-, and 18-inch diameter piles shall apply also to nonoctagonal precast or prestressed piles.

No pile shall be driven after it is spliced or built up.

Reinforcing bars, hoops, shoes, etc. shall be placed as the Drawings show, with all parts well wire tied together and placed to the specified spacings. No concrete shall be poured until all reinforcement is in place in the forms.

6-05.3(3)B CASTING

In casting concrete piles, the Contractor shall:

(a) Cast them either vertically or horizontally,
(b) Use metal forms (unless the Engineer approves otherwise) with smooth joints and inside surfaces that can be reached for cleaning after each use,
(c) Brace and stiffen the forms to prevent distortion,
(d) Use a concrete mix that will distribute aggregates evenly, with fine and coarse aggregates having approximately the same specific gravity,
(e) Place concrete continuously in each pile, guarding against horizontal or diagonal cleavage planes,
(f) Ensure that the reinforcement is properly embedded,
(g) Use internal vibration around the reinforcement during concrete placement to prevent rock pockets from forming, and
(h) Cast test cylinders with each set of piles as concrete is placed.

Centrifugally cast piles shall be fabricated in a machine that can spin the forms fast enough to distribute and consolidate the concrete without leaving voids behind the reinforcement. The forms shall be rigid enough to take the prestressing force without distortion or reduction in spinning speed. Concreting and spinning shall be continuous. Spinning shall begin before any of the concrete has taken initial set. The Contractor shall drain excess water forced to the center of the form as it spins.

6-05.3(3)C FINISHING

As soon as the forms for precast concrete piles are removed, the Contractor shall fill all holes and irregularities with 1:2 cement-sand mortar. That part of any trestle pile that will be underground or below the low-water line and all parts of any pile to be used in salt water or alkaline soil shall receive only this mortar treatment. That part of any trestle pile that will show above the ground or water line shall be given a Class 3 finish as described in Section 6-02.3(14)D.

6-05.3(3)D CURING

(a) **Precast Concrete Piles.** The Contractor:

(1) Shall keep the concrete continuously wet with water after placement for at least 10 days with Type II portland cement or at least 3 days with Type III.
(2) May remove side forms 24 hours after concrete placement, and then only if the surrounding air remains at no less than 50 degrees for 5 days with Type II portland cement or 3 days with Type III.
(3) May cure precast piles with saturated steam or hot air, as described in Section 6-02.3(25)E, provided the piles are kept continuously wet until the concrete has reached a strength of 3,300 psi.
(4) Piling shall not be subjected to any handling stresses until the concrete has attained a strength of at least 3,300 psi, as determined by test cylinders cured with the piling. Test cylinders shall be cast with each set of piles as they are poured.

(b) **Precast-Prestressed Concrete Piles.** These piles shall be cured as required in Section 6-02.3(25)E.

6-05.3(3)E STORAGE AND HANDLING

The Contractor shall not handle or stress any pile until test cylinders made with it reach a strength of at least 3,300 psi.

Storing and handling methods shall protect piles from fractures by impact and undue bending stresses. Handling methods shall never stress the reinforcement more than 12,000 psi. An allowance of twice the calculated load shall be made for impact and shock effects. Piles shall be lifted with bridles or

slings attached to them at points not more than 20-feet apart nor more than 10 feet from pile ends. The Contractor will take extra care to avoid injuring the surface of any pile to be used in sea water or alkaline soil.

6-05.3(3)F STRENGTH BEFORE DRIVING

No precast-prestressed pile shall be driven until test cylinders poured with it reach at least the specified design strength. On all other precast piles, the cylinders must reach a strength of at least 4,000 psi before the piles are driven.

6-05.3(3)G DRIVING

Pile caps of approved design shall protect the heads of all precast concrete piles as they are driven. Each pile cap shall have fitted into it a cushion next to the pile head. The pile cap shall fit into a casting which supports a shock block. The inside cap diameter shall be determined before casting the pile, and the pile head shall be formed to fit loosely inside the cap.

6-05.3(3)H EXTENSIONS OR BUILD-UPS

The Contractor shall add extensions, splices, or build-ups (if necessary) on precast concrete piles after they are driven.

Before adding to precast-prestressed piles, the Contractor shall remove any spalled concrete, leaving the pile fresh-headed and with a top surface perpendicular to the longitudinal axis of the pile. The concrete in the build-up shall have reached a strength of 5,000 psi at 28 days.

Before adding to other precast piles, the Contractor shall cut the pile head away to a depth 40 times the diameter of the vertical reinforcing bar. The final cut shall be perpendicular to the longitudinal axis of the pile. Reinforcement similar to that in the pile shall be fastened firmly to the projecting steel. Forms shall be placed to prevent concrete from leaking along the pile. The concrete in the build-up shall have reached a strength of 4,000 psi at 28 days.

Just before placing the concrete, the Contractor shall thoroughly wet the top of the pile. Forms shall remain in place at least 3 days.

6-05.3(3)I DETERMINATION OF BEARING VALUES

Bearing capacities of concrete piles shall be determined by the formulas in Section 6-05.3(2)F or Wave Equation Analysis criteria as follows:

The piles as specified on the Drawings, shall be driven to an ultimate load equal to two and one-half times the design load (e.g. 175 tons for a 70-ton pile), and all piles shall be subjected to the final driving criteria established for the production piles based on the wave equation analysis supplied by the City and on the result of the test piles. The following criteria shall be used for load bearing determination:

The piles shall be driven to the resistance criteria determined by the wave equation analyses, based on the ultimate pile capacity.

While the Contractor is responsible for driving all piles to a final driving resistance, the Engineer shall be the sole authority for evaluating penetration relative to ultimate capacity and acceptance of the pile foundations. Unless the Drawings say otherwise, precast concrete piles shall be driven to develop:

(a) Fifty-five tons for those 13 inches in diameter, and
(b) At least the capacity specified in the Drawings for those 16 and 18 inches in diameter.

The Project Manual will specify the type of analysis to use for the Contract in determining the bearing value of piles.

6-05.3(3)J PRESTRESSING STEEL

Prestressing steel shall meet the requirements of Section 9-07.6 and shall be tensioned as required in Section 6-02.3(25)F.

6-05.3(3)K TOLERANCES AND CUTOFF

Piles shall be driven with a variation of not more than 0.25 inch per foot of pile length from the vertical or from the axis of the batter shown on the Drawings. Manipulation of piles to force them into position will not be permitted.

The Contractor is advised that piles driven outside of these specified tolerances may require pile cap modification, related to both size and reinforcement, or may require additional piles to be driven. Such modifications shall be performed as directed by the Engineer at no additional cost to the Owner.

The tops of all piles shall be cut off to the elevation shown on the Drawings. Cutoff tolerance shall be plus 1.0 inch and minus 0.5 inch for 14-inch piles and 16 1/2-inch piles. Cutting off concrete piles shall be done with pneumatic tools sawing, or other approved means. The use of explosives for cutting will not be permitted.

6-05.3(4) CAST-IN-PLACE CONCRETE PILES

6-05.3(4)A GENERAL

These shall consist of steel casings or shells driven into the ground, reinforced as specified, and filled with Class AX concrete. They shall be driven to develop the bearing values shown in the Drawings.

6-05.3(4)B STEEL CASINGS OR SHELLS

Steel casings shall be strong and rigid enough not to distort from pressures from the soil or the driving of adjacent piles. The casings shall keep out water before and during concrete placement.

The diameter of steel casings shall be as follows:

(a) **Fifty-five Ton Bearing Capacity Piles.** Casings of constant diameter shall be at least 12 inches in outside diameter. Tapered or step-tapered casings shall be at least 14 inches in outside diameter at the butt and at least 8 inches in outside diameter at the tip.
(b) **Seventy Ton Bearing Capacity Piles.** Casings of constant diameter shall be at least 14 inches in outside diameter. Tapered or step-tapered casings shall be at least 16 inches in outside diameter at the butt and at least 10 inches in outside diameter 5 feet above the tip.

All sections in a step-tapered casing shall be the same length. The Contractor shall not weld a constant-diameter section onto the tip section to increase pile length unless the Engineer approves in advance.

The diameter of fluted pile sections shall be measured from crest to crest of the flutes.

All casing joints and splices shall be welded as required in Section 6-05.3(6)D. The lower end of each casing shall have a steel driving plate that is thick enough to keep the casing watertight and free from distortion as it is driven.

The Contractor shall obtain the Engineer's approval of casing design before any casings are ordered or shipped.

6-05.3(4)C DRIVING AND INSPECTING STEEL CASINGS

A driving head and pilot of the right size for the hammer shall distribute the blow and protect the top of the steel casing from driving damage. Rigid leads shall support hammer and pile.

The Contractor shall drive pile casings in true alignment and location as shown in the Drawings. If a casing will be driven within 15 feet of a pile containing reinforcement, the

concrete in that pile must have set for at least 7 days before the casing is driven. If the pile does not contain reinforcement, the concrete in it must have set at least 48 hours before the casing is driven.

After driving a pile casing, the Contractor shall leave it empty until the Engineer has inspected and approved it. The Contractor shall make available to the Engineer a light suitable for inspecting the entire length of its interior. The Engineer will reject any casing that is improperly driven, that shows partial collapse that would reduce its bearing value, or that has been reduced in diameter. The Contractor shall replace any rejected casing.

After approval by the Engineer, driven casings shall be cut off horizontally at the required elevation. They shall be clean and free of water when concrete and reinforcing steel are placed.

If part of the pile will show above the ground or water line, the steel casing shall be cut off at least 6 inches below the finished ground line or at the low water line as determined by the Engineer. Any pile build-up above the steel casing for 55-ton and 70-ton piles shall conform respectively to WSDOT Standard Plan No's. E-4 and E-4a for 13-inch and 16-inch diameter prestressed piles–except that these build-ups may be round or octagonal. Build-up forms shall comply with Section 6-02.3(17)G. The reinforcing steel for the build-up pile above the steel casing shall extend at least 8 feet into the lower, steel-encased section.

6-05.3(4)D REINFORCEMENT

No. 5 reinforcing steel bars shall be used in all cast-in-place concrete piles. The number of bars per pile shall be as follows:

(a) 12-inch diameter, 55-ton pile: 6 bars.
(b) 14-inch diameter, 70-ton pile: 7 bars.
(c) All other pile sizes: 1.5 percent of the cross-sectional area of the concrete.

Reinforcement shall extend to the bottom of the pile or 25 feet below the ground line (whichever is less). It shall extend at least 2 feet into the footing or pile cap or to within 2 inches from the top of the footing or pile cap.

All bars shall be fastened rigidly into a single unit and then lowered into the casing before the concrete is placed. No loose bars will be permitted. The reinforcement shall be positioned and secured in place and shall be at least 2 inches clearance between the main reinforcing bars and the pile casing.

Spiral hooping reinforcement shall be placed at 4-inch centers around the top 10 feet of the main reinforcement and at 6-inch centers around the remainder of the main reinforcement. Hooping on the upper 10 feet shall be No. 3 deformed steel bar, 3/8-inch diameter plain steel bar, W11 cold-drawn wire, or D11 deformed wire. Hooping on the remainder shall be W5 cold-drawn wire, or D5 deformed wire.

6-05.3(4)E PLACING CONCRETE

Before placing concrete, the Contractor shall remove all debris and water from the casing. If the water cannot be removed, the casing shall be removed (or filled with sand) and a new one driven.

The Contractor shall place concrete continuously in each casing, filling every part and working the mix around the reinforcement without moving it. Concrete in the reinforced section shall be vibrated. The vibration shall extend 25 feet below the top of the pile or to the bottom of the pile, whichever is less.

6-05.3(4)F DETERMINATION OF BEARING VALUES

The formulas in Section 6-05.3(2)F shall determine bearing capacities of cast-in-place concrete piles or as shown otherwise in the Project Manual.

6-05.3(5) PRESTRESSED HOLLOW CONCRETE PILING

6-05.3(5)A GENERAL

Section 9-10.4 governs the manufacture of prestressed hollow concrete piling.

6-05.3(5)B HANDLING AND INSTALLING

Before placement, piles shall have cured for at least 10 days and reached a compressive strength of at least 6,000 psi.

The Drawings specify pile lengths. If piles are too short, the Contractor shall follow the Drawings by adding solid build-ups of Class AX concrete to extend them to the required lengths. Forms for extensions shall be removable metal shells approved by the Engineer.

6-05.3(5)C PILE MANUFACTURE

Before making any piles, the Contractor shall obtain the Engineer's approval of a detailed set of manufacturing Drawings. Unless the Engineer approves splices, all piles shall be full length.

Forms shall be metal and shall be braced and stiffened to retain their shape under pressure of wet concrete. Forms shall have smooth joints and inside surfaces easy to reach and clean after each use. That part of a form which will shape the end surface of the pile shall be a true plane at right angles to the pile axis.

Each pile shall contain a cage of nonprestressed reinforcing steel. The Contractor shall follow the Drawings in the size and location of this cage, and shall secure it in position prior to and during concrete placement. Spiral steel reinforcing shall be covered by at least 1-1/2 inches of concrete measured from the outside pile surface.

The concrete mix shall yield uniform distribution of aggregates, with fine and coarse aggregates having nearly the same specific gravity. Section 6-02.3(25)E governs curing.

The Drawings specify tensioning stress for strands or wires. Tension shall be measured by jack pressure as described in Section 6-02.3(25)F. Mechanical locks or anchors shall temporarily maintain cable tension. All jacks shall have hydraulic pressure gauges (accurately calibrated and accompanied by a certified calibration curve) that will permit stress calculations at all times.

All piles shall be pretensioned. Post-tensioning is not allowed.

6-05.3(5)D DETERMINATION OF BEARING CAPACITIES

The formulas in Section 6-05.3(2)F shall determine bearing capacities of prestressed, hollow concrete piling, or as shown otherwise in the Project Manual.

6-05.3(6) STEEL PILING

6-05.3(6)A GENERAL

Steel piles shall be made of rolled steel H-pile sections or of other structural steel sections described in the Drawings.

6-05.3(6)B STORAGE AND HANDLING

The Contractor shall store and handle steel piles in ways that protect them from injury. The Engineer will reject bent or kinked piles he believes cannot be straightened without damaging the metal.

6-05.3(6)C DRIVING

Piles shall have square-cut ends. During driving, each pile head shall be protected by a fitted metal cap. The Contractor shall follow the Drawings in locating and driving each plumb or battered pile in true alignment.

6-05.3(6)D SPLICING

The Engineer will normally permit steel piles to be spliced. But in each case, the Contractor must obtain approval on the need and the method for splicing. Steel pile splices shall be spaced at a minimum distance of 10 feet.

Splice welds shall comply with Section 6-03.3(25). The Contractor may use E6010 or E6011 electrodes on A 36 steel up to 1-inch thick. These electrodes need not be oven-baked, but shall be stored in an atmosphere maintained at 80 degrees F (plus or minus 20 degrees F) and between 20 and 60 percent relative humidity. Each weld shall be made from one side with a single V groove (beveled 60 degrees) or double V groove (beveled 30 degrees). The root opening shall be 1/16 inch.

6-05.3(6)E CAPPING

If the Drawings require, steel piles (after being cut square and smooth at elevation) shall be capped with a steel plate of the size and shape shown in the Drawings. This cap shall be arc-welded to the pile in accordance with the Drawings.

6-05.3(6)F DETERMINATION OF BEARING CAPACITIES

The formulas in Section 6-05.3(2)F shall determine bearing capacities of steel H-piles, or as shown otherwise in the Project Manual.

Unless the Drawings say otherwise, 12-inch piles shall be driven to a bearing capacity of at least 70 tons. The plans specify bearing capacities for steel H-piles of other sizes.

6-05.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Furnishing and Driving (Kind) Test Piles" will be by each actually furnished and driven as these Specifications or the Drawings require.

Measurement for "Driving (Kind) Pile" will be the number of piles driven in place.

Measurement for furnishing timber (Untreated or Name Treatment), steel, precast concrete and precast-prestressed concrete pilings will be by the number of linear feet actually driven below cutoff.

Measurement of composite piles made with 2 or more pile sections spliced together as 1 pile will be the number of linear feet actually driven below cutoff for each type of pile used.

Composite piling made with an untreated timber lower section and a reinforced concrete upper section spliced together will be considered as one pile. Measurement will be the number of linear feet actually driven below cutoff for each type of pile used.

Measurement for cast-in-place concrete piling will be the number of linear feet actually placed.

Measurement for "Pile Splice-Timber" will be each splice the Drawings or the Engineer requires.

6-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-05 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Furnishing and Driving (Kind) Test Pile", per each.
(2) "Driving Timber Pile, (Untreated or Name Treatment)", per each.
(3) "Driving Timber Composite Pile", per each.
(4) "Driving Conc. Pile (Size)", per each.
(5) "Driving Steel Pile", per each.
(6) "Furnishing Timber Piling (Untreated or Name Treatment)", per linear foot.
(7) "Furnishing Conc. Piling (Size)", per linear foot.
(8) "Furnishing Steel Piling", per linear foot.
(9) "Pile Splice-Timber", per each.
(10) "Furnishing Prestressed Hollow Conc. Piling (Size)", per linear foot.
(11) "Placing Prestressed Hollow Conc. Pile (Size)", per each.
(12) "Driving Prestressed Hollow Conc. Pile (Size)", per each.

The unit contract price for "Furnishing and Driving (Kind) Test Pile" shall be full pay for furnishing and driving test piles to the bearing capacity or penetration required by the Engineer, furnishing and installing a pile tip when pile tips are specified for the permanent piles, preboring when preboring is specified for the permanent piles, for pulling the piles or cutting them off as required, and for removing them from the site or for delivery to the Owner or designated location for salvage when ordered by the Engineer. This price shall also include all costs in connection with moving all pile driving equipment or other necessary equipment to the site of the work and for removing all such equipment from the site after the piles have been driven. If, after the test piles have been driven, it is found necessary to eliminate the piling from all or any part of the structure, no additional pay will be allowed for moving the pile driving equipment to and from the site of the work.

The unit contract price for "Driving (Kind) Pile" shall be full pay for driving the pile to the bearing and/or penetration specified. No additional pay over the contract price for "Driving (Kind) Pile" will be made for driving piles to the additional penetration as directed by the Engineer and as provided in Section 6-05.3(1)C, except that if driving to an additional penetration of more than 3 feet, additional penetration will be paid for on the basis of force account work as covered in Section 1-09.6.

The unit contract price for "Furnishing (Kind) Piling" shall be full pay for furnishing the piling specified. Such price shall also be full pay, when measurement includes, for piling length ordered but not driven.

The unit contract price for "Pile Splice-Timber" shall be full pay for furnishing and installing the splice as specified. No payment will be made for steel or cast-in-place concrete pile splices.

Payment for build-ups of precast or precast-prestressed concrete piles will be made on the basis of force account work as covered in Section 1-09.6. No payment will be made for build-ups or additional lengths of build-up made necessary because of damage to the piling during driving. The length of splice for precast concrete piles includes the length cut off to expose reinforcing steel for the splice. The length of splice for precast-prestressed piles includes the length in which holes are drilled and reinforcing bars are grouted.

The unit contract price for "Furnishing Prestressed Hollow Concrete Piling (Size)", "Placing Prestressed Hollow Concrete Pile (Size)", and "Driving Prestressed Hollow Concrete Pile (Size)" shall be full pay for piling in place. Required extensions will be paid for on the basis of force account work as covered in Section 1-09.6 of these Specifications.

Any pile which is damaged or destroyed before or at the time it is being driven shall be replaced by the Contractor at his own cost.

The various unit contract prices for driving piles shall cover all costs related to the use of water jets. The Owner will not pay any costs the Contractor incurs in redriving piles loosened as a result of water jets.

The unit contract price per linear foot for furnishing concrete piling (size specified) shall cover all costs related to the pile build-up above the steel casing as specified in Section 6-05.3(4)C.

All costs to remove and replace damaged test pile which is to be left as a permanent pile due to handling or driving shall be borne by the Contractor.

All costs to remove and replace any pile damaged in driving or straightening, or any pile driven below grade shall be borne by the Contractor.

Should it be determined by survey and/or resurvey of pile top elevations after installation that piles have heaved, the Contractor shall, at his own expense, redrive the heaved piles to a pile tip penetration equal to or greater than that achieved during initial driving of the heaved pile.

All pile cutoffs shall become the property of the Contractor and shall be disposed of off the site by the Contractor. The Engineer will inspect all piling prior to driving and reserves the right to have any pile which is damaged or destroyed before or at the time it is being driven replaced by the Contractor at the Contractor's expense.

The Contractor shall furnish at his own expense the necessary lengths of piling to reach from cutoff elevation up to the position of this driving equipment.

All cost and expense to perform the work of removing the heaved soil within the limits of the footing excavation and filling the voids remaining from extracted piles with sand and per gravel shall be considered incidental to the construction and shall be included in the unit contract prices for the various pay items of work involved in this project.

All cost and expense for design of pile including uplift and pile build-ups, pile markings for blow count, and Shop Drawings shall be considered incidental to construction.

Payment for "Steel Reinforcing Bar" shall be in accordance with Section 6-02.5.

All cost and expense for jetting, sand and pea gravel and vibration monitoring shall be considered incidental to construction and no separate payment or further compensation shall be made.

SECTION 6-06 BRIDGE RAILINGS

6-06.1 DESCRIPTION

This work shall consist of providing and building bridge railings that meet the requirements of the Drawings, these Specifications, and the Engineer.

6-06.2 MATERIALS

Material shall meet the requirements of the following Sections:

Timber Railing	9-09
Metal Railing	9-06 and as shown in the Drawings

6-06.3 CONSTRUCTION REQUIREMENTS

6-06.3(1) TIMBER RAILINGS

Wheel guards and railings shall be true to line and grade and framed accurately. The Contractor shall follow Section 6-04 whenever this Section does not specify a construction method.

Unless the Drawings show otherwise, wheel guards shall be:

(a) Beveled and surfaced on the roadway side and surfaced on the top edge. They may be surfaced on four sides (S4S).
(b) Laid in sections at least 12 feet long.
(c) Bolted through the floor plank and outside stringer (or nailing piece) with 3/4-inch bolts spaced no more than 4 feet apart.

All rails and rail post material shall be S4S and painted as required in Sections 6-04 and 6-07. Railing members shall be fastened securely together, with the bolts tightened once at installation and again just before the Owner's final acceptance of the Contract.

6-06.3(2) METAL RAILINGS

Metal railing includes posts, web members, and horizontal members of the sidewalk and roadway railing. Unless the Drawings or Project Manual shows otherwise, these shall be made of aluminum alloy or steel.

Before fabricating the railing, the Contractor shall submit 6 copies of the Shop Drawings for the Engineer's approval. The Contractor may substitute other rail connection details for those shown in the Drawings if details of these changes are shown in the Shop Drawings and if the Engineer approves. In approving Shop Drawings, the Engineer indicates only that they are adequate and complete enough. Approval does not indicate a check on dimensions.

Anchor bolts or wedge anchors shall be positioned with a template to ensure that bolts match the hole spacings of the bottom channels or anchorage plates.

Where specified, cover plates shall fit the bottom channel tightly after being snapped into position.

Metal railings shall be installed true to line and grade (or camber). After first setting the railing, the Contractor shall readjust all or part of it, if necessary, to create an overall line and grade pleasing to the eye.

6-06.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Timber railing will be measured per "Timber and Lumber, (untreated or name treatment)" by the thousand board feet (MBM) as shown in Section 6-04.

Metal railing will be measured by the linear foot along the line and slope at the base of the completed railing.

6-06.5 PAYMENT

Compensation for the cost necessary to compete the work described in Section 6-06 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Bridge Railing, (Type)," per linear foot.
(2) "Metal Railing, (Type)," per linear foot.

The unit contract prices for "Bridge Railing, (Type)", and "Metal Railing, (Type)" shall be full pay for all costs necessary to construct the railings as shown in the Drawings and as specified in this Section, including longitudinal, vertical and inclined structural members, plates, fastenings, anchor bolts, galvanizing, grouting, and painting as specified. In case no bid item is included in the Bid Form for "Bridge Railing, (Type)" and "Metal Railing, (Type)" and payment is not otherwise provided, all metal railings shall be included in the lump sum contract price for "Structural Carbon Steel" as specified in Section 6-03.

Payment for timber railing shall be per "Timber and Lumber, (untreated or name treatment)" per Section 6-04.5 and all costs necessary to construct and paint the railings and posts as shown in the Drawings.

SECTION 6-07 PAINTING

6-07.1 DESCRIPTION

This work shall consist of preparing the surface, providing and applying the paint, shielding nearby areas from unwanted paint, and cleaning up after painting is completed. The work shall comply with all requirements of the Drawings, these Specifications, and the Engineer.

6-07.2 MATERIALS

Materials shall comply with the requirements in Section 9-08.

6-07.3 CONSTRUCTION REQUIREMENTS

6-07.3(1) PAINTING NEW STEEL STRUCTURES

6-07.3(1)A GENERAL

Shop painting of structural steel shall comply with Section 6-03.3(30). No new structural steel shall be painted until approved by the Engineer.

6-07.3(1)B NUMBER OF COATS AND COLOR

All new structural steel work shall be cleaned, and painted with three coats of paint, except as otherwise noted. Cleaning shall conform to the requirements set forth in 6-07.3(1)F. The first coat of paint shall conform to Formula A-4-83 (Phenolic-Red Lead Primer) and shall be applied before mechanical erection or after welding erection and immediately after the steel has been cleaned by sandblasting. The second coat shall conform to Formula B-4-83 (Phenolic First Field Coat for Steel). The second and third coats shall be applied after field erection. The third coat shall conform to Formula C-9-86 (Phenolic Finish Coat for Steel). The color of each succeeding coat shall be sufficiently different from that previously applied to readily permit the discovery of an incomplete application of the paint coat. The color of the third coat shall be as specified in the Project Manual. Three color samples, approximately 10 inches by 10 inches of the final coat shall be submitted to the Engineer.

6-07.3(1)C WEATHER CONDITIONS

Paint shall not be applied when:

(a) The air and metal are cooler than 40 degrees F.
(b) Metal surfaces are damp or the air is misty.
(c) The Engineer believes conditions are unsuitable.
(d) The metal is hot enough to cause the paint to blister and leave a porous finish.

Steel painted under cover in damp or cold weather shall remain under cover until the paint dries or weather conditions permit open exposure.

6-07.3(1)D APPLICATION

Painters shall be competent and do careful work. All field applied coats shall be brushed on unless the Project Manual states otherwise.

Painters shall use round or oval shaped brushes, but with aluminum paint, may use flat brushes up to 4 inches wide. Brushing shall first be in a series of tight circles to fill surface roughness, and then in parallel strokes to leave a smooth, even coating that adheres closely to the metal or previous coat. On surfaces that cannot be brushed, painters shall use sheepskin or other daubers approved by the Engineer.

Prior to the application of first coat primer, second coat primer or final coat, the Contractor shall obtain approval from the Engineer that the surfaces to be painted during that day have been cleaned in accordance with these contract documents.

Bolts, the edges of plates, angles, and other rolled shapes shall receive an extra heavy coating. Painters shall work the paint well into all joints and crevices. All areas named in this paragraph shall be painted lightly just before general painting. This light coating shall be recoated when the general coat is applied.

The Contractor shall schedule his operations so that all sand blasted surfaces, are painted before the end of the working day. Any blasted surface not primed before the end of the working day shall be reblasted then primed painted. If the air temperature or the temperature of the steel fall below the dewpoint after cleaning and prior to application of the first Primer Coat, the Contractor shall reclean the affected area(s) to the satisfaction of the Engineer, at no additional cost to the City.

The Contractor shall allow each coat of paint to cure for a minimum of 18 hours or until Engineers approval, prior to the application of the succeeding coat of paint. Each Succeeding coat of paint shall be applied within 72 hours after the application of the previous coat of paint.

Should a painted area indicate bond failure, become soiled, contaminated, or rusted prior to the application of any coat the Contractor shall reclean and repaint the area to the satisfaction of the Engineer, at no additional cost to the City.

Removed materials, scrap or waste materials, and debris shall not be disposed of in any stream, river, or other body of water.

Any structural defects, including cracks, missing bolts or rivets, deterioration, etc., detected during the painting of these structures shall be brought to the attention of the Engineer.

If the Project Manual permits spray painting, airless pump spray machines shall satisfactorily apply paint mixed strictly as these Specifications require. All sprayed paint shall be brushed as described elsewhere in this section. The Contractor shall not, in attempting to operate a sprayer, add more thinner or other substances than the formulas permit. The Engineer's approval is required for any airless pump sprayer. If it does not produce satisfactory work, the Engineer may prohibit its use and require brushing instead.

Before it is removed from its containers, paint shall be stirred thoroughly by a mechanical mixer or other means. During application, it shall be stirred often enough to keep pigments in suspension.

Paint shall be shipped from the factory at brushing consistency. In no case shall thinner, other than minor amounts neede for equipment cleanup, be used on this project. Any thinner used for equipment cleanup shall be used and stored off the bridge.

The final coat on any surface exposed to view (as determined by the Engineer) shall be made with paint from a common batch. The Contractor shall provide the Engineer with a written method for verifying and certifying that the final coat is, in fact, from a common batch.

6-07.3(1)E REMOVAL OF UNACCEPTABLE PAINT

The Contractor shall remove unacceptable paint and repaint to the satisfaction of the Engineer. Unacceptable paint is any that is improper, impure, or on metal not properly cleaned.

6-07.3(1)F FIELD CLEANING

After completing erection work (including bolting, straightening bent material, etc.), the Contractor shall thoroughly clean all metal surfaces to the satisfaction of the Engineer using metal brushes, scrapers, chisels, hammers, sandblasting, or other means the Engineer requires to remove rust, scale, and dirt. Solvents may be used to remove oil and grease, and bristle or wood fiber brushes to remove loose dust. If the structure is covered with dirt or concrete residue, pressure flushing may be required (as specified in Section 6-07.3(2)).

When shipping, handling, or welding injures the shop coat, damaged areas shall be thoroughly cleaned by wire brushing before field painting. Between coats of paint, if the Engineer requires, the Contractor shall reclean the structure by the methods described above.

6-07.3(1)G FIELD PAINTING

Immediately after the Engineer approves the field cleaning, the Contractor shall apply one touch-up coat of the same paint used for the shop coat to these areas: bolt heads, areas where the shop coat has been broken, and all marks made during shipping or erection.

The first field coat shall be applied only after the touch-up coat is completely dry. If the first field coat leaves small cracks and cavities that are not watertight, they shall be filled with red lead sealing paste (applied by brush or spatula) before the second field coat is applied. No later coat shall be applied until the full thickness of the previous coat has dried.

6-07.3(2) REPAINTING EXISTING STEEL STRUCTURES

Unless otherwise provided, maintenance painting includes cleaning and painting the metal parts of an existing bridge. Cleaning means removing rust, scale, dead paint, dirt, grease, and other foreign matter. The Contractor shall clean and paint all exposed metal surfaces that may rust. These include all metal surfaces that do not touch other metal, wooden floor or truss members, concrete or stone masonry, or other surfaces.

The first coat of paint shall conform to Formula A-4-83 (Phenolic-Red Lead Primer) and shall be applied immediately after the steel has been cleaned by sandblasting. The second coat shall conform to Formula B-4-83 (Phenolic First Field Coat for Steel). The third coat shall conform to Formula C-9-86 (Phenolic Finish Coat for Steel). The color of each succeeding coat shall be sufficiently different from that previously applied to readily permit the discovery of an incomplete application of the paint coat. The color of the third coat shall be as directed by the Project Manual. Three color samples, approximately 10 inches by 10 inches of the final coat shall be submitted to the Engineer.

Prior to pressure flushing and abrasive blasting, the contractor shall submit a written procedure for collection and removal of debris and blasting material to the Engineer for approval.

Pressure flushing shall precede all other methods of cleaning the metal surfaces. Flushing may be omitted in some areas, if directed by the Engineer.

Pressure flushing shall be done with clean, fresh water. The nozzle shall have sufficient pressure to remove all soilage debris; loose paint and loose rust scale from all metal surfaces. The pressure flushing equipment shall produce (at the nozzle) at least 3,000 psi with a discharge of at least 4 gpm. The nozzle shall have a 25-degree tip and shall be held no more than 9 inches from the surface being washed.

A period of three days shall elapse before applying paint to a surface which has been cleaned by flushing, with care being taken to remove any dust, or dirt, before painting, which may have settled on the steel members in the intervening time. In those areas where flushing cannot be safely accomplished, the surfaces shall be cleaned with an approved solvent to the satisfaction of the Engineer.

Rust removal shall be by meansof abbrasive blasting in accordance with SSPC-SP6 Specifications. All rust spots that are abrasive blasted shall be blasted to a uniform white metal appearance with no areas of stain and gray mill scale permitted. There shall be no evidence of red or yellow rust at the edges of the blasted area, but the blasted area shall be extended to sound paint and the sound paint edges shall be feathered to give a smooth surface. Minimum sandblasting nozzle pressure shall be 90 psi.

White metal shall be as defined by the Structural Steel Painting Council No. Sa3 and is a surface with gray-white metallic color, slightly rough to form a suitable base for paint. If the old paint at the edge of an abrasive blasted area lifts after the spot coats are applied, the lifted paint shall be scraped off and the damaged areas repainted. Rust spots which cannot be removed effectively by abrasive blasting shall be removed with power brushing, scraping or other effective means as directed by the Engineer.

Painting shall not begin until after approval of surface separation of each section of the structure by the Engineer.

All steel surfaces shall be uniformly sweep blasted prior to spot blasting corroded areas. Non galvanized railing shall be 100% sandblasted to Commercial Blast (SSPC-SP6) specifications.

Abrasive blasting operations shall be done in such a manner that no damage occurs to any portions of the work partially or entirely completed.

The degree of cleanliness shall be determined by the Engineer. After abrasive blasting, all loose rust, dirt, sand and dust shall be thoroughly removed before paint is applied. The contractor shall recover 95% of the waste abrasive blast material. Abrasive blasting clean up and painting shall be in conformance with local air/water/noise pollution ordinances.

After the second spot coat of paint has dried, all cracks and cavities which are not sealed with the spot coats, and all cracks and cavities throughout the bridge structure which are bordering upon rusted or stained areas, shall be sealed withh Red Lead Sealing Paste, Formula No. A-3 to which sufficient raw linseed oil has been added to render it workable. The sealing paste, as specified shall dry for at least 24 hours before additional paitning may proceed.

The cleaning-painting requirements of Sections 6-07.3(1)C, D, and E shall apply here unless the Drawings or Project Manual requires otherwise. The Drawings or Project Manual normally specify the number of coats required. If no number is given, the cleaned metal shall be painted with 3 coats.

If roadway or sidewalk planks lie so close to the metal that they prevent proper cleaning and painting, the Contractor shall remove or cut the planks to provide at least a 1-inch clearance. Any plank removal or cutting shall be done as the Engineer directs. The Contractor shall replace all planks after painting. If removal breaks or damages the planks and makes them unfit for reuse, the Contractor shall replace them.

6-07.3(3) PAINTING TIMBER STRUCTURES

6-07.3(3)A NUMBER OF COATS AND COLOR

Unless the Drawings state otherwise:

(a) Rails and rail posts on timber bridges shall receive 2 coats (with the wheel guard painted only on its top edge and roadway side).
(b) Other timber work shall receive 3 coats (if the Drawings or Project Manual requires it to be painted).

Paint color shall be as indicated in the Drawings, Project Manual, or the Engineer may require.

6-07.3(3)B APPLICATION

All wood surfaces which are to be painted must be thoroughly dry and free from oil and dirt. Paint shall be applied by brush, spread evenly, and worked thoroughly into all seasoning cracks, corners, and recesses. No later coat shall be applied until the full thickness of the previous coat has dried.

Final brush strokes with aluminum paint shall be made in the same direction to ensure that powder particles "leaf" evenly.

Paint shall not be applied directly onto creosote surface. If a painted surface has been stained by creosote, it shall be given one or more coats of an approved shellac before repainting.

6-07.3(3)C PAINTING TREATED TIMBER

Timber treated with creosote or oil-borne, pentachlorophenol preservatives shall normally not be painted.

Timber treated with water-borne preservatives shall be clean and be reduced to no more than 18 percent moisture content before it is painted. Any visible salt crystals on the wood surface shall be washed and brushed away–with the moisture content reduced again to the specified level before painting. Stored timber awaiting painting shall be covered and stacked with spreaders to ensure air circulation.

6-07.3(4) PAINTING GALVANIZED SURFACES

All galvanized surfaces to be painted shall be prepared and painted as follows:

(a) Clean all surfaces thoroughly with toluene base solvent.
(b) Wipe off the solvent with clean rags until surface is dry.
(c) The clean and dry surface shall be painted according to the following schedule:

A-6-86	First Coat, Zinc Dust Zinc Oxide Primer.
C-9-86	Second Coat, Phenolic Finish Coat for Steel.
C-9-86	Third Coat, Phenolic Finish Coat for Steel.

The color of the finish field coat shall be as specified in the Project Manual.

Each coat must be dry before the next coat is applied. All coats applied in the shop must be dried hard before shipment.

The second and third coats shall be applied after field erection. The second and third coats shall conform to Formula C-9-86 (Phenolic Finish Coat for Steel). The color of each succeeding coat shall be sufficiently different from that previously applied to readily permit the discovery of an incomplete application of the paint coat.

Color samples of the proposed paint manufacturer's product in number of shades as required by the Engineer to select a match shall be submitted to the Engineer for approval. After the color has been selected by the Engineer, three color samples, approximately 10 inches by 10 inches of the selected color shall be submitted to the Engineer.

6-07.3(5) PAINT FILM THICKNESS

A full, wet coat of Formula A-5-61–vinyl pretreatment–free from runs and sags produces the proper film thickness (the rapid solvent release in this vinyl pretreatment makes it difficult to measure wet film thickness). Dry film thickness shall be between 0.4 and 0.7 mils.

Any other finish, no matter how its being applied, shall have a wet thickness of at least 3.0 mils per coat and a dry film thickness of at least 1.5 mils per coat.

If the specified number of coats do not produce a combined dry film thickness of at least the sum of the thicknesses required per coat, the Contractor shall apply another full coat of finish paint.

Film thickness–wet and dry–shall be measured by suitable gages. Wet measurements shall be taken immediately after the paint is applied, and dry measurements after the coat is dry and hard.

6-07.3(6) PROTECTION OF PUBLIC AND PRIVATE PROPERTY

The Contractor shall protect public and private property, traffic, and other parts of the bridge (deck, sidewalks, etc.) from airborne or dripping paint. The Contractor shall supply and install enough canvas or other covering to provide this protection as painting proceeds. If the covering does not adequately protect traffic, the Engineer may require the Contractor to station lookouts who shall stop the painting while vehicles or pedestrians pass.

At the pre-construction conference, the Contractor shall submit for approval by the Engineer a written detailed method for the removal of fresh and cured paint caused by any accidental spills or drips on traffic which occur during the normal painting operations. This method shall also designate a supervisory employee of the Contractor who will be responsible for taking the required corrective action if and when paint damage occurs.

The Contractor is required to post signs approved by the Engineer for boaters, vehicular and pedestrian traffic regarding the cleaning and painting operations. These signs shall also include information regarding accident spill clean up.

6-07.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

6-07.5 PAYMENT

The Bid Form contains no separate payment item for painting because unit contract prices cover all costs related to painting new steel or timber structures. Costs related to painting include preparing the surface; applying the paint; protecting and drying the coatings; protecting pedestrians, vehicles, and public and private property from paint; and supplying all tools, tackles, scaffolding, labor, and materials needed to complete the work.

When required, repainting existing steel bridge will be specified in the Project Manual.

Damage and disfigurement of public and/or private properties due to the operation of the Contractor shall be repaired or replaced at the Contractor's own cost.

SECTION 6-08 WATERPROOFING

6-08.1 DESCRIPTION

This work shall consist of applying waterproofing materials to portland cement concrete surfaces as required by the Drawings, these Specifications, or the Engineer.

6-08.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Asphalt for Waterproofing	9-11.1
Waterproofing Fabric	9-11.2
Portland Cement Mortar	9-11.3

6-08.3 CONSTRUCTION REQUIREMENTS

6-08.3(1) STORAGE OF FABRIC

The fabric shall be stored in a dry, protected place. Rolls shall not be stored standing on end.

6-08.3(2) PREPARATION OF SURFACE

Concrete surfaces shall be reasonably smooth and without projections or holes that might puncture the waterproofing membrane. The surfaces shall be dry, with all dust and loose material removed. The Contractor shall not apply waterproofing in wet weather or when the air temperature is below 35 degrees F unless the Engineer approves in writing.

6-08.3(3) APPLICATION OF WATERPROOFING

Waterproofing asphalt shall be stirred frequently as it is heated to between 300° F and 350° F. Each heating kettle shall have a thermometer.

Each coat of primer or asphalt shall begin at the low point of the surface so that water will run over (not against or along) the laps.

In applying the waterproofing, the Contractor shall:

(a) Apply a coat of primer and let it dry before applying the first asphalt coat.
(b) Mop hot asphalt on a band about 20 inches wide across the full length of the surface.
(c) Immediately roll a starter strip of half-width fabric into the asphalt, pressing it into place to rid it of all air bubbles and to conform it closely to the surface.
(d) Mop hot asphalt over the starter strip and an adjacent section of surface so that the fresh asphalt forms a band slightly wider than the the full width of the fabric.
(e) Immediately roll a full-width strip of fabric into the fresh asphalt, pressing it into place as before.
(f) Mop hot asphalt on the latest strip and on an adjacent band of the surface slightly wider that the full width of the fabric.
(g) Immediately roll another strip of fabric into the asphalt, lapping the earlier strip by at least 2 inches and pressing it into place as before.
(h) Repeat steps (f) and (g) until the entire surface is covered.
(i) Mop the entire surface with a final coating of hot asphalt.

The three complete moppings of asphalt shall ensure that no fabric layer ever touches another fabric layer or the concrete surface. The Contractor shall examine all laps and ensure that they are thoroughly sealed down.

Each mopping shall cover completely, with a coat heavy enough to hide the fabric weave and all gray spots from the concrete. On horizontal surfaces, at least 12 gallons of asphalt shall be used for every 100 square feet of finished work. On vertical surfaces, at least 15 gallons per 100 square feet shall be used.

At the end of each day's work, all fabric that was laid shall have received its final mopping of asphalt.

Wherever the membrane ends or is punctured by drains, pipes, etc., the Contractor shall seal the area to prevent water from entering between the waterproofing and the concrete surface.

All flashing (at curbs, against girders, spandrel walls, etc.) shall be made of separate sheets that lap the main membrane by at least 12 inches. Flashing shall be sealed closely: (1) with full metal flashing, or (2) by imbedding its upper edges in a groove poured full of an acceptable joint cement.

At each expansion joint, the membrane shall not be broken but shall be folded to permit movement. At either end of the bridge, the membrane shall run well down abutments and shall allow for expansion and contraction.

6-08.3(4) PROTECTION COURSE

If the Drawings require, the Contractor shall place a layer of mortar at least 1-1/2 inches thick over the whole surface of the membrane just after it has cooled to air temperature. This layer shall be a mix of 1 part portland cement to 2 parts sand. It shall be distributed evenly over the membrane, tamped gently into place, finished by hand to a smooth, hard surface, then covered and kept moist for 1 week.

6-08.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement will be the number of square yards of the final surface of the waterproofed area.

6-08.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-08 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Waterproofing," per square yard.

The unit contract price for "Waterproofing" shall be full pay for all work required to complete the work. Waterproofing of construction joints not shown in the Drawings shall be at the Contractor's own cost.

SECTION 6-09 CRIBBING

6-09.1 DESCRIPTION

This work is providing materials and constructing cribbing as required by the Drawings, these Specifications, and the Engineer.

6-09.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Metal Cribbing	9-27
Gabion Cribbing	9-27
Wire	9-27
Clip Fasteners	9-27
Stone	9-27

Wirecage for gabion shall be woven wire type.

6-09.3 CONSTRUCTION REQUIREMENTS

6-09.3(1) GENERAL REQUIREMENTS

6-09.3(1)A FOUNDATIONS

Before placing any crib work, the Contractor shall excavate the foundation or bed to the specified grade and obtain the Engineer's approval on bearing quality.

6-09.3(2) VACANT

6-09.3(3) VACANT

6-09.3(4) VACANT

6-09.3(5) METAL CRIBBING

The Contractor shall follow the WSDOT Standard Plan No's. D-5 and D-5a in building metal cribbing.

Metal cribbing is classified under six designs based on bin widths:

Design	Base Width (in feet)
A	5.5
B	7.7
C	9.9
D	12.1
E	14.3
F	16.5

Cribbing members shall be handled carefully. Damaged members shall be removed and replaced.

The fabricator's or manufacturer's instructions and recommendations for field assembly shall accompany each shipment of cribbing materials. If the Engineer requests, a qualified agent of the materials supplier shall visit the field site to assist and advise during assembly.

The Contractor shall:

(a) Excavate in accordance with Section 2-09;
(b) Backfill in accordance with Section 2-09.3(1)E;
(c) Place backfill inside bins and behind walls in horizontal layers no more than 6 inches thick;
(d) Maintain an equal elevation of fill behind walls and inside bins during the backfilling operation; and
(e) Tamp and compact each layer to 95 percent of maximum density (determined by the Compaction Control Test described in Section 2-03.3(14)E).

6-09.3(6) GABION CRIBBING

6-09.3(6)A DESCRIPTION

This work is building wire gabion cribbing as required by the Drawings, these Specifications, and the Engineer.

6-09.3(6)B BASKETS

Baskets shall be fabricated from woven steel wire. Baskets may be fastened with either lacing wire or clip fasteners; however, a gabion structure shall not include both.

6-09.3(6)C DIMENSIONS

The Contractor shall supply gabion baskets in the lengths and heights the Drawings require. Each length shall be a multiple (double, triple, or greater) of horizontal width. Horizontal width shall 36 inches. All baskets from the same manufacturer shall be the same width and shall be within a tolerance of 5% of the manufacturer's stated sizes.

The Drawings show dimensions in feet. If the Contractor prefers to order baskets made with metric measurements, the Engineer's approval of substitute design details shall be obtained before gabion construction begins.

6-09.3(6)D FABRICATION

Gabions shall be made so that the sides, ends, lid, and diaphragms can be assembled into rectangular baskets of the required sizes at the construction site. Common-wall construction may be used in gabion structures up to 12 feet high. Common-wall construction includes any basket where its top serves as the bottom of the one above it or where one wall serves an adjacent basket. When gabion structures are more than 12 feet high the baskets shall have independent sides, ends, top, and bottom.

Each gabion shall be divided by diaphragms into cells the same length as horizontal basket width. Diaphragms shall be made of the same mesh and gage as the basket body.

All perimeter edges (including diaphragm edges) shall be laced or clipped together so that joints are at least as strong as the body of the mesh itself.

The ends of the lacing wire shall be anchored by three tight turns around the selvedge wire.

6-09.3(6)E FILLING BASKETS

Baskets shall be filled with stone that meets the requirements of Section 9-27.3(3). The stone shall be placed and compacted to meet the unit weight requirements of Section 6-09.3(6)F.

Filling shall be in compacted layers not more than 14 inches deep. If cross-connecting wires are required, the Contractor shall adjust the number and depth of layers so that wires ocur between the compacted layers.

6-09.3(6)F UNIT WEIGHT REQUIREMENTS AND TESTS

The unit weight of the filled gabion basket shall be at least 100 pounds per cubic foot. Should the unit weight be less than 100 pounds per cubic foot, the gabion will be rejected and the Engineer will require the Contractor to conduct and pass additional unit weight tests before completing other gabions.

The Contractor shall conduct either of the following unit weight tests (A or B) to prove the density of completed gabions:

(a) A filled gabion basket shall be selected from the completed structure and weighed.
(b) A gabion basket shall be filled with stone from a loaded truck that has been weighed. After filling, the truck and unused stone shall be weighed again. The difference between the two weighings shall be used to determine weight per cubic foot of the material in the gabion.

The Contractor shall conduct one unit weight test for each 500 cubic yards of gabions placed. The Engineer may reduce the required frequency of these tests after proper unit weight has been consistently demonstrated.

In conducting unit weight test A or B, the Contractor shall provide and use scales that comply with Section 1-09.2.

6-09.3(6)G CONSTRUCTION REQUIREMENTS

Each row or tier of baskets shall be reasonably straight and shall conform with alignment and grade. Hexagonal mesh baskets shall be stretched endwise before filling. Filler shall be placed carefully, then tamped or vibrated. The last layer shall fill each basket completely so that the secured lid will rest on the filler. Each basket shall be fastened securely to all adjacent baskets and its lid then secured to the sides, ends, and diaphragms.

All selvedge wires of ends of adjacent baskets shall be laced or clipped together. The bottom selvedge of the basket being constructed on a previously constructed basket must be laced or clipped to the top of that basket.

Excavation for gabions shall comply with the requirements for structure excavation in Section 2-09.

Backfilling behind or around gabions shall comply with Section 2-09.3(1)E.

6-09.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Metal cribbing shall be measured by the square foot using the sum of bin face areas.

To determine bin face area, the Owner will consider each bin as 10 feet long even when shorter stringers are used on the wall face. Bin height will be calculated by multiplying the number of stringers on the bin face by 1.33 feet. Each bin face area will be calculated as follows: Bin Face Area = (No. of stringers in face) x 1.33 x 10.

Gabion cribbing will be the calculated neat line volume of gabion baskets in place, using manufacturer's stated dimensions.

Structure excavation will be measured by the cubic yard as specified in Section 2-09.

6-09.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-09 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Metal Cribbing, (Type) (Design)," per square foot.
(2) "Gabion Cribbing," per cubic yard.

The unit contract price for "Metal Cribbing, (Type) (Design)" shall be full pay for construction and backfilling of the metal cribbing. All costs involved in the use of special corners shall be included by the Contractor in the unit contract price for the adjacent bins measured as specified in Section 6-09.4.

The unit contract prices for "Gabion Cribbing" shall be full pay to complete the work as specified including testing, clean-up, and any final adjustments deemed necessary by the Engineer.

Payment for "Structure Excavation" shall be per Section 2-09.5.

SECTION 6-10 CONCRETE BARRIER

6-10.1 DESCRIPTION

This work shall consist of building precast or cast-in-place cement concrete barriers as required by the Drawings, these Specifications, or the Engineer.

6-10.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement	9-01
Aggregates	9-03
Premolded Joint Fillers	9-04.1
Reinforcing Steel	9-07

Wire rope shall be Class 6 x 19, made of improved plow steel that has been galvanized and preformed. Galvanizing shall meet ASTM A 603. The wire rope shall have right regular lay and a fiber core. It shall be 5/8 inch in diameter and have a minimum breaking strength of 15 tons.

All hardware (connecting pins, drift pins, nuts, washers, etc.) shall be galvanized in keeping with AASHTO M 232.

Connecting pins shall comply with ASTM A 449 and the AISI 10xx series and shall have a maximum yield point of 105,000 psi after heat treatment. All other hardware shall comply with ASTM A 307.

6-10.3 CONSTRUCTION REQUIREMENTS

6-10.3(1) GENERAL

In all barriers, the Contractor shall use air-entrained concrete that complies with Section 6-02.3(3)A.

6-10.3(2) PRECAST CONCRETE BARRIER

The concrete in precast barrier shall reach a compressive strength of at least 4,000 psi at 28 days. No concrete barrier shall be shipped until test cylinders made of the same concrete and cured under the same conditions show the concrete has reached this strength.

Class AX concrete that complies with Section 6-02 will meet this strength requirement. The Contractor may, however, alter the mix and aggregate grading if:

(a) The Engineer approves,
(b) The altered mix meets the strength requirement, and
(c) No aggregate is used that is larger than the maximum for Class AX concrete.

The Contractor may use Type III portland cement, but shall bear any added cost.

Precast barrier shall be cast in steel forms. After release, the barrier shall be finished to an even, smooth, dense surface, free from any rock pockets or holes larger than 1/4-inch across. Trowelling shall remove all projecting concrete from the bearing surface.

The barrier shall be cured in keeping with Section 6-02.3(25)E with two exceptions:

(a) The barrier shall remain in the forms until a calibrated, Swiss rebound hammer (or other approved method) shows the concrete has reached a compressive strength of at least 2,500 psi; and
(b) After form removal, the barrier needs no more curing.

The barrier shall be precast in sections per WSDOT Standard Plan No's. C-8, C-8a, C-8b or C-8c, as applicable. All barrier in the same project (except end sections and variable length units needed for closure) shall be the same length. It shall be true to Drawings dimensions. The manufacturer shall be responsible for any damage or distortion that results from manufacturing.

Only one section less than 10 feet long may be used in any single run of precast barrier, and it must be at least 8 feet long. It may be precast or cast-in-place. Hardware identical to that used with other sections shall interlock such a section with adjacent precast sections.

When the barrier is being built next to roadway lanes open to traffic, a terminal section shall be connected temporarily to the end of the barrier built each day.

6-10.3(3) CAST-IN-PLACE CONCRETE BARRIER

Forms for cast-in-place barrier shall be made of steel or of exterior plywood coated with plastic.

The barrier shall be made of Class AX concrete that meets the requirements of Section 6-02. The Contractor may use portland cement Type III, but shall bear any added cost.

Immediately after removing the forms, the Contractor shall complete any finishing work needed to produce a uniformly smooth, dense surface. The surface shall have no rock pockets and no holes larger than 1/4-inch across. The barrier shall be cured in accordance with the requirements described in Section 6-02.3(11)B.

The maximum allowable deviation from a 10-foot straightedge held longitudinally on all surfaces shall be 1/4-inch.

The Contractor may build cast-in-place concrete barrier by the slip-form method. Concrete for slip-form barrier shall meet the requirements for concrete Class AX as outlined in Section

6-02.3, except that the fine aggregate gradation may be Class 1 or 2. Slip-form barrier shall be finished and cured in the same manner as required for concrete traffic and pedestrian barrier in Section 6-02.3(11)B.

At final acceptance of the project, the barrier shall be free from stains, smears, and any discoloration.

6-10.3(4) RESETTING CONCRETE BARRIER

The Contractor shall reset concrete barrier if the Drawings or the Engineer require. If resetting is impossible immediately after removal, the Contractor shall store the barrier at Engineer-approved locations.

6-10.3(5) JOINING PRECAST CONCRETE BARRIER TO CAST-IN-PLACE BARRIER

The Contractor may join segments of cast-in-place barrier to precast barrier where transitions, split barriers, or gaps shorter than 10 feet require it. At each joint of this type, the cast-in-place segment shall include hardware that ties both its ends to abutting precast sections.

6-10.3(6) TEMPORARY CONCRETE BARRIER

For temporary concrete barrier, the Contractor may use new or used precast barrier. This barrier shall comply with WSDOT Standard Plan No. C-8d requirements and cross-sectional dimensions, except that: (1) it may be made in other lengths than those shown in the Standard Plans, and (2) it may have permanent lifting holes no larger than 4 inches in diameter or lifting loops. The word "temporary" shall be visibly stamped or stencil painted on each barrier segment.

All barrier shall be in good condition, without cracks, chips, spalls, dirt, or traffic marks. If any barrier segment is damaged during or after placement, the Contractor, shall immediately repair it to the Engineer's satisfaction or replace it with an undamaged section.

As soon as the temporary barrier is no longer needed, the Contractor shall remove it from the project. Owner furnished barrier shall remain Owner property, and the Contractor shall deliver it wherever the Engineer directs. Contractor furnished barrier shall remain the property of the Contractor.

6-10.3(7) PLACING CONCRETE BARRIER

Precast concrete barrier shall rest on a paved foundation shaped to a uniform grade and section. The foundation surface shall meet this test for uniformity: When a 10-foot straightedge is placed on the surface parallel to the centerline for the barrier, the surface shall not vary more than 1/4 inch from the lower edge of the straightedge. If deviations exceed 1/4 inch, the Contractor shall correct them as required in Section 5-04.3(13).

The Contractor shall align the joints of precast segments so that they offset no more than 1/4-inch transversely and no more than 3/4-inch vertically. Grouting is not permitted. If foundation grade and section are acceptable, the Engineer may permit the Contractor to obtain vertical alignment of the barrier by shimming. Shimming shall be done with a polystyrene, foam pad (12-inch x 24-inch) under the end 12 inches of bearing surface.

Precast barrier shall be handled and placed with equipment that will not damage or disfigure it.

6-10.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Both precast and temporary concrete barrier will be measured by the linear foot along its completed line and slope.

Resetting concrete barrier will be measured by the linear foot along the relocated line and slope. No measurement will be made for temporary storage of barrier pending resetting.

Cast-in-place concrete barrier will be measured by the linear foot along its completed line unless the Contract specifies that it be measured per cubic yard for concrete Class AX and per pound for steel reinforcing bar (as required in Section 6-02.4).

6-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-10 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Precast Concrete Barrier, (Type)," per linear foot.
(2) "Cast-In-Place Concrete Barrier," per linear foot.
(3) "Cast-In-Place Concrete Barrier Light Standard Section," per each.
(4) "Temporary Concrete Barrier," per linear foot.
(5) "Resetting Concrete Barrier," per linear foot.

The unit contract price for "Precast Concrete Barrier, (Type)" and "Cast-In-Place Concrete Barrier" shall include all costs for the work required to furnish material and construct barrier as specified.

The unit contract price for "Cast-in-Place Concrete Barrier Light Standard Section" shall include all costs for the work required to furnish and construct the section as shown in the Drawings.

The unit contract price for "Temporary Concrete Barrier" shall include all costs for the work required to furnish, place, maintain, and remove the temporary concrete barrier as specified.

The unit contract price for "Resetting Concrete Barrier" shall include all costs for the work required to reset and temporarily store the barrier.

Payment for concrete class AX and steel reinforcing bar shall be in accordance with Section 6-02.5.

Payment for Transition sections between different types of barrier shall be made at the unit contract price for the type of barrier indicated in the Drawings for each transition section.

All cost for the work in connection with loading, transporting and unloading concrete barrier for storage (or is no longer needed) at owner's property within the Seattle City limit shall be considered incidental to construction.

DIVISION 7
STORM DRAINS, CULVERTS, SANITARY AND COMBINED SEWERS, WATER MAINS AND RELATED STRUCTURES

SECTION 7-01 DRAINS

7-01.1 DESCRIPTION

This work shall consist of constructing subsurface drain pipe in accordance with the Drawings, these Specifications and WSDOT Standard Plan No. B-10, at the locations as staked by the Engineer.

This work also includes constructing sidewalk drains as specified herein and in accordance with Standard Plan No. 281. The work shall include installing a 4-inch drain pipe under the sidewalk, installing a 12-inch x 12-inch gravel drain behind the sidewalk, installing filter fabric, saw cutting and removing the curb, and constructing a reinforced cement concrete curb block as specified in other Sections of these Specifications.

7-01.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Gravel Backfill for Drains	9-03
Zinc Coated (Galvanized) Iron Pipe	9-05
Subsurface Drain Pipe	9-05
Filter Fabric	9-05
Filter Material	9-03
Joints	9-04

Gravel drain and filter material shall be Mineral Aggregate Type 26, meeting the requirements of Section 9-03.

7-01.3 CONSTRUCTION REQUIREMENTS

A trench of the dimensions shown in the Drawings or as specified by the Engineer shall be excavated to the grade and line given by the Engineer. Subsurface drain pipe shall be laid in reasonably close conformity with the line and grades as shown in Drawings. The subsurface drain pipe shall be laid with watertight rubber gasketed joints unless otherwise specified.

PVC drain pipe shall be jointed with a bell and spigot joint using a flexible elastomeric seal as described in Section 9-04.8. The bell shall be laid upstream. PE drain pipe shall be jointed with snap-on, screw-on, or wraparound coupling bands as recommended by the manufacturer of the tubing.

The subsurface drain trench shall be dug to the required alignment and grade only so far in advance of pipe laying as the Engineer will approve. The clear width of unsheeted or sheeted trench measured at the horizontal diameter of the pipe in place shall be 24 inches, or 1 foot greater than the outside diameter of the pipe, whichever is the greater.

Extreme care shall be exercised by the Contractor at all times during the performance of the work to maintain the trench. There shall be no mixing of the excavated material with the filter material to be used for backfilling. All excess excavated material not required elsewhere on the project shall be disposed of by the Contractor, unless otherwise provided for in the Project Manual.

The filter material and the gravel drain material for drain shall be damp when placed in the trench and shall be deposited uniformly on both sides of the pipe for the full width of the trench and to the springline of the pipe. The material shall be tamped in 4-inch layers to provide thorough compaction under and on each side of the pipe. Succeeding layers of gravel shall be deposited in 8-inch layers and be thoroughly compacted to the depth shown on the Drawings, or as specified.

The filter fabric shall be placed in the manner and at the locations shown on the Drawings. The surface to receive the fabric and/or the trench into which the fabric is to be placed shall be free of obstructions and debris.

Should the fabric be damaged during construction, the torn or punctured section shall be repaired by placing a piece of fabric that is large enough to cover the damanged area and to meet the overlap requirement. Adjacent borders of the fabric shall be overlapped a minimum of 12 inches or sewn.

The Contractor shall construct subsurface and sidewalk drains where indicated on the Drawings or where designated by the Engineer.

Where shown on the construction Drawings for sidewalks or directed by the Engineer, 4-inch galvanized iron pipe, or such other pipe material as directed by the Engineer, shall be placed under the sidewalk in 1 length and extended across the planting area to the roadway gutter line, or if existing, through curb. See Standard Plan No. 281.

The slope of the 4-inch drain pipe will be established in the field by the Engineer at the time of excavating for the sidewalk construction.

One end of the drain pipe shall terminate at a gravel drain behind the sidewalk. The opposite end of the drain pipe shall terminate at the gutter line or face of the curb. Where curb exists or new curb is to be installed under the contract, the curb side terminus of the drain pipe shall be encased in an 18-inch x 24-inch reinforced cement concrete curb block of the depth indicated in Standard Plan No. 281.

The gravel drain shall be 12 inches x 12 inches and of the length indicated on the Drawings.

Clearances between water mains and drains shall be maintained per Section 1-07.17(1).

When it is necessary to intercept water flowing underneath the roadway surfacing, the subsurface drain shall be constructed in accordance with WSDOT Standard Plan No. B-10, the Drawings or as directed by the Engineer.

Concrete drain pipe shall be laid with the bell or larger end upstream.

All perforated pipe shall be laid with the perforations down. Upon final acceptance of the work, all drain pipes shall be open, clean, and free draining.

7-01.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Filter Material" will be per cubic yard based on the neat line cross section indicated on the Drawings.

Measurement for "Filter Fabric" will be per square yard installed. Measurement will not be made for extra fabric required to meet overlap requirements.

No Measurement will be made for the reinforced concrete curb block at the curb face, and the gravel pocket corresponding to that shown on Standard Plan No. 281, Section A-A for a length of 3 feet parallel to the back of the sidewalk.

7-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-01 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Pipe, Subsurface Drain, (Material), (Size)," per linear foot.
(2) "Filter Material," per cubic yard.
(3) "Filter Fabric," per square yard.

(4) "Sidewalk Drain, 4-inch, Type 281," per linear foot.
(5) "Gravel Drain, Type 281," per linear foot.

The unit contract price for "Pipe, Subsurface Drain, (Material), (Size)" shall include all costs for the work required to furnish and install the pipe, and excavation of the pipe trench.

The unit contract price of "Filter Material" shall include all costs for the work required to furnish and install and compact Mineral Aggregate Type 26.

The unit contract price of "Filter Fabric" shall include all costs for the work required to furnish and install the filter fabric.

The unit contract price for "Sidewalk Drain, 4 inch, Type 281" shall include all costs for the work required to furnish and install the drain pipe and the reinforced concrete curb block at the curb face, screen, excavation and backfill and to saw cut and remove the existing curb. It shall also include excavation at the inlet end of the pipe to make a gravel pocket corresponding to that shown on Standard Plan No. 281, Section A-A, that is a minimum of 3 feet in length parallel to the back of the sidewalk.

The unit contract price for "Gravel Drain, Type 281" shall include all costs for the work required to excavate a trench 12 inches wide, fill it with Mineral Aggregate Type 26 to a depth of 12 inches, install filter fabric and backfill trench with suitable excavated material.

Any part of the trench excavated below grade or to a greater width than specified shall be backfilled with filter material as specified at the expense of the Contractor.

SECTION 7-02 CULVERTS

7-02.1 DESCRIPTION

This work shall consist of constructing culverts of the various types and classes in accordance with the Drawings, these Specifications, and the Standard Plans, at the locations as staked by the Engineer.

7-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Plain Concrete Culvert Pipe	9-05
Reinforced Concrete Culvert Pipe	9-05
Beveled Concrete End Sections	9-05
Steel Culvert Pipe and Pipe Arch	9-05
Steel End Sections	9-05
Aluminum Culvert Pipe	9-05
Aluminum End Sections	9-05
Joints	9-04

Where steel or aluminum are referred to in this Section in regard to a kind of culvert pipe, pipe arch, or end sections, it shall be understood that steel is zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel, and aluminum is corrugated aluminum alloy as specified in Sections 9-05.4 and 9-05.5.

Unless otherwise shown in the Drawings or specified, the class of concrete pipe or the thickness of steel or aluminum pipe or pipe arch shall be the same for the entire length of any culvert, and shall be that required for the maximum height of cover.

Culvert pipe and culvert pipe arch of all sizes shall be of the treatment, class, material, and size specified in the Drawings.

Beveled end sections shall be of the same material as the culvert pipe to which they are attached.

7-02.3 CONSTRUCTION REQUIREMENTS

7-02.3(1) PLACING CULVERT PIPE

7-02.3(1)A GENERAL

A trench shall be excavated to the width, depth, and grade as shown in the Drawings or as designated by the Engineer.

Proper preparation of foundation, placement of foundation material where required, and placement of bedding material shall precede the installation of all culvert pipe. This shall include necessary leveling of the native trench bottom or the top of the foundation material as well as placement and compaction of required bedding material to a uniform grade so that the entire length of pipe will be supported on a uniformly dense and unyielding base. The backfill material shall be placed around the pipe in a manner to meet the requirements specified.

Material meeting the requirements of gravel backfill for pipe bedding shall be placed under the pipe and along the sides of the pipe in accordance with Standard Plan No. 285. Bedding shall be placed in two or more lifts. The first lift shall provide 0.65 foot compacted thickness under the pipe, and shall be placed, spread, and compacted before the pipe is installed so that the pipe is uniformly supported along the barrel. Subsequent lifts of pipe bedding, of not more than 6 inches in thickness, shall be placed and compacted along the sides to the height shown in Standard Plan No. 285. Lifts shall be brought up together on both sides of the pipe and shall be worked carefully under the pipe haunches and then compacted. If the Engineer determines that the existing material in the bottom of the trench is satisfactory for bedding the pipe, gravel backfill for pipe bedding is not required. The existing material shall be loosened, regraded, and compacted to form a dense and unyielding base.

If, in the opinion of the Engineer, the material in the bottom of the excavation is of such character as to cause unequal settlement along the length of the pipe, box culvert, or pipe arch culvert, the trench shall be dug below the grade to such a depth as ordered and to a width on each side of the pipe equal to the increased depth or the nominal width of the excavated area and backfilled with gravel backfill for foundations or other suitable material, and compacted to form a dense and unyielding foundation.

A dike or plug of impervious material shall be placed near the intake end of the culvert to prevent piping. The dike shall be 2 feet long and adequately surround the pipe to form an impervious barrier. When suitable impervious materials are not available at the site, suitable backfill shall be obtained as provided in Section 2-09.3(1)E.

Where pipe is to be placed in a new embankment, the embankment shall be constructed as shown in the Drawings or as directed by the Engineer for a distance each side of the pipe location of not less than five times the diameter and to a minimum height equal to 1/2 the outside diameter of the pipe. The embankment material shall be compacted to 95 percent density and the moisture content at the time of compaction shall be between optimum and 3 percentage points below optimum as determined by the Compaction Control Tests specified in Section 2-03.3(14)E. The trench shall then be excavated to a width as indicated in Standard Plan No. 284, and the pipe installed, and backfill compacted in accordance with the Standard Plans.

The ends of the pipe, box or pipe arch shall be rigidly supported to prevent movement before and during the construction of end walls or headers.

Culverts shall not be left extending beyond the staked limits unless approved by the Engineer.

Culvert pipe shall be constructed within the same tolerance limits as specified for sanitary sewer pipes in Section 7-17.3(2)B.

In excavation for culverts, if any part of the excavated materials meets the specifications of Section 9-03.12(3), the Engineer may require that such material, in the quantity required, be selectively removed, stockpiled separately, and used as pipe bedding instead of quantities of gravel backfill for pipe bedding. If material so stockpiled becomes contaminated, the Contractor shall furnish suitable material in an amount equal to that lost by contamination at no expense to the Owner.

Upon final acceptance of the work, all culverts and end sections shall be open, clean, and free draining.

If the Contractor elects to use an alternate pipe installation, Shop Drawings for the alternate shall be submitted to the Engineer for approval prior to procuring or constructing the alternate.

When schedule A, B, C or D culvert pipe is specified in the Drawings, the Contractor may provide alternates in accordance with the requirements of the schedule shown in the Standard Plan. If the option selected requires Design C trench construction while another acceptable alternate does not, the Design C trench construction shall be incidental to the culvert pipe.

Pipe installed under side road connections, where the depth of cover is less than 2 feet, shall not be of the bell and spigot type.

7-02.3(1)B PLACING CONCRETE PIPE

7-02.3(1)B1 GENERAL

In the trench, prepared as specified in Section 7-02.3(1)A, concrete pipe shall be laid beginning at the lower end, with the bell or groove end up grade. For pipe with elliptical reinforcement, the minor axis of reinforcement shall be in a vertical position.

When it is necessary to connect dissimilar pipe, an adapter coupling shall be used as detailed in the Drawings.

7-02.3(1)B2 RUBBER GASKETED JOINTS

In laying concrete pipe with rubber gaskets, the bottom of the trench shall be dewatered, firm, and free of loose material so that joining can be accomplished without contaminating the joint with mud, silt, gravel, or other foreign material.

Pipe with affixed gaskets shall be handled carefully to avoid knocking the gasket out of position or contaminating it with foreign material. Any gasket so disturbed shall be removed, cleaned, relubricated if required, and replaced before joining the sections.

The pipe shall be properly aligned before joints are forced home. Sufficient pressure shall be applied in making the joint to ensure that the joint is home, as defined in the standard installation instructions provided by the pipe manufacturer. The Contractor may use any method acceptable to the Engineer for pulling the pipe together, except that driving or ramming by hand or machinery will not be permitted. Any pipe damaged during joining and joint tightening shall be removed and replaced at no expense to the Owner.

Sufficient restraint shall be applied to the line to ensure that joints once home are held so by compacting backfill material under and alongside the pipe or by other acceptable means. At the end of the day's work, the last pipe shall be blocked in such a manner as may be required to prevent creep.

7-02.3(1)B3 VACANT

7-02.3(1)B4 ELLIPTICAL REINFORCEMENT

In lieu of marking circular pipe with elliptical reinforcement in accordance with ASTM C76, the location of the top of the pipe shall be indicated by 3-inch wide, waterproof, painted stripes on the inside and outside of the pipe for a distance of 2 feet from each end of the section. At the option of the Contractor, a lift hole or lift holes may be provided at the top of the pipe in lieu of the painted stripes. If one lift hole is provided, it shall be at the balance point of the pipe; and if two lift holes are provided, they shall be spaced equidistant each side of the balance point Such holes shall not interfere with the reinforcement. After placing, open lift holes shall be filled with mortar or concrete plugs before backfilling.

In addition to the requirements as set forth in ASTM C76, it will be required on all pipe 30 inches and over in diameter with elliptical steel reinforcement that the manufacturer expose the reinforcement in not less than one of three lengths of pipe manufactured. A hole exposing the steel shall be cut on the inside of the pipe at Top or Bottom and a second hole on the outside, 90 degrees from the Top or Bottom position. After placing, holes exposing the reinforcement shall be filled with mortar or concrete plugs before backfilling.

7-02.3(1)C PLACING STEEL OR ALUMINUM PIPE

7-02.3(1)C1 GENERAL

Metal pipe and metal pipe arch shall be placed in a trench prepared as specified in Section 7-02.3(1)A. Separate sections of the pipe shall be laid in the trench with the outside laps of circumferential joints upgrade and with longitudinal laps positioned other than in the invert, and firmly joined together with approved bands.

7-02.3(1)C2 INSTALLATION OF METAL END SECTIONS

7-02.3(1)C2A GENERAL

Metal end sections shall be installed in accordance with the requirements of WSDOT Standard Plan No's. B-7 and B-7a, Drawings, and applicable portions of these Specifications.

7-02.3(1)C2B VACANT

7-02.3(1)C2C MITERED ENDS

The ends of steel culvert pipe or pipe arch shall not be beveled unless called for in the Drawings. If beveled ends are specified, the ends of culvert pipe over 30 inches in diameter shall be mitered to conform to the slope of the embankment in which the culvert is to be placed whether the culvert is constructed normal to or at an angle with the centerline of the roadway.

Beveled steel pipe end sections 12 inches through 30 inches in diameter shall be of the same material and thickness and have the same protective coating as the pipe to which they are attached. Beveled pipe ends of these dimensions shall be constructed in conformance with WSDOT Standard Plan No. B-7a.

7-02.3(1)C3 PROTECTIVE TREATMENT

7-02.3(1)C3A TREATMENT OF STEEL PIPE

Steel pipe and pipe arch culverts shall be coated by one of the following protective treatments, when such treatment is specified:

Treatment 1	Coated uniformly inside and out with asphalt.
Treatment 2	Coated uniformly inside and out with asphalt and with an asphalt paved invert.

Treatment 3 Coated inside and out with fibers embedded in the spelter coating and then covered on both sides with asphalt.
Treatment 4 Coated as in Treatment 3 and with an asphalt paved invert.
Treatment 5 Coated inside and out with asphalt and a 100 percent periphery inside spun asphalt lining.
Treatment 6 Coated as in Treatment 3 and with a 100 percent periphery inside spun asphalt lining.

7-02.3(1)C3B TREATMENT OF ALUMINUM PIPE

When plain aluminum pipe or pipe arch is used where it will be in contact with concrete or concrete pipe, all aluminum surfaces in contact with the concrete or concrete pipe shall be painted with two coats of paint. The aluminum pipe to be painted shall be cleaned with solvent to remove contaminants. After cleaning, the pipe shall be painted with two coats of paint conforming to Federal Specification TT-P-645 (Primer, Paint, Zinc Chromate, Alkyd Vehicle).

7-02.3(2) HEADWALLS

If headwalls are specified in the Drawings, they shall be constructed as soon as the embankment has been completed to a sufficient height over the structure to allow the required work. Headwalls shall be constructed in accordance with applicable portions of Section 6-02.

7-02.3(3) BACKFILLING

Placement of earth materials around and over culverts shall be performed in accordance with requirements specified within the pipe compaction zone as shown in WSDOT Standard Plan No. B-11 or as indicated in the Drawings.

Material placed within the pipe compaction zone shall be nonclay material and not contain stones larger than 3 inches in the greatest dimension, frozen lumps, roots, or moisture in excess of that permitting thorough compaction. Material placed within the pipe compaction zone shall be brought up simultaneously on each side of the culvert to the top of the culvert.

In either trench or embankment installations, the material within the pipe compaction zone and up to the top of the pipe shall be placed in 6-inch loose layers and compacted to 95 percent maximum density. Placement of materials within the pipe compaction zone above the top of the pipe shall be in accordance with WSDOT Standard Plan No. B-11. In the remaining portion of the backfill, the backfill material shall be placed in accordance with Section 2-03.3(14)D.

The Contractor shall not operate tractors or other heavy equipment over the culvert until it has been backfilled as provided above, or until the embankment has reached a height of 2 feet above the top of the culvert, or as provided in Section 1-07.7 if the site of the culvert is at a location where legal highway load limitations are not in effect.

7-02.3(4) REMOVING AND RELAYING CULVERTS

Where shown in the Drawings or where designated by the Engineer, existing culverts shall be removed and relaid in accordance with these Specifications. In the case of concrete pipe, all joints of the pipe before being relaid shall be cleaned so as to be free from all adhering materials, including old mortar placed as a collar or seal in the original construction.

All culvert sections removed and not relaid shall become the property of the Contractor.

7-02.3(5) PLUGGING EXISTING CULVERTS

Where shown in the Drawings or where designated by the Engineer, existing culverts shall be plugged on the inlet end with Class 5 (3/4) concrete. Care shall be used in placing the concrete in the culvert to see that the opening of the pipe is completely filled and thoroughly plugged.

When Drawings call for abandon and fill culvert, it shall be filled with low strength concrete. Measurement and payment will be per Section 2-02.

7-02.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

The length of culvert pipe, box culvert or pipe arch culvert will be the number of linear feet of completed installation measured along the invert.

Beveled end sections will be considered as part of the culvert pipe, box culvert or pipe arch culvert and shall be measured as culverts.

Embankment construction before culvert placement under the applicable provisions of Section 7-02.3(1) will be measured in accordance with Section 2-03.

7-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-02 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Pipe, Culvert, (Material) (Class), (Size)," per linear foot.
(2) "Pipe Arch, (Material) (Class), (Size)," per linear foot.

The unit contract price for "Pipe, Culvert, (Material) (Class), (Size)" and "Pipe Arch, (Material) (Class), (Size) shall include all cost for the work required to furnish and install culvert pipe and pipe arch, as specified in Section 7-02; including beveled end sections when required, and final cleaning of the culvert.

Where culvert pipes are to be removed but are not to be relaid, see Section 2-02.5 for payment.

No payment will be made for plugging existing pipes. See Section 2-02.5.

Alternate pipe installations to that shown in the Drawings and approved by the Engineer shall have no increase in the cost to the Owner.

All costs involved in storing, protecting, re-handling, and placing the excavated material as directed by the Engineer shall be included in other items of work on the project.

All costs of cleaning and painting the aluminum surfaces of aluminum pipe as specified shall be included in the unit contract price per linear foot for the aluminum pipe or pipe arch.

SECTION 7-03 STRUCTURAL PLATE PIPE, PIPE ARCH, ARCH, AND UNDERPASS

7-03.1 DESCRIPTION

This work shall consist of constructing structural plate pipe, pipe arches, arches, and underpasses of the various types and designs in accordance with the Drawings, these Specifications, and WSDOT Standard Plan No's. B-8 and B-8a, at the locations and in conformity with the lines and grades as staked by the Engineer.

Structural plate pipes shall be full circle of the type, gage or thickness, and diameter specified.

Structural plate pipe arches shall be a multi-centered shape made up of four circular arcs tangent to each other at their junctions and symmetrical about the vertical axis and of the type, gage or thickness, and span specified.

Structural plate arches shall be a single-centered circular arc shape, placed on a reinforced concrete foundation, and of the design, type, gage or thickness, and span as provided for in the Drawings.

Structural plate underpasses shall be a multi-centered shape made up of a variable number of circular arcs tangent to each other at their junctions and symmetrical about the vertical axis and of the design, type, gage or thickness, and span specified.

7-03.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Concrete Class B	6-02
Corrugated Steel	9-05
Corrugated Aluminum	9-05
Reinforcing Steel	9-07

Bolts and bolted connnections shall conform to the requirements of AASHTO M 167 for steel and AASHTO M 219 for aluminum.

7-03.3 CONSTRUCTION REQUIREMENTS

7-03.3(1) FOUNDATIONS

7-03.3(1)A GENERAL

Structural plate pipes, pipe arches, underpasses, and bases for arches shall be placed on stable foundations prepared to the widths, depth, and grade as shown in the Drawings or as designated by the Engineer. Soft spots encountered in the base shall be excavated to a depth directed by the Engineer and be backfilled with gravel or other suitable material and thoroughly compacted per Section 7-17.3(3)B.

Rock, in either ledge or boulder formation, hard pan, or cemented gravel occurring in the base material shall be excavated below grade and backfilled with suitable material so there will be a minimum 8-inch cushion under the pipes, pipe arches, or underpasses.

Concrete required for constructing structural plate arch foundations shall be Class B concrete in conformance with the requirements of Section 6-02.

Steel reinforcing bars shall conform to the requirements of Section 9-07.

7-03.3(1)B STRUCTURAL PLATE PIPE, PIPE ARCH, AND UNDERPASS

The base for structural plate pipes, pipe arches and underpasses shall be shaped to conform to their bottom and shall form firm and uniform bearing throughout their length. Where pipes, pipe arches, or underpasses are to be installed in new embankment, the embankment shall be constructed to the 1/3-point of structural plate pipes (measured from the invert of the pipe), to the height of maximum horizontal dimension of structural plate pipe arches and as provided for in WSDOT Standard Plan No's. B-8 and B-8a or, in the case of a special design, in the Drawings for structural plate underpasses, after which the trench shall be excavated and installation made.

The ends of structural plate pipes, pipe arches, arches or underpasses shall not be mitered unless called for in the Drawings, Project Manual or WSDOT Standard Plan No's. B-8 and B-8a. If mitered ends are specified, the slope shall conform to the slope of the embankment in which the culvert is to be placed and shall be limited to the top arc only.

7-03.3(1)C STRUCTURAL PLATE ARCH

The base for structural plate arches shall be as shown in the Drawings.

7-03.3(2) ASSEMBLING

Structural plate pipes, pipe arches, arches, and underpasses shall be assembled in place in accordance with the manufacturer's instructions, which shall accompany the shipment of materials and show the position of each plate and the order of assembly.

7-03.3(3) BACKFILLING

After the structural plate pipe, pipe arch, arch, or underpass has been placed in position it shall be backfilled in accordance with Section 7-02.3(3).

7-03.3(4) INVERT TREATMENT

Earth, or other material as specified, shall be placed and compacted in the invert of structural plate pipes, pipe arches, or underpasses in conformance with the Drawings, Project Manual, or WSDOT Standard Plan No. B-11.

7-03.3(5) HEADWALLS

If headwalls are specified in the Drawings, they shall be constructed as soon as the embankment has been completed to a sufficient height over the structure to allow the required work. Headwalls shall be constructed in accordance with the applicable portions of Section 6-02.

7-03.3(6) ALTERNATE INSTALLATION

If the Contractor elects to use an alternate installation, Shop Drawings for the alternate shall be submitted to the Engineer for approval prior to procuring or constructing the alternate.

7-03.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

The length of structural plate pipes, pipe arches, arches, and underpasses will be the number of linear feet of completed installation measured along the invert.

Concrete will be measured by the cubic yard as specified in Section 6-02.

Steel reinforcing bars will be measured by the pound as specified in Section 6-02.

Structure excavation will be measured by the cubic yard as specified in Section 2-09.4.

Gravel backfill for foundation will be measured by the cubic yard as specified in Section 2-09.4.

7-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-03 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Structural Plate Pipe (Material) (Thickness) (Dia)," per linear foot.
(2) "Structural Plate Pipe Arch (Material) (Thickness) (Span)," per linear foot.
(3) "Structural Plate Arch (Material) (Thickness) (Span)," per linear foot.
(4) "Underpass (Design) (Thickness) (Span)," per linear foot.

The unit contract price per linear foot for structural plate pipe, pipe arch, and underpass of the design, type, gage or thickness, and size specified shall be full pay for furnishing, hauling, and assembling in place the completed structure.

Payment for the class of concrete shall be as specified in Section 6-02.

Payment for steel reinforcing bar shall be as specified in Section 6-02.

Payment for structure excavation shall be as specified in Section 2-09.

Payment for imported Mineral Aggregate backfill shall be per Section 4-01.5

SECTION 7-04 VACANT

SECTION 7-05 MANHOLES, CATCH BASINS, AND INLETS

7-05.1 DESCRIPTION

This work shall consist of constructing manholes, catch basins, and inlets in accordance with these specifications and Standard Plans at locations shown on the Drawings. The work shall include excavation, shoring, backfilling, and compacting as specified in Section 7-17.

7-05.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Reinforced Concrete	9-12
Steps	9-12
Ladders	9-12
Mortar	9-12
Non-Shrink Grout	6-02
Concrete Masonry Units	9-12
Concrete Brick	9-12
Metal Castings	9-12
Traps	9-12
Joints	9-04

Manholes, catch basins and inlets shall be constructed of pre-cast units in accordance with the following Standard Plans:

Item	Standard Plan No's.
Manholes	200a through 207
Catch Basins	240 through 243b
Inlets	250 through 252

Any deviations from Standard Plans will be subject to a Shop Drawing submitted by Contractor and approved by the Engineer. Concrete blocks or concrete (masonry) rings may be used for adjustment of the casting to final street grade.

Joints between manhole elements shall be rubber gasket.

The concrete mix for manhole channel shall be Class 6(3/4).

Precast manhole components shall conform to ASTM C478 except as modified herein Section 7-05.

7-05.3 CONSTRUCTION REQUIREMENTS

7-05.3(1) MANHOLE

7-05.3(1)A FOUNDATION PREPARATION

7-05.3(1)A1 DEWATERING

Dewatering of manhole and catch basin excavations shall conform to the requirements for trench dewatering in Section 7-17.3(1)A1.

7-05.3(1)A2 SUB-BASE PREPARATION

Adequate foundation shall be obtained by removal of unsuitable material and replacement with well graded granular material; or with coarse ballast rock, or by such other means as provided for foundation preparation of the connected sewers, or as required in the Project Manual. Where water is encountered in the excavation, all cast-in-place bases or monolithic structures shall be placed on a one-piece waterproof membrane, so placed as to prevent any movement of water into the fresh concrete.

7-05.3(1)B BEDDING

7-05.3(1)B1 BEDDING FOR PRECAST BASE SECTION

Unless otherwise provided in the Project Manual or directed by the Engineer, manholes and catch basins constructed with precast base sections shall be placed to grade upon a 4-inch minimum thickness of Mineral Aggregate Type 9 per Section 9-03 mixed with 4 sacks of portland cement per cubic yard of mineral aggregate, with sufficient water added to form a stabilized layer. The mixed material shall be placed across the entire width of the base excavation and leveled so as to provide bearing contact with the entire bottom area of the precast base section.

7-05.3(1)B2 BEDDING FOR CAST-IN-PLACE BASE SECTION

Manholes and catch basins constructed with cast-in-place bases shall be poured to grade upon undisturbed earth or may require 4 inches of Mineral Aggregate Type 2 to be compacted in place prior to pouring the base. The Mineral Aggregate shall be placed across the entire width of the excavation and leveled. The base shall be poured with the indicated reinforcement to thickness as specified in the Standard Plans.

7-05.3(1)C DIMENSIONS

Manhole dimensions shown on the Drawings shall conform in all respects to the applicable requirements on the corresponding Standard Plans for each type specified.

7-05.3(1)D REINFORCED CONCRETE

7-05.3(1)D1 MIXTURE

The aggregates shall be so sized and graded, and proportioned and thoroughly mixed in proportions of cement and water as will produce a homogeneous concrete mixture of such quality that the manhole components will conform to the strength and watertightness requirements of these Specifications. Admixtures or blends may be used with the written permission of the Engineer.

7-05.3(1)D2 CURING

Upon completion of casting, the precast components shall be placed in a location free from outside drafts, covered and cured in a moist atmosphere maintained by an injection of steam for such a time and under such a temperature as may be needed to enable the manhole components to meet the strength requirements.

Or, precast components may be water-cured by covering the manhole components with a water saturated material, or by a system of perforated pipes, mechanical sprinklers, porous hose, or by any other approved method that will keep the components continuously moist during the curing period. Cast-in-place components shall be moist cured for a period not less than 7 days, except that when high-early-strength cement is used the curing shall be not less than 3 days. Pigmented membrane curing compound or other approved method may be applied in lieu of moist curing.

7-05.3(1)E BASE

7-05.3(1)E1 GENERAL

Base sections shall conform to the requirements for precast manhole sections in Section 7-05.3(1)F, except that the reinforced base slab shall be made an integral part of the unit, and openings for pipe shall be provided to meet job requirements as indicated on the Drawings. The base slab thickness shall be not less than that called out in the Standard Plans and on Type 200 and 201 manhole, the base slab shall be cast monolithically with the wall section, or otherwise constructed in such manner as to achieve a completely watertight structure.

Reinforcement of the base slab shall be in accordance to the Standard Plans. The steel shall be placed 1-1/2 inches from the top, and shall extend into the wall of the manhole section and be tied to the longitudinal steel when called for in the Standard Plans. The walls of the base section shall be reinforced in accordance with ASTM C 478. Openings to receive pipe shall be circular, and shall be held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joint. Resilient connectors conforming to ASTM C 923 may be used at the Contractor's option.

7-05.3(1)E2 PRECAST BASE

The base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment, and ensuring that all entering pipes can be inserted on proper grade.

All lift holes shall be thoroughly wetted and then completely filled with mortar, and smoothed both inside and out to ensure watertightness. All joints between precast sections shall be rubber-gasketed joints.

Precast sections shall be placed and aligned to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimensions, and watertight.

In precast manhole sections where steel loops have been provided in lieu of lift holes, the loops shall be removed flush with the inside wall surface after the manhole has been completed. No sharp cutoff protrusion will be permitted. If concrete spalling occurs as a result of the loop removal, the spalled area shall be restored in a workmanlike manner to a uniform smooth surface with mortar.

7-05.3(1)E3 CAST IN PLACE BASE

The first precast section shall be placed on the cast-in-place bottom slab and shall be carefully adjusted to true grade and alignment. The bottom slab shall be constructed in accordance with the modified Standard Plans. The existing pipe which the manhole will be built around shall be inspected by the Contractor prior to placing the bottom slab of the manhole. If the existing line is in bad condition, the Contractor shall immediately notify the Drainage and Waste Water Utility to replace the pipe. The bottom slab shall not be placed prior to the replacement of the damaged pipe.

The first manhole section shall be uniformly supported by the base concrete, and shall not bear directly on any of the pipes.

All lift holes and all pipes between precast elements and cast-in-place bases or structures shall be thoroughly wetted, completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness.

Precast sections shall be placed and aligned so as to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimension, and watertight.

7-05.3(1)F PRECAST WALL SECTIONS

Reinforcement for standard sections shall consist of a single cage of steel, placed at the approximate center of the wall of the section. The cage shall be welded at every circumferential wire, or lapped 40 diameters and tied. The welded splice shall develop a tensile strength of 50,000 psi of wire diameter.

Joints between sections shall be tongue and groove, and shall provide 1/2 inch nominal annular space and a minimum of 1-1/4 inches lap.

No more than two lift holes shall be cast into each section. Holes shall be so located as to not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

Steps shall be installed in each section so that sections placed together in any combination will provide a continuous vertical ladder with rungs equally spaced at 12 inches. The lowest rung shall be not more than 16 inches above the shelf, and the uppermost rung shall be not more than 14 inches below the street surface.

Steps shall project uniformly from the inside wall of the manhole per Standard Plan No. 232 and shall be cast or firmly grouted in place so as to ensure complete watertightness. Where it is intended that manholes be installed without fixed steps, the Project Manual will so specify.

7-05.3(1)G PRECAST CONES

Standard precast cones shall provide reduction from 48 inches to 24 inches with height of not less than 18 inches, and 54 to 24 inches with height of not less than 24 inches. Jointing to the riser sections shall be similar to jointing between riser sections, but the top surface shall be flat and at least 5 inches wide, radially, to receive adjustment block brick. Wall thickness shall be 4 inches minimum and reinforcing shall conform to the requirements specified for standard sections of the larger diameter. Steps shall be provided as specified for standard precast sections, and an additional step shall be provided in the 48-inch to 24-inch and the 54-inch to 24-inch concrete cones opposite the ladder steps and about midway in elevation, as shown on the Standard Plans. Steps install in the cone section and leveling bricks or collar shall be modified to allow a minimum clear opening of 21 inches measured at the shortest dimension, but the step shall be not less than 3 inches from the inside face of the wall. No more than two lift holes shall be cast into each cone, and they shall be located so they will not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

7-05.3(1)H FLAT SLAB COVERS

Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed. Details of opening location and reinforcing shall be as shown on the Standard Plans.

7-05.3(1)I FLAT SLAB REDUCTION SECTIONS

Reductions to 24 inches and 48 inches openings can be made by means of a flat slab reducing sections as shown on the Standard Plans. Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed. Details of opening location and reinforcing shall be as shown on the Standard Plans.

7-05.3(1)J T-TOP PIPE MANHOLES

T-Top pipe manholes shall conform to the Drawings and shall be provided with foundation and bedding.

7-05.3(1)K JOINTS

Joints between precast manhole elements shall be rubber gasketed in a manner similar to pipe joints conforming to ASTM C 443. Shop Drawings of the joint design shall be submitted to the Engineer for approval, prior to manufacture. Completed joints shall show no visible leakage and shall conform to the dimensional requirements of ASTM C 478.

7-05.3(1)L SHOP FABRICATED CORRUGATED METAL MANHOLES

Shop fabricated corrugated metal manholes, shall be constructed in strict accordance with the Drawings and Shop Drawings as approved by the Engineer, and shall conform to all applicable provisions of these Specifications.

7-05.3(1)M MANHOLE CHANNELS

All manholes shall be channeled unless otherwise stated in the Drawings.

Manhole Channels shall be made to conform accurately to the sewer grade and shall be brought together smoothly with well rounded junctions, satisfactory to the Engineer. Channel sides shall be carried up vertically to the crown elevation of the various pipes, and the concrete shelf between channels shall be smoothly finished and warped evenly with slopes to drain.

7-05.3(1)N MANHOLE PIPE CONNECTIONS

All pipes except CMP and PVC pipe entering or leaving the manhole shall be provided with flexible joints within 1/2 of a pipe diameter or 12 inches, whichever is greater, from the outside face of the manhole structure and shall be placed on firmly compacted bedding, particularly within the area of the manhole excavation which normally is deeper than that of the sewer trench. Special care shall be taken to see that the openings through which pipes enter the manhole are completely and firmly rammed full of non-shrink grout to ensure watertightness. (See Section 6-02.3(3)D for non-shrink grout.)

PVC pipe connecting to manhole shall be provided with a manhole adaptor complete with gasket and approved by the Engineer. No pipe joint in PVC pipe shall be placed within 10 feet of the outside face of the manhole.

7-05.3(1)O BACKFILL

Backfill around the manhole above the pipe zone shall consist of selected native material and shall conform to the applicable provisions of Section 7-17.3(3) "Backfilling Trenches". Compaction of backfill shall be by means of mechanical tampers to 95% of maximum density in accordance with Section 7-17.3(3)B "Compaction of Trench Backfill."

Backfill and compaction of backfill around a catch basin shall provide adequate foundation support for shallow inlet and outlet connection pipe, and shall meet requirements for backfill and compaction around a manhole as stated above.

7-05.3(1)P MANHOLE GRADE ADJUSTMENT

The Contractor shall initially construct manholes of the type specified on the Drawings so as to provide adjustment space of not less than 8 inches or more than 16 inches between the top of the cone or slab and the underside of the frame and cover to street grade or ground surface. The grade sheet furnished by the Engineer shows the approximate top grade for the structure plus or minus 0.2 foot, and the final grade will be set by the Engineer.

Final elevation and slope of the frame and cover shall conform to the restored street surface. No warping of grades in lieu of manhole frame adjustment will be allowed. All joints in the brick or ring adjustment shall be filled with mortar, and the casting shall be seated in mortar placed on the top course. A 3/8 inch thick mortar lining shall be installed inside and out of the adjustment section to provide a smooth, watertight finish.

7-05.3(1)Q LADDER

Except as otherwise provided in the Project Manual or indicated in the Drawings, base sections of precast manholes more than 3 feet in height shall be provided with a ladder as detailed in Standard Plan No. 232.

7-05.3(1)R FRAME AND COVER

For pavement depth 7 inches, the frame and cover shall be constructed to the finished grade of the pavement. Reinforcement shall be placed around the casting at mid point between the finish grade of the pavement and the top of the flange. #4 reinforcing bars shall be used in the configuration of 2 separate squares off-rotated 45 degrees from each other and giving a clearance of 2 inches at the shortest distance with the frame.

For pavement depth greater than 7 inches, use ring extension(s) as shown in Standard Plan No. 231 to bring the cover up to the level of the finished pavement without embedding bottom flange of the casting in the pavement. Total height of ring extension, casting and leveling bricks shall not exceed 26 inches.

7-05.3(1)S CONNECTIONS TO EXISTING MANHOLES

The Contractor shall verify invert elevations prior to construction. The crown elevation of laterals shall be the same as the crown elevation of the incoming pipe unless specified. The existing base shall be reshaped to provide a channel equivalent to that specified for a new manhole.

The Contractor shall excavate completely around the manhole to prevent unbalanced loading. The manhole shall be kept in operation at all times and the necessary precautions shall be taken to prevent debris or other material from entering the sewer, including a tight pipeline bypass through the existing channel if required.

The Contractor shall core drill, line drill or wall sawing an opening to match the size of pipe to be inserted. Where line drilling is the method used, the drilled holes must be interconnected. Line drilling shall be accomplished by the use of a small core drill or a rotary hammer. Jackhammer shall not be used. All openings must provide a minimum of 1 inch and a maximum of 2 inches clearance around the circumference of the pipe. Upstream pipes, except PVC pipe, penetrating the walls of manholes shall be placed with the bell facing out such that the bell is placed snug against the outside wall of the structure as the angle of penetration allows. Pipe, except PVC pipe, leaving or entering manholes shall be provided with a flexible joint within 1/2 of a pipe diameter, or 12 inches, whichever is greater. After pipes have been placed to their final position, they shall be grouted tight with non-shrink grout in a workmanlike manner. PVC pipe connecting to existing manhole shall be per Section 7-05.3(1)N.

7-05.3(1)T RECHANNEL EXISTING MANHOLE

This work shall be in accordance with Section 7-05.3(1)M, 7-05.3(1)N and shall also include the provision of a knock-out at the designated location and level on the existing manhole wall by core drilling a full size hole in one operation to accommodate the inlet or outlet pipe as required. The bonding area between the inlet or outlet pipe and the core-drilled surface shall be cleaned of all dirt or dust, grease, oil or other contaminants. The annular space between the inlet or outlet pipe and the core-drilled surface shall be tightly packed with

non-shrink grout to ensure watertightness. The connection shall be neatly finished on the inside and outside of the manhole.

7-05.3(1)U REBUILD EXISTING MANHOLE

Where noted on the Drawings, the Contractor shall rebuild the existing manhole to accommodate a new frame and cover as shown on the Drawings. Work required to rebuild existing manhole includes excavation around the manhole; removal of the existing manhole ring and cover, leveling bricks, and the upper portion of the cone section to a depth yielding an opening of inside diameter as indicated on the Drawings. The cone section shall be rebuilt, leveling bricks laid new manhole steps installed meeting the requirements of Sections 7-05.3(1)F and 7-05.3(1)G, and a new frame and cover installed. The surrounding shall be backfilled and compacted with suitable material. Excavation, backfill, and compaction shall conform to the applicable portions of Section 7-17. Salvage shall be in accordance with Section 2-02.3(7).

7-05.3(2) CATCH BASINS AND INLETS

7-05.3(2)A GENERAL

Construction requirements for catch basins and inlets shall follow all applicable specifications of Section 7-05.3(1) for manholes, except channels, manhole pipe connections, and manhole grade adjustment.

7-05.3(2)B PIPE CONNECTIONS FOR CATCH BASINS AND INLETS

All new catch basins shall be provided with openings or knockouts for insertion of pipe connections and a trap for the outlet pipe. The Contractor shall furnish and install new traps for relocated catch basins and rebuilt catch basins. When connections are to be made to existing catch basins with no available hole or knockout, or where a "knockout" of adequate size is not provided, connections to structures shall be accomplished by core drilling, line drilling or wall sawing. Where line drilling is the method used, the drilled holes must be interconnected. All openings must provide a minimum of 1 inch and a maximum of 2 inches clearance around the circumference of the pipe. Line drilling shall be accomplished by the use of a small core drill or a rotary hammer. Jackhammers shall not be used. After pipes have been placed to their final position, they shall be grouted tight in place in a workmanlike manner to present an inside and outside surface conforming to the Standard Plans. Traps shall be firmly seated but not grouted. Upstream pipes penetrating the walls of catch basins or inlets shall be placed with the bell facing out such that the bell is placed as snug against the outside wall of the structure as the angle of penetration allows.

For "Catch Basin Connection" and "Inlet Connection", see Section 7-08.3(4) and Section 7-08.3(5), respectively.

Pipe leaving or entering catch basins and inlets shall be provided with a flexible joint within 1/2 of a pipe diameter, or 12 inches, whichever is greater.

7-05.3(2)C CATCH BASIN GRADE ADJUSTMENT

Catch basin grade adjustment shall be in accordance with Section 7-05.3(1)P.

7-05.3(2)D INLET GRADE ADJUSTMENT

The inlet frame may be either cast into a concrete collar or set flange down on a minimum of one row of concrete adjustment blocks and mortared. It shall not, in any case, be grouted to final grade until the final elevation of the pavement, gutter, ditch or sidewalk in which it is to be placed has been established and permission has been given by the Engineer to mortar the casting in place. Location of inlet will be staked by the Engineer. The bottom of the inlet shall be level with the invert of the outlet pipe.

7-05.3(2)E RELOCATE EXISTING CATCH BASIN OR INLET

Work required for relocation of existing catch basin or inlet shall include necessary excavation to remove without damage the existing catch basin or inlet, its frame and grate or cover and transporting and installing at the new location where shown on Drawing or designated by the Engineer, and the excavation, placement of backfill and compaction around catch basin or inlet. Backfill and compaction shall be in accordance with Section 7-17.

The Contractor shall furnish and install new outlet traps.

Existing type 164 inlets shall be removed and not relocated when the adjacent pavement is designated to be removed.

7-05.3(2)F REBUILD EXISTING CATCH BASIN

Where noted on the Drawing, the Contractor shall rebuild existing catch basin to accommodate a new frame and grate or cover as designated. Work required to rebuild catch basin includes excavation, the removal of the existing frame and grate or cover, leveling bricks, upper portion of catch basin chamber, and installing a new cone section, leveling bricks and new frame and grate or cover. Excavation, backfill, and compaction shall conform to the applicable portions of Section 7-17. Salvage shall be in accordance to Section 2-02.3(7).

The Contractor shall furnish and install new outlet traps.

7-05.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Extra Depth (Type) Manhole," will be by the vertical foot for all depth in excess of 10 feet measured from the invert of the outlet pipe to the top of the casting.

7-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-05 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Manhole (Type)," per each.
(2) "Extra Depth, (Type) Manhole," per vertical foot.
(3) "Rechannel Manhole," per each.
(4) "Catch Basin (Type)," per each.
(5) "Inlet (Type)," per each.
(6) "Rebuild (Item)," per each.
(7) "Relocate (Item)," per each.

The unit contract price for "Manhole (Type)" shall include all costs for furnishing and installing manholes complete to finish street grade, including excavation, bedding, mortar, non-shrink grout, brick, block, castings, channeling, ladder, steps, connections to pipelines, and backfill with suitable native material for a manhole depth up to and including 10 feet.

The unit contract price for "Extra Depth, (Type) Manhole" shall include all costs for the work required to construct the portion of a manhole in excess of 10 vertical feet deep.

The unit contract price for "Rechannel Manhole," shall include all costs to complete the manhole channeling work as specified in Section 7-05.3(1)T when performed in an existing manhole.

Where a newly constructed manhole and cover casting has been completed to the finished grade set by the Engineer, and is later required to be adjusted up or down to a revised grade by the Engineer, the adjustment shall be paid in accordance with Section 7-20.

The unit contract price for "Catch Basin (Type)," shall include all costs for the work required to furnish and install the catch basin including trap, excavation and backfill with native material, adjustment brick and block, mortar, non-shrink grout, plaster, and castings.

The unit contract price for "Inlet (Type)," shall include all costs for the work required to furnish and install the inlet including excavation, brick, block, mortar, and castings.

When directed by the Engineer, Mineral Aggregate Type 17 or such other material acceptable to the Engineer shall be used as backfill and paid for per Section 4-01.5.

Payment for "Extra Excavation," will be per Section 7-17.5.

Payment for foundation material, when required by the Engineer, will be paid as "Mineral Aggregate, (Type)" according to Section 7-17.5.

The unit contract price for "Relocate Catch Basin," and "Rebuild Catch Basin" shall include all costs for the work required to relocate or rebuild the catch basin including furnishing and installing new traps, excavation and backfill with native material, adjustment brick and block, mortar, non-shrink grout, plaster and castings.

No separate payment for final adjustment of the casting for new construction of manhole, catch basin and inlet will be made and all costs thereof shall be considered incidental and included in the unit contract price for the manhole, catch basin, or inlet except as provided for in Section 7-05.5.

The unit contract price for "Rebuild Existing Manhole" shall include all costs for the work required to completely rebuild the existing manhole to finished street grade as specified in Section 7-05.3(1)U.

SECTION 7-06 PIPE ANCHORS

7-06.1 DESCRIPTION

This work shall consist of constructing concrete pipe anchors, prefabricated pipe anchors on tongue and groove concrete pipe and other pipes as designated and in accordance with WSDOT Standard Plan No. B-12, these Specifications, the details shown in the Drawings and as directed by the Engineer.

7-06.2 MATERIALS

Material shall meet the requirements of the applicable portion of Sections 6-02 and 6-03.

7-06.3 CONSTRUCTION REQUIREMENTS

The construction shall be in accordance with the Drawings and the applicable portions of Sections 6-02.3 and 6-03.3.

7-06.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

7-06.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-06 will be made at the unit contract price bid only for the bid item listed or referenced below:

(1) "Pipe Anchor," per each.

The unit contract price for "Pipe Anchor," shall include all costs for the work specified in Section 7-06.

SECTION 7-07 CLEANING EXISTING DRAINAGE STRUCTURES

7-07.1 DESCRIPTION

This work shall consist of cleaning and removing all debris and obstructions from existing culvert pipes, sanitary sewer pipes, drains, inlet structures, manholes, box culverts, grates, trash racks, or other drainage features within the limits of the project.

7-07.2 VACANT

7-07.3 CONSTRUCTION REQUIREMENTS

All pipes and drainage structures shown in the Drawings shall be cleaned by flushing, rodding, or whatever means are necessary to provide unobstructed drainage. All catch basin sumps, manholes, inlet and outlet structures, and debris racks shall also be freed of all dirt, rock, and debris. Existing drainage facilities shall be cleaned as a first order of work to enhance natural drainage off and through the project. It shall be kept clean throughout the life of the project and be clean upon final acceptance of the work.

7-07.4 MEASUREMENT

Work described in Section 7-07 will not be measured for payment.

7-07.5 PAYMENT

All work described in Section 7-07 shall be considered incidental to the various bid items comprising this improvement.

SECTION 7-08 MISCELLANEOUS PIPE CONNECTIONS

7-08.1 DESCRIPTION

This work shall consist of excavation, foundation preparation, bedding, backfilling and compacting for the construction of miscellaneous sanitary sewer and drain appurtenances other than those described in Section 7-17.

7-08.2 MATERIALS

Materials shall meet the requirements in Section 9-05 and Section 9-04.

7-08.3 CONSTRUCTION REQUIREMENTS

7-08.3(1) EXCAVATION AND BACKFILL

Trench excavation and backfill shall be as specified in Section 7-17.

7-08.3(2) CONNECTIONS TO EXISTING SANITARY SEWERS

When making a connection to an existing sanitary sewer line or manhole, the Contractor shall excavate and expose the existing facility where shown on the Drawings. In the event there is no existing tee or wye, refer to Section 7-17.3(2)C3 CUT-IN TEE ON EXISTING PIPE.

See Section 7-05.3(12) for connections to existing manholes.

7-08.3(3) PIPE LAYING, JOINTING AND TESTING

Pipe laying, bedding, jointing, backfilling, and pipe connections shall conform to the applicable requirements of Section 7-17. Testing for acceptance as provided in Section 7-17.3(4) will not be required.

7-08.3(4) CATCH BASIN CONNECTIONS

Catch basin connections are pipe lines connecting outlets of catch basins to a sanitary sewer, or other facilities. Both the alignment and the slope shall be on straight line, unless otherwise approved by the Engineer. In no case will 90 degree bends be allowed.

No connection shall be made to the catch basin outlet pipe until the excavation around the catch basin has been backfilled and compacted to an elevation which will provide support for pipe bedding and the connection pipe. Bedding for catch basin connection pipe shall be Class B bedding.

Connection pipe may be deflected to avoid obstacles to within the allowable angular deflection recommended by the manufacturer and such deflection shall still allow rodding the pipe in a relatively easy manner as determined by the Engineer. Under no circumstances will deflection or change of direction be allowed by cutting or trimming the end of the pipe on a bias or an angle. All pipe ends shall be normal angle.

The Contractor shall furnish and install a new trap to the new outlet of the existing catch basin.

7-08.3(5) INLET CONNECTIONS

Inlet connections are pipe connections from drainage inlets to catch basins or other approved outlets. Inlet connections shall be laid upgrade from catch basin openings or other originations in straight alignment and be on a uniform slope. Where a straight alignment, or a uniform slope is not feasible and curves are necessary, the altered alignment shall be made by deflecting each pipe into a smooth curve. Bends shall not be used. Deflection shall not exceed that necessary to maintain a watertight connection at each pipe joint.

Pipe connections shall not be made to a catch basin until the compaction requirements as specified in Section 7-08.3(4) have been completed and approved by the Engineer. Bedding for inlet connection pipe shall be Class B bedding.

7-08.3(6) DROP CONNECTION

Drop connections, used in conjunction with different types of manholes to allow for abrupt drop in elevation of the sewer line, shall be constructed of Ductile Iron Pipe in accordance with Standard Plan No. 233. Inside drop connections, when called for on the Drawings, may be constructed of PVC material. Drop connections shall be constructed at the location indicated on the Drawings and shall match the given design invert elevations.

7-08.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pipe, Catch Basin Connection (Material) (Class), (Size)," will be by the linear foot of pipe installed between the tee or wye in the receiving main pipe and the inside face of the catch basin.

Measurement for "Pipe, Inlet Connection (Material) (Class), (Size)," will be by the linear foot of pipe installed between the inside face of the inlet, and the inside face of the catch basin.

Measurement for "Drop Connection (Size)," will be by the vertical foot from the invert at the bend to the invert at the tee.

7-08.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-08 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Pipe, Catch Basin Connection, (Materiai) (Class), (Size)," per linear foot.
(2) "Pipe, Inlet Connection, (Material) (Class), (Size)," per linear foot.
(3) "Drop Connection, (Size)," per vertical foot.

The unit contract price for "Pipe, Catch Basin Connection, (Material) (Class), (Size)," and "Pipe, Inlet Connection, (Material) (Class), (Size)," shall include all costs for the work required to furnish and install the pipe including connections to catch basins or inlets, excavation, backfill, and compaction.

The unit contract price for "Drop Connection, (Size)," shall include all costs for the work required to furnish and install the complete drop connection including the concrete footing, ductile iron spool and fittings at the drop connection and the ductile iron pipe that span between the flexible coupling and the tee of the drop connection.

The cost for furnishing and installing new traps when installing catch basin connection pipe to existing catch basin shall be included in the unit contract price for "Pipe, Catch Basin Connection, (Material) (Class) (Size)".

SECTION 7-09 PIPE AND FITTINGS FOR WATER MAINS

7-09.1 DESCRIPTION

The work included under Sections 7-09 through 7-15 and the materials included in Section 9-30 shall apply to the construction of water distribution and transmission mains and appurtenances for both temporary and permanent installation.

7-09.2 MATERIALS

Materials shall meet the requirements of Section 9-30.

Specification references made herein for manufactured materials such as pipe, hydrants, valves and fittings refer to designations for Amercian Water Works Association (AWWA), United States of America Standards Institute (USASI), American National Standards Institute (ANSI) or to American Society of Testing and Materials (ASTM) which are in effect on the date of advertisement for bids.

The Contractor shall only install new and unused materials suitable and approved for potable water supply.

It is not intended that materials listed herein are to be necessarily considered equal or generally interchangeable for all applications. Those suitable for the project will be specified in the Project Manual or shown in the Drawings.

The pipe manufacturer shall test all pipe and fittings as required by these Specifications and the standards referenced. The pipe manufacturer shall submit to the Engineer two copies of all test results including a certification that material to be delivered is represented by the samples tested and that such delivered materials meets or exceeds the specified requirements. No pipe shall be delivered until test results and certifications are in the hands of the Engineer.

The Engineer shall have free access to all testing and records pertaining to material to be delivered to the job site. The Engineer may elect to be present at any or all material testing operations.

7-09.3 CONSTRUCTION REQUIREMENTS

Installation of pipe and fittings is described in Section 7-11.

7-09.4 VACANT

7-09.5 VACANT

SECTION 7-10 TRENCH EXCAVATION, BEDDING, AND BACKFILL FOR WATER MAINS

7-10.1 DESCRIPTION

This work shall consist of excavating, bedding, and backfilling for water mains and appurten- ances, the construction of water distribution mains and appurtenances for both temporary and perm- anent installation under ordinary conditions.

Water mains shall be constructed at the locations shown on the Drawings.

Where grading is required, such grading as excavation and embankment shall conform to the requirements of Section 2-03. Rough grading shall be completed before excavating for the water main trench.

Waste and borrow sites shall conform to the requirements of Section 2-01.2 and 2-01.5

7-10.2 MATERIALS

Materials specified as "Mineral Aggregate, (Type)" shall be in accordance with Section 9-03.

7-10.3 CONSTRUCTION REQUIREMENTS

7-10.3(1) GENERAL

Material excavated from trenches and piled adjacent to the trench, or in a roadway or public thoroughfare, shall be piled and maintained so that the toe of the slope of the material is at least 2 feet from the edge of the trench. It shall be piled in such manner as will cause a minimum of inconvenience to public travel, and provisions shall be made for merging traffic where such is necessary. Free access shall be provided to fire hydrants, water valves, and meters, and clearance shall be left to enable free flow of storm water in gutters, other conduits, and natural watercourses.

Free access shall be maintained to all other utility control valves, meters and vaults.

7-10.3(2) UNGRADED STREETS

On ungraded streets, when grading is not called for in the contract, the depth of trench excavation shall be as shown on the Drawings and profile and as staked by the Engineer.

Where the Drawings show the pipe is to be laid above the existing ground surface, an embankment fill shall be made and compacted to conform with the section shown on the Drawings, and the water main trench shall be excavated therein. That portion of the embankment below the bottom of the pipe shall be compacted with rollers or mechanical compactors under controlled moisture conditions as required under Method B of Section 2-03.3(14)D.

7-10.3(3) CLEARING AND GRUBBING IN UNGRADED STREETS

On ungraded streets, where clearing and grubbing is not called for in the contract, the area to be excavated or filled shall be cleared and grubbed by the Contractor. This work shall consist of the removal and disposal of all logs, stumps, roots, brush, and other refuse within 5 feet of the centerline of the pipe. All such material shall be disposed of in accordance with the Project Manual.

7-10.3(4) REMOVAL OF EXISTING STREET IMPROVEMENTS

Removal of existing street improvements and pavement from driveways and sidewalks shall be performed as specified in Section 2-02. Stockpiling of waste materials along the trench will not be allowed.

7-10.3(5) GRADE AND ALIGNMENT

Prior to any pavement cutting or removal, or excavation for pipe laying, the Contractor shall verify, in the presence of the Engineer, the locations and establish the depth of the existing water mains at the points where connections are to be made. The Contractor shall verify the dimensions, type, and condition of the existing water main. The profile shall be adjusted so neither a high spot nor a low spot is created adjacent to the connection to the existing water mains.

Unless otherwise specified in the Drawings or Project Manual the depth of trenching for water mains shall give a minimum depth of cover of 36 inches over the top of the pipe for 8-inch and smaller water mains. Depth of cover over larger water mains shall be in accord with the Standard Plans for "Locations for Underground Utilities." Deeper excavation may be required due to localized breaks in grade, or to install the new main under existing culverts or other utilities where necessary. Where profile of pipeline and ground surface is shown on the Drawings, pipeline shall be laid to the elevation shown regardless of depth. Excavation shall be to such depth that the minimum cover over the valve nuts shall be 1 foot.

Grade and alignment on ungraded streets will be given from hubs set parallel to the line of the pipe. On graded streets, the grade and alignment shall be taken from established points on the existing curbs or sidewalks, when directed by the Engineer. Trenches for the pipe shall be opened in accordance with the lines and grades given, or to the standard depth of cover provided in Standard Plan No. 030. The Contractor shall transfer lines and grades to the pipe from hubs set by the Engineer or from existing concrete curbs or sidewalks.

7-10.3(6) EXISTING UTILITIES

Existing utilities of record, except services, are shown on the Drawings. These are shown for convenience only, and the Engineer assumes no responsibility for improper locations or failure to show utility locations on the Drawings. The Contractor shall be responsible for protecting existing utilities as specified in Section 1-07.17 and shall be responsible for any damage as specified in Section 1-07.18.

When utility services occupy the same space as the new water main, the Contractor shall do all necessary excavation to fully expose such services. The Contractor shall protect said services and work around them during excavating and pipe laying operations. The Contractor shall be responsible for all damages to the services due to his operation and shall immediately notify the Engineer and arrange for replacement of all damaged services in accordance with Section 1-07.17.

In the event of conflict, the Contractor shall remove and restore existing catch basin connections, inlet connections, drains, side sewers, inlets, and other sewerage and drainage facilities. All restoration shall be constructed to correct City Standards. Mainline sewers and storm drains shall not be damaged, removed or relocated. Watermain pipe shall be installed to clear these utilities.

Existing water mains and fittings encountered during trench excavation and indicated on the Drawings to be removed (or if removal is required by the Engineer) shall be removed and disposed of by the Contractor.

Ends of abandoned water main shall be plugged by filling with Class 5(3/4) concrete for a minimum longitudinal length of 12 inches.

When utility owned water services occupy the same space as the project trench, the Contractor, in order to avoid damage and the subsequent cost of repairs, may request, with three days notice, that the Seattle Water Department cut the services ahead of the excavating machine and reconnect them after the machine passes.

It is anticipated that the Contractor will encounter private water service utilities (water service lines running between the Seattle Water Department union and private residences) during work operations. Records of these utilities are not maintained by the City and therefore do not appear on the Drawings and will not be field located by the Seattle Water Department. It shall be the Contractor's responsibility to ascertain the location of and protect these private utilities from damage.

If it is necessary to provide temporary water supply connections due to conflict between existing private water service pipes and the new water main, it shall be the responsibility of the Contractor to provide temporary services.

If the Contractor damages the private water service lines, he shall notify the Engineer of any such damage and shall begin repairs immediately and work continuously until water service is restored.

7-10.3(7) TRENCH EXCAVATION

7-10.3(7)A GENERAL

The Contractor shall perform all excavation of every description and of whatever materials encountered to the depth indicated on the Drawings or specified in the Project Manual. All excavations shall be made by open cut unless otherwise provided for. The bottom of trenches shall be accurately graded to provide uniform bearing and support for each length of pipe on undisturbed or compacted soil at every point along its entire length, except at the joints.

Bell holes shall be excavated to the extent necessary to permit accurate work in making and inspecting the joints. The banks of the trenches shall be kept as nearly vertical as soil conditions will permit. Where determined necessary by the Engineer to control trench width, to protect adjacent structures, or to provide safe working conditions, the trench shall be properly sheeted and braced. The maximum trench excavation width for pipes 4 inches to 12 inches in diameter shall not exceed 30 inches, and for larger sizes of pipe the trench width shall not exceed that indicated on the Standard Plan for trenching, unless authorized by the Engineer. Standard excavating equipment shall be adjusted so as to excavate the narrowest trench possible.

The length of trench excavation in advance of the pipe laying shall be kept to a minimum, and in no case shall it exceed 500 feet unless otherwise specifically authorized by the Engineer.

The Contractor shall exercise care in excavating the trench and maintaining it so that no damage will occur to any foundation, structure, pole line, pipe line, or other facility because of slough of slopes, or from any other cause. If, as a result of the excavation, there is disturbance of the ground such as to endanger other property, the Contractor shall immediately take remedial action at his expense.

Care shall be taken not to excavate below the depth indicated. Excavation below that depth shall be backfilled with native material, or Mineral Aggregate Type 17, and shall be compacted to the satisfaction of the Engineer at the Contractor's expense.

At locations where trench excavation equals or exceeds 4 feet in depth, trench excavation work shall be performed pursuant to Section 7-17.3(1)A.

Grading and other excavations nearby shall be controlled to prevent surface water from flowing into the excavations. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance away from the edges of trenches to avoid overloading and to prevent slides or cave-ins. Unsuitable material, or that in excess to the needs for embankments or backfill, shall be wasted and disposed of by the Contractor.

Excavation for manholes and other structures shall be sufficient to provide a minimum of 12 inches between their surfaces and the sides of the excavation.

Trench and bell holes shall be kept dewatered until the pipe has been laid, jointed, coated and backfilled.

7-10.3(7)B ROCK EXCAVATION

Rock excavation shall cover the removal and disposal of rock, i.e., ledge rock that requires systematic drilling and blasting for its removal, and boulders exceeding 1/2 cubic yard in volume. Ledge rock, boulders, or stones shall be removed to provide a minimum clearance of 6 inches under the pipe. Solid rock excavation is classified in Section 2-03.1(2).

Hardpan, hard clay, glacial till, sandstone, siltstone, shale, or other sedimentary rocks which are soft, weathered, or extensively fissured will not be classified as rock excavation. Rock is defined as one which has a modulus of elasticity of more than 200,000 psi or unconfined compressive strength at field moisture content of more than 2,000 psi.

Material removed shall be replaced with selected native materials from adjacent trenches or with Mineral Aggregate Type 17 in accordance with Section 9-03 and as designated by the Engineer.

7-10.3(7)C EXTRA EXCAVATION

Changes in grades of the water main from those shown on the Drawings, or as provided in the Project Manual, may be necessary because of unplotted utilities, or for other reasons. If, in the opinion of the Engineer, it is necessary to adjust, correct, relocate, or in any way change the line and grade, such changes shall be made by the Contractor under the terms of these Specifications.

When pipeline grade is lowered in excess of 1 foot below the grade indicated on the Drawings, the Contractor shall make such extra excavation as necessary.

When the pipeline horizontal alignment is changed by more than 1 foot from the line indicated on the Drawings, after the trench has been excavated, the Contractor shall excavate the trench at the changed location and backfill and compact the previous trench.

Additional excavation so required will be classified as extra excavation.

7-10.3(7)D CRIBBING AND SHEETING - SHORING

The Contractor shall adequately shore trenches to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench. The method of shoring shall be according to the Contractor's design. The Contractor may elect to use a combination of shoring and overbreak, tunneling, boring, sliding trench shields or other methods of accomplishing the work, provided the method meets all applicable local, state and federal safety codes. Damages resulting from improper cribbing or from failure to crib shall be the sole responsibility of the Contractor.

All cribbing and sheeting shall be removed from the trench. Removal shall be accomplished in such a manner as to fulfill the above requirements. Bedding or side support disturbed by cribbing or sheeting removal shall be reconsolidated. If a

moveable box is used in lieu of cribbing or sheeting, and the bottom cannot be kept above the springline of rigid pipe or the crown elevation of flexible pipe, the bedding or side support shall be carefully reconsolidated behind the moveable box prior to placing backfill.

The use of horizontal strutting below the barrel of a pipe or the use of the pipe as support for trench bracing will not be permitted.

When, in the opinion of the Engineer, the withdrawal of sheeting from the trench will result in damage to adjacent utilities or other property, the Engineer may order all or a portion of the sheeting to be left in place, in which case it shall be cut off as directed by the Engineer.

7-10.3(8) MATERIAL FROM TRENCH EXCAVATION

7-10.3(8)A REMOVAL AND REPLACEMENT OF UNSUITABLE MATERIAL

Whenever in excavating the trench for water mains the bottom of the trench exposes peat, soft clay, quicksand, or other unsuitable foundation material, such material shall be removed to the depth directed by the Engineer and backfilled with foundation material. Foundation material shall be Mineral Aggregate Type 2, or as directed by the Engineer.

Material removed from the trench that is unsuitable for backfill shall be removed and disposed. If surplus native backfill material is not available within the limits of the project, as determined by the Engineer, the Contractor shall furnish Mineral Aggregate of the Type designated by the Engineer in accordance with Section 9-03.

All unsuitable material shall be loaded directly into trucks and hauled to a waste site obtained by the Contractor. Stockpiling of unsuitable material at the project site will not be allowed.

7-10.3(8)B SURPLUS MATERIALS

Surplus material obtained from trench excavation and determined to be suitable for use elsewhere on the project by the Engineer shall be used per Section 2-03.3(10).

Surplus material not needed elsewhere on the project and unsuitable material shall be wasted in accordance to Section 2-01.2 and 2-01.5.

7-10.3(9) BEDDING THE PIPE

7-10.3(9)A RIGID PIPE

7-10.3(9)A1 GENERAL

Class B Bedding material, when specified or required by the Engineer, shall be Mineral Aggregate Type 9 in accordance with the requirements of Section 9-03.

Class B Bedding for ductile iron water mains will not ordinarily be required. When required, bedding material shall be Mineral Aggregate Type 9 in accordance with Section 9-03.

Class B bedding shall include the zone 6 inches below the pipe, around the pipe and up to 6 inches above the pipe.

Class B bedding consisting of Mineral Aggregate Type 9 shall be compacted by vibrating.

Care should be taken to prevent any damage to the pipe or its protective coating.

7-10.3(9)A2 BEDDINGFOR POLYETHYLENE ENCASED, TAPE COATED, OR SPECIAL COATED PIPE

Class B bedding material for specially protected or coated pipe shall be Mineral Aggregated Type 6 or 7 (paving or building sand) in accordance with the requirements of Section 9-03. Class B bedding consisting of Mineral Aggregate Type 6 or 7 shall be compacted by tamping.

Bedding of specially protected pipe shall be conducted at all times in such manner as to prevent damage and abrasion to the protective coating or wrap.

Placing of Class B bedding about the pipe shall be done only in the presence of the Engineer after his final inspection and approval of the specially coated or wrapped pipe. Any damage to the special coating or wrap shall be repaired by the Contractor at the Contractor's expense, as directed by the Engineer.

7-10.3(9)B FLEXIBLE PIPE

7-10.3(9)B1 BEDDING FOR POLYVINYL CHLORIDE (PVC) PIPE

PVC Pipe shall be bedded in Class B Bedding in accordance with Section 7-10.3(9)A1.

7-10.3(10) BACKFILLING TRENCHES

Prior to backfilling, all form lumber and debris shall be removed from the trench. Sheeting used by the Contractor shall be removed just ahead of the backfilling unless it is ordered by the Engineer to be left in place. Backfill up to 6 inches over the top and both sides of the pipe shall be evenly and carefully placed, but not until all large rocks capable of damaging the pipe or its coating have been removed from the backfill material.

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting. The Contractor shall backfill from the side of the trench to a maximum uniform depth of 2 feet above the crown of the concrete pipe and 1 foot above ductile iron pipe before starting compaction.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the pipe installation, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and persons.

The Contractor shall use suitable native excavated material for trench backfill unless notified by the Engineer that the native material is unsuitable. The Engineer will examine excavated native material at the time of excavation to determine its suitability for use as backfill. Native material will be considered suitable for trench backfill if it meets the requirements set forth in Section 2-03.3(14).

Unsuitable backfill material shall be removed from the site, disposed of, and replaced with Mineral Aggregate Type 17 or such other imported material as designated by the Engineer.

The Contractor shall take any necessary steps to protect the excavated material from becoming contaminated with excessive moisture.

Where it is required that a blanket of select material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation as shown on the Drawings, or as the Engineer may direct, and shall be leveled to provide for a uniform thickness of the borrow material. Compaction is required, and it shall be performed prior to placing the borrow material.

7-10.3(11) COMPACTION OF BACKFILL

Trench backfill shall be spread in layers and be compacted by mechanical tampers of the impact type approved by the Engineer. Water settling will not be permitted. After the initial backfill is placed the remaining backfill material shall be placed in successive layers not exceeding 1 foot in loose thickness, and each layer shall be compacted to the density specified below:

(a) Improved areas such as street and sidewalk areas shall be compacted to 95% of maximum dry density.

(b) Unimproved areas or landscape areas shall be compacted to 90% of maximum dry density.

Compaction control tests shall be performed as specified in Section 2-03.3(14)E.

The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of pipeline to be designated by the Engineer.

The Engineer will sample excavated material to determine suitability of the native material for backfill use. If native material is found to be compactable and within the tolerance range of moisture content, the Contractor will be required to use the native material for backfilling. The Contractor shall take any necessary steps to protect the excavated material from becoming saturated beyond the critical moisture limits.

The Contractor shall excavate test pits in the backfill as directed by the Engineer for the purpose of testing the backfill compaction. At the option of the Engineer, density tests may be taken on a lift of compacted backfill immediately prior to placing the next lift.

If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact using an improved technique, heavier compaction equipment or more passes. This process shall be repeated until the Contractor has established a procedure that will provide the required field density. The Contractor will then be permitted to proceed with backfilling and compacting the remainder of the pipeline under the approved compaction procedure.

In the event routine field densities taken during the course of construction show the specified compaction is not being obtained because of changes in soil types or for any other reason, the Contractor will be required to reestablish his compaction procedure. In no case will excavation and pipelaying operations be allowed to proceed until the specified compaction is attained.

7-10.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Solid Rock Excavation," shall be in accordance with Section 2-03.4.

Measurement for "Mineral Aggregate, (Type)," shall be in accordance with Section 4-01.4.

Measurement for "Extra Excavation," and "Bedding, (Class), (Size) Pipe," shall be in accordance with Section 7-17.4.

7-10.5 PAYMENT

The unit price for "Mineral Aggregate, (Type)," shall be in accordance with Section 4-01.5.

Payment for "Extra Excavation" and "Bedding, (Class), (Size) Pipe" shall be in accordance with Section 7-17.5.

Payment for "Solid Rock Excavation" shall be in accordance with Section 2-03.5.

If no bid item is in the Bid Form for "Mineral Aggregate" of the type designated by the Engineer, "Solid Rock Excavation," or "Extra Excavation," the Contractor shall perform the work as directed by the Engineer, and payment will be made in accordance with Section 1-09.4.

No separate payment will be made for excavating the trench, placing and compacting the native backfill material, hauling and placing excess suitable native material elsewhere on the project, or hauling and disposing of excess materials offsite. These costs shall be considered as being included in the unit bid prices for each class, size, and type of pipe.

Payment for safety systems required for trench excavation work shall be in accordance with Section 7-17.5.

Where unexpected objects, such as stumps, railroad ties, etc. are encountered in the trench excavation, and such unexpected objects cause the Contractor delays or require Extra Work or equipment for its removal, payment will be in accordance with Section 1-09.4. When the presence of these objects are indicated on the Drawings or Project Manual, and is not included in the Bid Form, the removal of these objects shall be considered incidental to the various bid items comprising the work.

No separate payment will be made for furnishing and installing sand cushion and protection of existing utilities and services. These items shall all be considered as incidental to the work of constructing the water main.

All costs for plugging ends of abandoned water main shall be considered incidental to the various bid items comprising the Contract.

All costs incurred by the Contractor in providing temporary water service when deemed necessary shall be considered incidental to the Contract.

No act, representation or instruction of the Engineer or his representatives shall in any way relieve the Contractor from liability for damages or costs that result from trench excavation.

In the event the Contractor elects to use pipe bedding, or to use mineral aggregate of any type below the pipe to facilitate dry ditch construction, all costs for furnishing and placing the mineral aggregate shall be borne by the Contractor.

Any material that becomes unusable due to the Contractor's failure to take adequate measures to provide protection from moisture shall be replaced at the Contractor's expense with Mineral Aggregate Type 17 or such other material as the Engineer will accept.

All costs in connection with excavating test pits and from standby time during field density tests shall be considered as incidental to the backfill.

All costs for removing existing water mains and fittings as specified in Section 7-10.3(6) shall be considered incidental to the various bid items comprising the Contract.

The cost for cutting and reconnecting water services by the Seattle Water Department as requested by the Contractor for his work as specified in Section 7-10.3(6) will be charged to the Contractor.

The hauling away of surplus material from the excavation to other areas of the project or disposing of the material offsite shall be considered as incidental to the unit price of each size and type of pipe installed.

SECTION 7-11 PIPE INSTALLATION FOR WATER MAINS

7-11.1 DESCRIPTION

Pipe shall be installed in accordance with the manufacturer's printed specifications and instructions, and to the standards of the AWWA for installing the type of pipe used.

Pipe sections shall be joined in such a manner as not to damage the lining or coating. Any damage to the lining or coating shall be repaired by the Contractor at the Contractor's expense. All touch-up coating for outside water main pipe accessories shall be made with epoxy coal tar. Inside parts of the pipe accessories shall be touched up with asphaltic varnish, Royston Roykote #612 XM or approved equal. The method of pulling or jacking the pipe home must allow both vertical and horizontal movement of the pipe for the protection of the gasket.

Water main installation shall not proceed until line and grade hubs have been set and measurements for connection fittings have been made in accordance with Section 7-11.3(9)A.

Short lengths of pipe supplied by the manufacturer shall be used whenever possible to provide the proper spacing of valves, tees, or special fittings.

Clearances shall be maintained between water mains and other utilities per Section 1-07.17.

7-11.2 MATERIAL

Material shall meet the requirements of Section 9-30 and Section 9-04.

7-11.3 CONSTRUCTION REQUIREMENTS

7-11.3(1) DEWATERING OF TRENCH

Where water is encountered in the trench, it shall be removed during pipe-laying operations and the trench so maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe. Trench water or other deleterious materials shall not be allowed to enter the pipe at any time.

7-11.3(2) HANDLING OF PIPE

All types of pipe shall be handled in a manner that will prevent damage to the pipe, pipe lining or coating. Pipe and fittings shall be loaded and unloaded using hoists and slings in a manner to avoid shock or damage, and under no circumstances shall they be dropped, skidded, or rolled against other pipe. Damaged pipe will be rejected, and the Contractor shall immediately place all damaged pipe apart from the undamaged and shall remove the damaged pipe from the site within 24 hours.

Methods of handling shall be corrected by the Contractor if the Engineer determines that these methods are damaging to the pipe.

Threaded pipe ends shall be protected by couplings or other means until laid.

The pipe and fittings shall be inspected for defects.

Ductile iron and cast iron pipe, while suspended above grade, shall be rung with a light hammer to detect cracks.

Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations, and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned, and relaid. A clean whisk broom shall be used for this purpose and for brushing to remove foreign matter prior to joining of pipe ends. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the Engineer to ensure cleanliness inside the pipe.

Pipe shall be stacked in such a manner as to prevent damage to the pipe, to prevent dirt and debris from entering the pipe, and to prevent any movement of the pipe. The bottom tiers of the stack shall be kept off the ground on timbers, rails or other similar supports. Pipe on succeeding tiers shall be alternated by bell and plain end. Timbers 4-inch X 4-inch in size shall be placed between tiers and chocks shall be placed at each end to prevent movement. For safety each size of pipe shall be stacked separately.

Handling and shipping of enameled or multilayered polyethylene tape coated ductile iron pipe while being transported and in the field shall be in accordance with the AWWA Standard Specifications C 214, and as specified herein.

Pipe, at all times, shall be handled with equipment such as stout wide canvas slings and wide padded skids designed to prevent damage to the coating. Bare cables, chains, hooks, metal bars or narrow skids shall not be permitted to come in contact with the lining or coating. When shipped by rail, all pipe shall be carefully loaded on properly padded saddles not less than 12 inches in width. Pipe sections shall be separated so that they do not bear against each other and the whole load shall be securely fastened together and to the cars to prevent movement in transit.

In truck shipments, the pipe shall be supported in wide cradles of suitable padded timbers hollowed out on the supporting surface to fit the curvature of pipe. All chains, cables or other equipment used for fastening the load must be carefully padded.

The Engineer will inspect the pipe and coating after delivery to the jobsite, while the pipe is stored along side the trench, prior to installation by the Contractor. The Contractor shall allow inspection of the coating on the underside of the pipe while suspended from the sling, before the pipe is lowered in the trench.

Pipe stored along the trench side shall be supported by padded wooden timbers placed under the pipe to hold the pipe off the ground, or by other means satisfactory to the Engineer.

Repair of multi-layered polyethylene tape coating shall be in accordance with AWWA C214 and Section 7-11.3(6)C.

7-11.3(3) CUTTING PIPE

Whenever it becomes necessary to cut a length of pipe, the cut shall be made by abrasive saw or by a special pipe cutter. All pipe ends shall be square with the longitudinal axis of the pipe and the outside shall be bevelled and otherwise smoothed so that good connections can be made without damage to the gasket. Threads shall be cleanly cut. Oxyacetylene torch cutting of ductile iron pipe will not be allowed.

7-11.3(4) LAYING OF PIPE ON CURVES

Long radius curves, either horizontal or vertical, may be laid with standard pipe by deflecting the joints. If the pipe is shown curved in the Drawings and no special fittings are shown, the Contractor can assume that the curves can be made by deflecting the joints with standard lengths of pipe. If shorter lengths are required, the Drawings will indicate maximum lengths that can be used. The amount of deflection at each pipe joint when pipe is laid on a horizontal or vertical curve shall not exceed the manufacturer's printed recommended deflections.

Where field conditions require deflection or curves not anticipated in the Drawings, the Engineer will determine the methods to be used.

When rubber gasketed pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

Maximum deflections at pipe joints and laying radius for various pipe lengths are specified in the Drawings and Project Manual or, if not, shall conform to the manufacturer's and AWWA specifications for the given type of pipe.

7-11.3(5) CLEANING AND ASSEMBLING JOINT

All parts of the pipe ends, couplings, fittings, and appurtenances shall be cleaned to remove oil, grit, or other foreign matter from the joint. Care shall be taken to keep the joint from contacting the ground.

Pipe not furnished with a depth mark shall be marked before assembly to ensure visual observation of the work.

7-11.3(6) LAYING AND JOINTING PIPE

7-11.3(6)A LAYING AND JOINTING - DUCTILE IRON PIPE AND APPURTENANCES

The installation of ductile iron pipe and appurtenances shall be in accordance with AWWA C600.

Except where restrained joint systems are required, mechanical or push on joints may be used.

7-11.3(6)B LAYING AND JOINTING POLYETHYLENE ENCASED PIPE

Pipe with polyethylene encasement shall be installed in accordance with AWWA C105. The method used for encasing the pipe shall be approved by the Engineer. All damage to the polyethylene encasement shall be repaired at the Contractor's expense. Bedding and backfill shall be in accordance with Sections 7-10.3(9), and 7-10.3(10), and 7-10.3(11).

7-11.3(6)C LAYING AND JOINTING MULTI-LAYERED POLYETHYLENE TAPE COATED PIPE

Pipe shall be hoisted from the trench side into the trench by means of a wide canvas or leather sling. Use of chains, cables, tongs or other equipment likely to cause damage to the lining or to the coating of the pipe will not be permitted. Dragging or skidding the pipe will not be permitted. The Contractor shall allow inspection of the coating on the under side of the pipe while suspended from the sling. Any damage shall be repaired to the satisfaction of the Engineer before the pipe is lowered into the trench. Bedding and backfill shall be in accordance with Sections 7-10.3(9), 7-10.3(10), and 7-10.3(11).

At all times during construction of the pipeline, the Contractor shall use every precaution to prevent damage to the protective coating on the pipe. No metal tools or heavy objects shall be unnecessarily permitted to come in contact with the finished coating. Workers will be permitted to walk upon the coating only when necessary. In case of such necessity, the workers shall wear shoes with rubber or composition soles and heels. This shall apply to surfaces whether bare, primed or coated. Any damage to the protective coating from any cause, prior to final acceptance of the pipeline, shall be repaired as directed by the Engineer, by and at the expense of the Contractor.

Cutbacks on the spigot end shall be 6 inches or less and shall be made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. No cutback shall be made on the bell end of the pipe.

Following the application of the outerwrap, the coating shall be electrically tested for holidays with a pulse tape holiday detector. The detector voltage range for this coating is 7000-9800 volts. The testing shall conform to NACE RP-02-74.

All holidays detected in the field shall be repaired by removing the outerwrap and primary coating from the damaged area, cleaning the exposed surfaces thoroughly, and then apply suitable primer and tape as specified by the manufacturer to the exposed area. If required by the Engineer, the repaired area shall be outerwrapped after patching.

If the outerwrap is damaged and a holiday is not found in this area, the Contractor need not repair the outerwrap unless, at the discretion of the Engineer, the damage is deemed to be severe enough to jeopardize the integrity of the coating. If the outerwrap is to be replaced the damaged outerwrap shall be removed, taking care not to damage the inner coating. Before the outerwrap is replaced, a holiday detector shall be applied to the exposed innerwrap to determine if it has been damaged during removal of the outerwrap. The damaged outerwrap area shall be repaired by applying a patch as specified by the manufacturer, or approved equal, at the discretion of the Engineer.

7-11.3(6)D LAYING AND JOINTING COAL-TAR EPOXY COATED PIPE

Specifications for installation of coal-tar epoxy coated pipe shall be as noted in Secton 7-11.3(6)C, paragraph 1 and 2.

Holidays detected in the field shall be repaired by grinding to remove the defective area of the coating, and then recoating the area in accordance with AWWA C210, Sections 2.2 and 2.3.

7-11.3(6)E LAYING AND JOINTING POLYVINYL CHLORIDE (PVC) PIPE

Laying and jointing of PVC pipe shall be in accordance with "Recommended Standard for Installation of PVC Pressure Pipe" (Uni-Bell UNI-B-3-79) Sections 5.3 through 5.3.4.4. Bedding and backfill shall comply with Sections 7-10.3(9)D, and 7-10.3(10).

All valves and fittings shall be supported by concrete cradles; their weight shall not be carried by the PVC pipe. The cradle shall be trench width x 2 feet x long 6 inches thick, and shall be poured against undisturbed earth. The valves and fittings shall be set to design grade and firmly braced while the concrete cradles are poured and cured.

7-11.3(7) LAYING STEEL PIPE

7-11.3(7)A THREADED STEEL PIPE LESS THAN 4 INCHES IN DIAMETER

Steel pipe in sizes up to and including 3-1/2 inches shall be connected with malleable iron screwed couplings. Couplings shall be galvanized. Unions or flanges shall be used at all equipment and valves. Cut ends shall be reamed and threads clearly cut. Exposed threads, after jointing, shall be brush-coated with an asphalt varnish, Royston Roskote #612XM or approved equal.

7-11.3(7)B COUPLED PIPE 4 INCHES IN DIAMETER AND LARGER

Steel pipe 4-inch and larger, for use in underground services, shall be coupled as specified in the Drawings and Project Manual.

Any welding of steel pipe shall be in accordance with AWWA C206.

Bell and spigot joints shall be thoroughly cleaned before assembly, and a vegetable soap solution shall be brushed on the inside of the bell just prior to assembly.

7-11.3(7)C STEEL CASING PIPE INSTALLED UNDER RAILROAD TRACKS

Where shown on the Drawings, the Contractor shall install steel casing pipe for the water main by tunneling, jacking or augering without damage to existing streets, roads, highways, railroad track alignment or other utilities.

All joints shall be welded by operators who have been qualified by tests as prescribed by the AWS in Standard Qualifications Procedure to perform the type of work required. The quality of welding shall conform to AWS D1.1-80 Structural Welding Code, Section 3, Workmanship.

Before placing the casing and water main, the Contractor shall submit to the Engineer, for approval, an outline of his construction procedure together with a listing of the equipment for the work. The approval of procedure and equipment by the Engineer shall not relieve the Contractor of responsibility, or waive, or modify any of the provisions of the Contract.

Special care shall be taken during the installation of the pipe to ensure that no settlement of adjacent areas occurs. Any such settlement caused by the placement of the pipe shall be the Contractor's responsibility. The Contractor shall repair all areas so affected, as directed by the Engineer. In the event that the pipe is damaged during the installation and the defects cannot be corrected to the satisfaction of the Engineer, the Contractor shall be required to remove and replace the pipe.

7-11.3(7)D STEEL CASING SEALS AND SPACERS

Casing seals shall provide a moisture-proof seal that is resistant to heat, cold, vibration, impact, abrasions, fluids, disbonding, and expansion and contraction of the casing and the water main. Casing seals shall be installed according to the manufacturer's instructions.

The Crossing Insulators (Spacers) shall be composed of polyester fiberglass or polyvinyl chloride (PVC). The material shall be resistant to abrasion and sliding wear. There shall be two Crossing Insulators (Spacers) per length of pipe, spaced no more than 10 feet apart. Crossing Insulators (Spacers) shall be installed per manufacturers instructions.

Casing seals and Crossing Insulators (Spacers) shall be located as shown on the Drawings.

7-11.3(8) LAYING CONCRETE CYLINDER PIPE

7-11.3(8)A GENERAL

Concrete cylinder pipe with steel joint rings, or concrete noncylinder pipe when called for in the Drawings, shall be laid to conform with requirements of the following Sections.

7-11.3(8)B CLEANING AND ASSEMBLING JOINT

All parts of the joint, both bell and spigot ends, shall be brushed and cleaned to remove oil, grit, and other foreign matter. The circular rubber gasket provided with the pipe shall be stretched and snapped into the groove provided on the spigot end. It shall be lifted and released at several points on the circumference to equalize tension and remove twist in the gasket.

The bell end of the pipe shall be lubricated with a solution of vegetable soap and water or other prepared solution supplied by the pipe manufacturer and approved by the Engineer. The pipe shall then be jacked home until it stops.

The outside annular space at the joint shall be filled with cement mortar.

The grouting of the outside joints shall be made by wrapping the joint with two bands of strong, waterproof sisalkraft paper. The bands of paper shall then be tightly strapped to the pipe with 3/8-inch box strapping, using tools recommended by the manufacturer of the strapping. Hand-tamped backfill shall be built up around the band to the horizontal diameter of the pipe. The joint shall then be filled with mortar from one side only until the mortar appears on the other side of the pipe. Mortar shall be mixed with the least amount of water that will permit placing by the method described. Flexible wires shall be worked around the joint to assist grouting and ensure proper filling of the joint. The top of the pipe shall then be grouted and the paper band laid over the entire joint to protect it while curing.

The inside annular space shall also be filled with cement mortar and troweled flush. Mortar shall consist of one part portland cement and two parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for "dry packing."

No grouting of joints will be allowed within three joints of laying operations. An inspector shall be present when outside joints are being poured.

7-11.3(8)C VACANT

7-11.3(9) CONNECTIONS

7-11.3(9)A CONNECTIONS TO EXISTING MAINS

No water system valves on existing mains shall be operated by the Contractor.

The Seattle Water Department will make all connections to charged water mains and pipelines, and will operate all valves to accomplish shutdowns and subsequent reactivations. Draining of existing water mains will be done by SWD staff.

Connection points shall be verified in accordance with Section 7-10.3(10).

Water mains and appurtenances must be installed completely per Contract, and approved, prior to connections being scheduled or made.

The Seattle Water Department requires 2 working days prior notice to schedule inspections for approval of water main installations. Within 2 working days after the inspection, the Contractor will be provided with written approval or a list of items to be corrected. Items to be corrected must be reinspected. The response and notification times for reinspection are the same as for the initial inspection.

Approval is contingent on the water main and appurtenances being installed completely and satisfactorily tested per contract documents excluding street, sidewalk and planting strip restorations. Water main and appurtenances include all pipe, fittings, all blocking except temporary blocking, all hydrants, hydrant pads, blowoff assemblies, valves, flowmeters, chambers, corrosion protection, and coating systems.

Tests are for pressure and water quality, and the requirements are specified elsewhere in this Section.

Scheduling of connections with the Engineer is the Contractor's responsibility. After approval of the water mains has been received, the Contractor shall request that the Engineer schedule the shutdown of existing water mains required to complete the connection. The Contractor's request must be submitted to the Engineer a minimum of 3 working days in advance of the desired date of the connection, and is subject to Seattle Water Department approval. The excavation for the connection shall be complete, shored and dewatered, and all required materials and equipment shall be available at the scheduled shutdown. Notifications of the scheduled shutdown will be made by Seattle Water Department personnel to the affected consumers.

The Seattle Water Department will furnish connection fittings, as shown on the Drawings. In addition, prior to and after connection of the new main, the Seattle Water Department will:

(a) Deactivate water main.
(b) Cut, remove, and dispose of pipe sections as necessary to install the new materials.
(c) Dewater the pipe, as required, to perform Seattle Water Department connections.
(d) Swab all connecting pipe with chlorine solution (5-6% cl)
(e) Install required fittings.
(f) Reactivate and flush the water main.

All fittings not specifically called out as being furnished by SWD, and other materials and equipment required to complete the connection shall be furnished by the Contractor. The Contractor shall coat, wrap and bond the connection to conform with the requirements of the new water main. If the connecting pipe is longer than one standard pipe length (including any hydrant branch added at time of connection), a satisfactory bacteriological sample must be obtained.

The Contractor shall make all necessary excavations, shorings and backfills and provide any equipment and operators required to move and lower the component parts of the connection into position. All temporary and permanent blocking shall be done by the Contractor.

In addition to those connections shown on the Drawings, segments of a new water main may be placed in service prior to completion of the entire water main. In such cases, connections between the charged and uncharged segments of the new water main will be done by SWD personnel.

Locations of connections between segments of new main are dependent on Contractor's operations and therefore are not shown. All materials for such connections shall be furnished by the Contractor.

7-11.3(9)B MAINTAINING SERVICE

Where existing services are to be transferred from old to new mains, the Contractor shall plan and coordinate its work with that of the Utility so that service will be resumed with the least possible inconvenience to customers.

To supply customers with water during the construction of a project, where any section of pipe has passed a satisfactory hydrostatic and bacteriological test, the Seattle Water Department reserves the right to tap corporation cocks into a section of a new main and install corporation cocks and service connections at such locations as the Seattle Water Department may elect, at no expense to the Contractor. The attaching of any such service connections by the Seattle Water Department shall not be construed by the Contractor as any acceptance by the Owner of any part of the work required under the Contract.

7-11.3(9)C WATER SERVICE CONNECTIONS

The Seattle Water Department will, at no cost to the Contractor, make all taps for service connections, and will supply and install the service pipe.

The Seattle Water Department will make excavations for the service connections, furnish and install service connections, backfill, compact the trench, and complete temporary patching. The Contractor shall make all repairs for the temporary patching and the permanent street restorations over all trenches per Section 5-07.

The Seattle Water Department normally will schedule and make all service connections within 20 working days after the main is approved and in service.

Where the Drawings show 4-inch, 6-inch and 8-inch service connections, the Contractor shall furnish and install service connection tees, valves, and valve boxes. The tees shall be mechanical joint (MJ) x mechanical joint x Flange (FLG). MJ x FLG valves with temporary, removable MJ plugs shall be installed on the service connection tees. The MJ plugs will be returned to the Contractor after installation of the water service by the Water Department.

The Contractor shall install valve boxes, on water service valves, at the time the water service valve is installed. Valve boxes disturbed by the Seattle Water Department during water service installation will be reset by the Seattle Water Department. The Contractor shall adjust all valve boxes to final grade prior to final surface restoration, at no additional cost to the Seattle Water Department.

Where existing services are to be transferred from old to new mains, the Contractor shall plan and coordinate the work with that of the Seattle Water Department so that service will be resumed with the least possible inconvenience to consumers. Service tee locations will be field determined by the Seattle Water Department. The Contractor shall not remove or abandon old pipe until all service connections have been transferred to the new main or temporary service has been provided. Adequate provisions shall be made by the Contractor during construction for the care and protection of mains or services in use.

7-11.3(9)D TEMPORARY WATERMAINS AND SERVICES

When called for in the Drawings, the Seattle Water Department will install and maintain temporary water mains and services in such a manner as to provide constant adequate water supply to consumers and to avoid impeding vehicular and pedestrian traffic and access to abutting properties.

The Contractor's schedule shall allow adequate time for the Seattle Water Department to install these facilities; a minimum of 2 weeks written notice shall be provided to the Engineer for scheduling and completion of the temporary water main and service work.

The Seattle Water Department will make all required excavation, backfill, and compaction as well as furnishing the necessary equipment and pipe for temporary water mains.

All temporary water mains will be chlorinated, flushed, and a satisfactory bacteriological sample obtained by the Seattle Water Department prior to placing in service.

7-11.3(10) LOCATING WIRE

Locating wire shall be installed directly over all PVC pipe with minimum 2-1/2 feet of cover. The locating wire shall be bonded by exothermic welds to all ductile iron fittings, valves and valve boxes to form an electrically continuous system.

7-11.3(11) HYDROSTATIC PRESSURE TEST

7-11.3(11)A GENERAL

All water mains and appurtenances shall be tested as soon as possible after they are laid, backfilled and prior to bacteriological testing.

All labor, equipment, pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, necessary for performing the test shall be furnished and operated by the Contractor.

Pressure recorders and charts, which will be furnished by the Seattle Water Department, shall be used to record the tests.

At points where pressure reaction and movement may occur, such as at bends, tees, and plugs, the pipe shall be properly blocked or braced. Where permanent blocking is not required, the Contractor shall furnish and install temporary blocking and remove it after testing.

Where water for testing is not available the Contractor shall provide the water from a Seattle Water Department approved source.

To protect existing watermains from contamination by backflow of test water, during filling operations, two check valves or a double check valve assembly shall be temporarily installed between the test and supply main. Prior to hydrostatic testing the temporary backflow protection shall be removed and the main under test isolated from the supply main.

Ductile iron water mains and appurtenances shall be tested hydrostatically to: 300 psi for pipe 12 inches in diameter and smaller, and 250 psi for pipe 16 inches in diameter and larger unless otherwise specified.

Polyvinyl Chloride (PVC) water mains (C1.200) and appurtenances 12 inches in diameter and smaller shall be tested hydrostatically to 300 psi.

Test pressure for other pipe will be as noted in the Project Manual.

The test pressure shall be applied at the low end of the section of water main being tested. All air in the pipe shall be vented prior to test.

The hydrostatic test pressure shall be maintained until the Engineer has determined that the section of pipe, valves, and fittings are watertight. If there are no visible leaks and the test pressure is maintained without pumping for 15 minutes with a pressure drop of less than 15 psi, the main will be accepted as a watertight installation. When testing short (less than 18 feet) lengths of main pipe or when testing hydrant pipe, maintaining the test pressure without pumping for 5 minutes with less than 5 psi drop in pressure will be evidence of a satisfactory test.

Sections to be tested shall normally be limited to 1,500 feet. The Engineer may require that the first section of pipe, not less than 1,000 feet in length, installed by each of the Contractor's crews, be tested in order to qualify the crew and the material. Pipe laying shall not be continued more than an additional 1,000 feet until the first section has been tested sucessfully.

Hydrostatic tests shall be performed on every complete section of water main between valves, or as directed by the Engineer. Each side of each valve shall withstand the same test pressure as the pipe, with no pressure active in the section of pipe beyond the closed valve.

All tests shall be made with the hydrant auxiliary gate valves open and pressure against the hydrant valve. After the test has been completed, each gate valve shall be tested by closing each in turn and relieving the pressure beyond. This test of the gate valve will be acceptable if there is no immediate loss of pressure on the gauge when the pressure comes against the valve being checked. The Contractor shall verify that the pressure differential across the valve does not exceed the rated test pressure of the valve.

Any visible leakage detected shall be corrected by the Contractor regardless of the allowable leakage specified above. Should the tested section fail to meet the pressure test successfully as specified, the Contractor shall, at his expense, locate and repair the defects and then retest the pipeline.

Prior to calling out the Engineer to witness the pressure test, the Contractor shall have all equipment set up completely ready for operation and shall have successfully performed the test to assure himself that the pipe is in a satisfactory condition.

Defective materials or workmanship discovered as a result of hydrostatic field test shall be replaced by the Contractor. Whenever it is necessary to replace defective material or correct the workmanship, the hydrostatic test shall be rerun until a satisfactory test is obtained.

7-11.3(11)B TESTING EXTENSIONS FROM EXISTING MAINS

When an existing water main is extended with new pipe to a new valve and the distance from the existing pipe to the new valve is 18 feet or less, the section of new pipe installed between the new valve and the end of the existing main will be made by the Seattle Water Department with pretested, pre-chlorinated pipe, and no hydrostatic test will be required. When the required hydrostatic tests are conducted in the new main section beyond the installed new valve in the closed position, the normal pressure of the existing main may be present against the other side of the new valve.

Where the distance between the end of an existing water main pipe extension to the new valve is more than 18 feet, the connection of the new pipe to existing pipe shall not be made until after hydrostatic tests have been made to the required pressure in both directions against the new valve. This shall be accomplished by a temporary cap or plug installed on the end of the new pipe, beyond the new valve, as close as possible to the existing pipe for testing purposes.

The short length of pipe between the temporary cap or plug end with the new valve in the closed position, with no hydrostatic pressure active on the opposite side of the valve, shall be subjected to the required test pressure. The same test shall be made against the other side of the new valve when that section of pipe is tested with no hydrostatic pressure active in the short section of pipe toward the existing main pipe. The final connection to the existing main shall be made by the Seattle Water Department with pretested, pre-chlorinated pipe, and no hydrostatic test will be required.

7-11.3(11)C TESTING SECTION WITH HYDRANTS INSTALLED

When hydrants are included with the section of main pipe to be tested, the testing shall be conducted in three separate tests as follows:

Test No. 1 Water main gate valves and hydrant auxiliary gate valves closed, with the hydrant operating stem valves and hose ports wide open.

Test No. 2 Water main gate valves and the hydrant operating the stem valves tightly closed but the hydrant auxiliary gate valves and hose ports wide open.

Test No. 3 Each hydrant shall be tested to the pressure indicated in Section 7-11.3(11)A with the hydrant auxiliary gate valve and hose ports closed and the hydrant operating stem valve wide open. Twenty-five pounds per square inch shall be in the supply main beyond the hydrant auxiliary gate valve when testing a hydrant singly.

7-11.3(11)D TESTING HYDRANTS INSTALLED ON EXISTING MAINS

For hydrants installed and connected to an existing main, the hydrant connection including hydrant tee, connection pipe, and auxiliary gate valves, shall be installed with pretested materials.

Before the hydrant connection is made to the existing main, the hydrant installation shall be subjected to the hydrostatic Test No. 3 as specified in Section 7-11.3(11)C. Hydrants installed and connected to an existing main shall have a satisfactory bacteriological sample obtained following the hydrostatic test.

7-11.3(12) FLUSHING AND DISINFECTION OF WATER MAINS

7-11.3(12)A GENERAL

Before being placed in service, all newly installed pipe shall be flushed, chlorinated and a satisfactory bacteriological report obtained.

The Seattle Water Department laboratory will perform the bacteriological test and report the results to the Engineer. Results will be available no earlier than 48 hours after samples are delivered to the Seattle Water Department Laboratory. The Seattle Water Department may require bacteriological samples at any time.

7-11.3(12)B PRE-DISINFECTION FLUSHING

Sections of pipe smaller than 24-inch diameter to be disinfected by methods other than that found in Section 7-11.3(12)D - METHOD 1 shall first be flushed to remove any solid or contaminated material. If METHOD 1 is used, the 2-1/2 fps flushing shall be done after disinfection is complete (see Section 7-11.3(12)L, Final Flushing and Testing). If no hydrant is installed at the end of the new pipe, a tap shall be provided, by the Contractor, large enough to develop a velocity of at least 2.5 feet per second in the pipe. Flushing period shall be at least 5 minutes for every 150 feet of new pipe but in no case less than 30 minutes. One 2-1/2 inch hydrant opening will, under normal pressure of 40 psi, provide this velocity in pipe sizes up to and including 12 inches. For pipe sizes exceeding 12-inch diameter, flushing taps size requirements are:

REQUIRED FLOW AND OPENINGS TO FLUSH PIPELINES

Pipe Diameter (inches)	Flow Required to Produce 2-1/2 fps Velocity in Main (gpm)	Number/Size of Taps Required for a 2-1/2 fps Flush
14	1200	3 - 2", or 1 - 3"
16	1600	4 - 2", or 1 - 4"
20	2500	6 - 2", or 3 - 3", or 2 - 4"
24	3600	4 - 3", or 2 - 4", or 1 - 6"
30	5625	4 - 4", or 2 - 6", or 1 - 8"
36	8100	2 - 6", or 1 - 8"
42	11025	3 - 6", or 1 - 10"
48	14400	4 - 6", or 1 - 12"

Taps required for chlorination, flushing, or temporary or permanent release of air shall be furnished and installed by the Contractor and are incidental to the construction of water mains. When a hose bibb faucet is installed for bacteriological sampling, it shall be located upstream from the flushing point. Taps on existing mains required for chlorination or flushing will be furnished and installed by the Seattle Water Department.

As an alternative to 2-1/2 fps flushing, sections of pipe 24 inches or larger diameter may be prepared for disinfection by mechanical cleaning methods approved by the Engineer.

The Contractor shall be responsible for disposal of treated water flushed from mains and shall neutralize the wastewater before disposal into any natural drainage channel. The Contractor shall be responsible for disposing of disinfecting solution to the satisfaction of State and local authorities. When approved by the Engineer, disposal may be made to any available sanitary sewer provided the rate of disposal will not overload the sewer and the wastewater is neutralized.

7-11.3(12)C REQUIRED CHLORINE DOSAGE

Before being placed into service, all newly installed pipe shall be chlorinated so that a chlorine residual of not less than 10 mg/l remains in the water after standing 24 hours in the pipe. The initial chlorine content of the water shall not be less than 25 mg/l.

7-11.3(12)D FORM OF APPLIED CHLORINE

Chlorine shall be applied by one of three methods to give a dosage of not less than 25 mg/l of available chlorine:

METHOD - 1 Dry Calcium Hypochlorite

As each length of pipe is laid, sufficient high test calcium hypochlorite (65 -70% chlorine) shall be placed in the pipe to yield a dosage of not less than 25 mg/l available chlorine, calculated on the volume of the water which the pipe and appurtenances will contain. This method may only be used if the pipes and appurtenances are kept clean and dry during construction.

The number of ounces of 65% test calcium hypochlorite required for a 20 foot length of pipe equals $0.004216d^2$ in which "d" is the pipe diameter in inches.

METHOD - 2 100% Gas Chlorine

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device. Chlorinating devices for feeding solutions of the chlorine gas must provide means for preventing the backflow of water into the chlorine supply.

METHOD - 3 Sodium Hypochlorite

Sodium Hypochlorite, commercial grade (12.5% Cl_2) or in the form of liquid household bleach (5 - 6% Cl_2), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the main with fill water in correct proportion to produce a mixture of at least 25 mg/l Cl_2.

7-11.3(12)E CHLORINE DOSAGE

The amounts of chlorine (Cl_2) required to give 25 mg/l for 100-foot lengths of various diameters of pipe are:

AMOUNTS OF CHLORINE REQUIRED FOR 25 MG/L DOSAGE

Pipe Size (inches)	Volume of Water per 100 ft Length (gallons)	100% Cl_2 (lbs)	Household Bleach 5 1/4% (gallons)	Commercial Bleach 12 1/2% (gallons)
4	65.3	.014	.03	.013
6	146.5	.031	.07	.03
8	261.0	.054	.13	.053
10	408.0	.085	.2	.08
12	588.7	.121	.3	.12
14	799.6	.167	.4	.16
16	1044.4	.22	.5	.21
20	1631.9	.34	.8	.33
24	2349.9	.49	1.1	.47
30	3671.7	.77	1.8	.75
36	5287.3	1.1	2.5	1.1
42	7196.6	1.5	3.5	1.44
48	9399.6	2.0	4.6	1.6

7-11.3(12)F POINT OF APPLICATION

The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension or a valved section of it, and through a corporation stop inserted in the horizontal axis of the pipe. The water injector for delivering the chlorine-bearing water into the pipe shall be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension. Alternate points of application may be used when approved or directed by the Engineer.

7-11.3(12) BACKFLOW PREVENTION REQUIREMENT

To prevent contaminated water from the new main from entering the existing distribution system, two check valves or a double check valve assembly shall be used on the line supplying the water. Two check valves or a double check valve assembly is sufficient backflow protection only for filling and flushing of the new main. During the hydrostatic pressure test, the temporary connection between the new main and the existing distribution system shall be removed.

7-11.3(12)H RATE OF APPLICATION

Water from the existing distribution system, or other approved source of supply, shall be controlled to flow very slowly into the newly laid pipeline during application of the chlorine. The rate of chlorine gas-water mixture or dry gas feed shall be in such proportion to the rate of water entering the newly laid pipe that the dosage applied to the water will be at least 25 mg/l.

Sodium hypochlorite, commercial grade (12.5% Cl_2) or in the form of liquid household bleach (5-6% Cl_2), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the main in correct proportion to the fill water so that dosage applied to the water will be at least 25 mg/l.

7-11.3(12)I DISINFECTION CONTACT TIME

Treated water shall be retained in the pipe at least 24 hours. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hours. After the retention

retention period chlorine residual shall be tested at all extremities of the pipe and shall measure at least 10 mg/l. If a measurement of less than 10 mg/l is obtained a repeat disinfection is required.

7-11.3(12)J CHLORINATING VALVES, HYDRANTS AND APPURTENANCES

All valves, hydrants, and other appurtenances shall be operated while the newly laid pipe is filled with the chlorinating agent and under normal operating pressure.

7-11.3(12)K CHLORINATING CONNECTIONS TO EXISTING WATER MAINS AND WATER SERVICE CONNECTIONS

Connections shall be chlorinated to the requirements of AWWA C651 section titled "Disinfection Procedures When Cutting into or Repairing Existing Main" except that all pipe and fittings shall be swabbed or sprayed with a chlorine solution at least as strong as liquid household bleach (5 - 6% Cl_2).

7-11.3(12)L FINAL FLUSHING AND TESTING

Following chlorination, all treated water shall be flushed from the pipe until the replacement water tested throughout its lengths shows an absence of chlorine. In the event chlorine is normally used in the source of supply tests shall show a residual not in excess of that carried in the system.

Where dry calcium hypochlorite has been used for disinfection, flushing velocity must be at least 2.5 feet per second in the main. Flushing period shall be at least 5 minutes for every 150 feet of new main but in no case less than 30 minutes.

A sample tap shall be located ahead of the flushing hose for convenience and for sanitary sampling.

Hydrants on the new main shall flushed to remove excess chlorine from the hydrant and hydrant branch. If the hydrant branch, including horizontal and vertical measurements, is longer than one standard pipe length, the hydrant shall be fitted with a sample tap. No hoses shall be used in collection of samples.

Prior to acceptance and placing the pipe into service a satisfactory bacteriological test report is required on samples collected from representative points in the new installation. Samples will be collected and analyzed by the Seattle Water Department Laboratory.

A period of 48 hours is required before bacteriological results are made available to the Engineer.

7-11.3(12)M REPETITION OF FLUSHING AND TESTING

Should the initial treatment result in an unsatisfactory bacteriological test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained. Failure to get a satisfactory test shall be considered as failure of the Contractor to keep the pipe clean during construction, or to properly chlorinate the main.

7-11.3(13) CONCRETE THRUST BLOCKING

Concrete thrust blocking, as indicated on the Drawings and Standard Plan No's. 330a through 331b, shall be placed at bends, tees, deadends, crosses and as designated by the Engineer. Blocking shall be sized by the Engineer to withstand the test pressures in Section 7-11.3(11). Blocking shall be Class 5 (1-1/2) concrete mix poured in place.

Concrete blocking shall bear against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints of the pipe or fittings.

7-11.3(14) BLOWOFF ASSEMBLIES

Water main blowoff assemblies shall be constructed as shown on the Drawings or Standard Plan No's. 340a and 340b. A standard meter box shall be installed in non-traffic bearing areas; a Type 361 Ring and Cover shall be used for all other installations subject to vehicular traffic. Care shall be taken in locating the meter box or ring and cover such that it is not in any water course or in any other location subject to drainage or sewerage contamination. Tops shall be set to conform to finished grade. Backfilling and compaction shall conform with Sections 7-10.3(10) and 7-10.3(11).

Drilling and tapping into the water main will be performed by the Contractor except in the event of installation on a charged (in-use) water main, in which case the Seattle Water Department will make the connection.

7-11.3(15) CORROSION PROTECTION OF DUCTILE IRON PIPE

7-11.3(15)A GENERAL

Where called out on the Drawings, the pipeline contractor furnishing the pipe shall comply with the following:

(a) Install Electrical Continuity Bonds: The Contractor shall furnish and install electrical bonds, as specified herein, at all mechanical couplings and all rubber gasket joints. The Contractor shall take special precautions to avoid disturbing bonds, electric cables, and wires for test stations and other cathodic protection equipment connected to, or installed near the pipeline.

(b) Install Electrolysis Test Stations: The Contractor shall furnish and install the Electrolysis Test Stations where shown, and as detailed on the Drawings.

7-11.3(15)B ELECTRICAL JOINT BONDS FOR ALL DUCTILE IRON PIPES AND FITTINGS

7-11.3(15)B1 GENERAL

Each length of ductile iron pipe in the pipeline, and each hydrant run, shall be electrically bonded together, and each mechanical joint shall be bonded to the pipe as shown on the Drawings. The Engineer will make adhesion tests of all bonds and bonded joints. Any bonded joint which fail to meet the adhesion test shall be rebonded until a satisfactory test is obtained. Bonding cable shall be as specified in Section 9-30.14 herein.

Details of mechanical joint bonding shall be as shown in Standard Plan No. 362.

7-11.3(15)B2 BOND CONNECTIONS FOR DUCTILE IRON PIPE

Prior to making any bond connection to metal, an area approximately 2 inches by 2 inches square shall be thoroughly cleaned to expose bare metal. The point of connection for the bond shall be centered in the bared area. The bared area shall be filed or ground, to expose uniformly bright metal. Immediately prior to making the bond connection all bared areas shall be cleaned of all dirt, dust, moisture, oil and grease. All bonded areas shall be cleaned in the same manner immediately prior to insulating. All bond connections shall be made with approved exothermic weld type connections as shown on the Drawings, and shall be tested for adhesion as directed by the Engineer.

7-11.3(15)B3 INSULATED BOND CONNECTIONS

Each bond connection shall be insulated thoroughly with a Royston Handy Cap or approved equal. The cap shall completely cover the cleaned area and provide insulation of the bond connection from the soil environment. The cap must be

attached by use of a bonding cement or primer and must contain an elastomeric material under a plastic dome. The elastomeric material must mold completely around the bond wire and weld area. The plastic cap shall be a minimum of 4 inches x 4 inches x 125 mils thick. Bond caps are not required when the connection is covered by heat shrink joint wrapping.

7-11.3(15)B4 APPLICATION OF HEAT SHRINK PIPE JOINT SLEEVE

After electrical bonds are installed and tested, the entire pipe joint and electrical bond strap shall be protected with a heat shrink joint sleeve. The sleeve shall be wraparound type with a joint closure and shall contain a Thermal Indicator. The sleeve shall be Raychem Thermofit Wraparound Pipe Sleeve WPCT and the closure shall be Raychem WPCP III or approved equal.

7-11.3(15)C ELECTROLYSIS TEST STATION

7-11.3(15)C1 GENERAL

Electrolysis Test Stations shall be installed as shown on Standard Plan No. 360 and on the Drawings. Items used shall be as specified in the following Sections.

7-11.3(15)C2 ZINC REFERENCE ELECTRODES

The electrode shall be packaged in a backfill material of 50% gypsum and 50% bentonite clay. The package shall be water permeable and of sufficient size to ensure complete envelopment of the reference electrode.

7-11.3(15)C3 TEST STATION

The test station shall consist of a molded fiberglass junction box installed inside a conventional cast iron water meter box for non-traffic areas or inside a Type 361S Ring and Cover for traffic areas.

7-11.3(15)C4 TEST WIRES

Wire location, connections to pipe, size, and insulation color shall be as shown on the Drawings.

7-11.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pipe, Water Main, (Material), (Class), (Size), including Fittings", will be per linear foot based on the slope distance from point to point. The point of beginning or ending of measurement in any particular run of pipe shall be the vertical intersection of the center line of the intersecting pipe, or with the beginning or ending of any new pipe laid. No deductions will be made for the linear length of fittings, valves, couplings, etc. contained within the measured length. At changes in pipe size connected by a reducer, the point of measurement shall be taken as the midpoint of the reducer. See Standard Plans.

Measurement for "Blocking, Cement Concrete" will be by the cubic yard of concrete placed as computed by the Engineer.

Measurement for "Blowoff Assembly, (Size)" will be per each installed and shall include the blowoff connection pipe.

Measurement for "Steel Casing Pipe, (Size) Diameter, Tunneled, Jacked or Augered" will be per linear foot actually installed.

Measurement for "Station, Electrolysis Test," will be per each installed complete.

7-11.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-11 will be made at the unit contract prices bid only for the bid items listed or reference below:

(1) "Pipe, Water Main, (Material), (Class), (Size), including Fittings" per linear foot.
(2) "Blocking, Cement Concrete" per cubic yard.
(3) "Blowoff Assembly, (Size)" per each.
(4) "Pipe, Blowoff, (Material), (Size)" per linear foot.
(5) "Steel Casing Pipe, (Size) Tunneled, Jacked or Augered" per linear foot.
(6) "Station, Electrolysis Test," per each.

The unit price for "Pipe, Water Main, (Material), (Class), (Size), including Fittings" shall be full compensation for the costs required for excavating, laying, joining, backfilling and compacting native material, disposing of or placing excess and/or unsuitable native material elsewhere, flushing, testing, and disinfecting of the pipe line. Materials shall include, but are not limited to, the pipe, all fittings, all pipe supports, locating wire, and any items called for in the Project Manual. Where required, the costs of sand or foam cushioning between the water main and other pipes shall also be included.

Payment for safety systems required for for trench excavation work shall be in accordance with Section 7-17.5.

All costs not provided for otherwise for the work required to furnish and install the mechanical joint sleeves and furnish and install pipe supports including pipe hanger rods with nuts, single pipe rolls, steel angles, reinforcing bars, nuts, bolts, washers, mastic, galvanizing, trench excavation, backfill, compaction, removal of surplus excavation, and all other incidental work, shall be included in the unit contract price for "Pipe, Water Main, (Material), (Class), (Size), including Fittings."

All costs in connection with furnishing and installing polyethylene encasement, multi-layered polyethylene tape coating or special coating to the pipe where required as indicated on the Drawings shall be included in the unit contract price for the new pipe "Pipe, Water Main, (Material), (Class), (Size), including Fittings" as listed in the Bid Form.

Payment for bedding for polyethylene encased, multi-layered polyethylene tape coated or specially coated pipe shall be in accordance with Section 7-17.5.

No separate payments will be made for the hydrostatic field tests, temporary caps, pipe fittings, plugs, corp stops, temporary blocking/anchorage and the cost of all labor, material, tools, supplies and equipment required to complete the test shall be considered as incidental to the pipeline construction.

Defective materials or workmanship discovered as a result of hydrostatic field test shall be replaced and subsequent hydrostatic field tests thus required to be rerun shall be by the Contractor at his own cost.

Special fittings used but not called for on the Drawings will be paid for at the supplier's invoice cost plus 15 percent for overhead and profit. Special fittings called for on the Drawings but not used will be deducted from the Contractor's final estimate based on the current cost of the supplier of fittings used on the improvement.

The unit contract price for "Blocking, Cement Concrete" shall include all costs to place concrete blocking of the proportions required, including excavation, turnbuckles, shackle rods, steel plates, concrete form work, finishing, removal and disposal of excavation not required for backfill, and any other work that may be necessary for constructing the blocking in place as specified.

The unit contract price for "Blowoff Assembly, (Size)" shall include all costs for furnishing and installing the complete assembly including corporation, fittings, pipes, valve, meter

box or ring and cover, and all excavation, backfill with native material and compaction.

All costs to furnish and install the pipe between the corporation and the blowoff assembly including fittings shall also be included in the unit contract price for "Blowoff Assembly, (Size)."

If the location of the blowoff assembly differs from that shown in the Drawings and requires an increase of more than 10 feet of connection pipe, the excess of pipe over 10 feet will be paid for in accordance with Section 1-09.4.

The unit contract price for "Steel Casing Pipe, (Size) Tunneled, Jacked, or Augered," shall be full compensation for the casing pipe in place, including tunneling, excavation and backfill of jacking pits, furnishing and placing sand filler, spacers, and sealing both ends with concrete.

Payment will be made at the bid price for "Station, Electrolysis Test," which shall include furnishing and installing water meter box, test box, terminal blocks, wires, zinc reference electrodes, removal and restoration of side walks, and all other materials and labor required to complete the job.

No separate payment will be made for Electrical Joint Bonds, but the cost for all labor, material and equipment required for satisfactorily bonding across mechanical couplings and across rubber gasket joints, and all incidentals required to provide satisfactory and complete bonding sets, including but not limited to all required cable, bolts, molds and cold applied tape coating or heat shrink sleeve for any one coupling or any one rubber gasket joint shall be considered as included in the price bid for "Pipe, Water Main, (Material), (Class), (Size), including Fittings".

If either the pipe, lining or coating is damaged, the Contractor will be required, at his own expense, to repair the damage to the satisfaction of the Engineer prior to installation.

No additional payment will be made for laying pipe on curves as shown in the Drawings, nor for field changes involving standard lengths of pipe deflected at the joints. When special fittings not shown in the Drawings are required to meet field conditions, additional payment will be made for special fittings as provided in Section 1-09.6.

Costs of all material, labor and equipment associated with making the pipe connection as specified in Section 7-11.3(9)A shall be considered incidental to and included in the unit price bid for "Pipe, Water Main, (Material), (Class), (Size), including Fittings".

All costs for furnishing and installing service connecting tees 4-inch and larger and shall be considered to be included in the cost of "Pipe, Watermain, (Material), (Class), (Size), including Fittings".

Any area settled due to the placement of steel casing pipe shall be repaired as directed by the Engineer at the Contractor's own cost.

All costs to remove and replace damaged steel casing pipe deemed necessary by the Engineer shall be at the Contractor's own cost.

No additional payment will be made for the replacement and realignment of the casing pipe.

SECTION 7-12 VALVES FOR WATER MAINS

7-12.1 DESCRIPTION

This work shall consist of furnishing and installing valve, operating nut extensions, valve chamber and vault, valve box, valve box extension, combination air release/air vacuum valves, steps and ladders, water proofing materials, support piers, adjustment bricks, castings and lids, and plastic foam cushion; furnishing tapping sleeve and tapping valve; painting; coating; disinfecting; hydrostatic testing; excavating; backfilling; compacting; plastering; and installing foundation.

7-12.2 MATERIALS

Materials shall meet the requirements of Section 9-30.

Valves for water mains shall be suitable for ordinary waterworks service, intended to be installed in a normal position on buried pipelines for water distribution systems.

Valves shall open counter clockwise and shall be equipped with a 2-inch square AWWA standard operating nut. Unless otherwise specified, all valves shall be the nonrising stem type.

7-12.3 CONSTRUCTION REQUIREMENTS

7-12.3(1) GENERAL

All valves shall be inspected upon delivery in the field to ensure proper working order before installation and shall be free of all rust and dirt. They shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connecting ends furnished. The valves shall also be carefully inspected for injury to the outer protective coatings.

At all places where the coating has been ruptured or scraped off, the damaged area shall be thoroughly cleaned to expose the iron base installation. The cleaned area shall then be recoated with zinc chromate primer. After recoating with the primer, the entire valve shall be field painted with two or more coats of Royston Roskote No. 612XM or approved equal.

An Operating Nut Extension shall be installed when the ground surface is more than 30 inches above the valve operating nut. The Operating Nut Extension shall extend into the top section of the Standard Valve Box and shall clear the bottom of the lid by a minimum of 6 inches. When required, it shall be furnished and installed by the Contractor.

Upon delivery at the work site, all valves shall be opened to prevent the collection of water in the valve. Valves shall have the interiors cleaned of all foreign matter and shall be inspected both in open and closed position prior to installation. Valves and valve boxes shall be set plumb and valve boxes shall be placed over the valve or valve operator in a manner that the valve box does not transmit shock or stress to the valve. The lower casting of the unit is installed first, in a manner as to be supported by a minimum backfill or by a styrofoam collar not less than 2 inches in thickness. The casting shall not rest directly upon the body of the valve or upon the water main. Backfill shall be carefully tamped around the valve box to a distance of 3 feet on all sides or to the undisturbed face of the trench if it is closer. The cast iron valve box cover shall be set flush with the roadbed or finished paved surface.

The combination air release/air vacuum valves shall be installed as shown in the Drawings. All piping shall be sloped to permit escape of any entrapped air. Backfilling and compaction shall be as specified in Section 7-10.

After installation, all valves shall be subjected to field testing and disinfected as outlined in Section 7-11. Should any defects in design, materials, or workmanship appear during these tests, the Contractor shall correct such defects with the least possible delay and to the satisfaction of the Engineer.

7-12.3(2) VALVES CHAMBERS AND VAULTS

7-12.3(2)A GENERAL

This section shall apply to the construction of standard valve chambers and special valve chambers, all in accordance with the Standard Plans.

Where shown on the Drawing or where directed by the Engineer, valves shall be enclosed in valve chambers set over the operating stem.

Valve chambers may be either precast, cast in place, solid concrete blocks, concrete brick or made of clay brick.

7-12.3(2)B PRECAST VALVE CHAMBERS

The concrete base shall be poured-in-place or precast. Poured-in-place base shall be allowed to attain sufficient strength to support the chamber (usually 2 or 3 days), as directed by the Engineer. Precast chambers shall be set on the base in cement mortar with the slotted holes straddling the water main.

The water main shall be wrapped with 2-inch thick plastic foam material at those areas where the main intersects the chamber wall. Any remaining space between the chamber wall and the plastic foam material shall be filled with cement mortar or mortared bricks. In no case shall the water main rest on the chamber wall.

7-12.3(2)C CHAMBERS MADE WITH PRECAST CONCRETE BLOCKS

Circular or rectangular chambers may be made with solid precast concrete blocks. The base shall first be poured in place. After the base has reached sufficient strength (usually 2 or 3 days), the walls may be constructed of concrete blocks with water-tight cement mortar joints.

Circular chambers shall be constructed with curved manhole blocks. The chamber top shall be tapered in to the dimensions shown on the Standard Plans.

Chambers shall have a cast-in-place or precast concrete top slab suitable for H-20 traffic loading.

7-12.3(2)D CAST-IN-PLACE CHAMBERS

Cast-in-place chambers may be constructed by using forms and poured concrete. Finishing of walls is not required other than the patching of porous spots (rock pockets) and bolt holes. Forms shall be removed for inspection of concrete.

7-12.3(3) SETTING RING AND COVER

The cast iron frame and cover shall be set to grades furnished by the Engineer. Provisions for future adjustment of frame to changes in grade shall be made by constructing a minimum of 2 courses of brick with mortar joints between the top of the chamber and the bottom of the casting. Brick for this purpose shall be standard clay or concrete brick 2-1/4 inches thick.

7-12.3(4) SETTING VALVE BOX

Cast iron valve boxes shall be set to position during backfilling operations so that they will be in a vertical alignment with the gate valve operating stem. The lower casting of the unit shall be supported by a plastic foam collar not less than 2 inches thick, and shall be held in place by carefully compacted backfill. The casting shall not rest directly upon the body of the gate valve or upon the water main. The upper casting of the unit shall be placed in proper alignment and to such an elevation that its top will be at final grade.

Compaction shall be as specified in Section 7-10.3(11).

7-12.3(5) VALVES INSTALLED ON SPECIALLY COATED PIPE

Valves installed on water mains that are polyethylene encased, tape coated, or special coated, shall be encased, tape, or special coated the same as the water main.

7-12.3(6) LADDERS

Refer to Section 7-05.3(19).

7-12.3(7) PAINTING OF VALVES

7-12.3(7)A PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces shall be painted inside and out with two coats of asphalt varnish, Federal Specification TT-V-51A or approved equal.

7-12.3(7)B PAINTING IN THE FIELD

The valve shall be carefully inspected for injury to the outer protective coatings. At all places where the coating has been ruptured or scraped off, the damaged area shall be thoroughly cleaned to expose the iron base installation, and the cleaned area shall then be recoated with zinc chromate primer and the entire valve shall be field painted with two or more coats of Royston Roskote 612XM, or equal.

7-12.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

7-12.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-12 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Valve, Gate, (Size)," per each.
(2) "Valve, Butterfly, (Size)," per each.
(3) "Valve, Gate or Butterfly, (Size)," per each.
(4) "Tapping Sleeve, (Size) x (Size) and Tapping Gate Valve, (Size)," per each.
(5) "Valve Chamber, (Type), (Size)," per each.
(6) "Valve Box, Cast Iron," per each.

The unit contract price for "Valve, (Type), (Size)" shall include all costs for the work required to furnish and install the valve, including painting, jointing, disinfecting, hydrostatic testing, operating nut and extensions.

When the valve is to be polyethylene encased, multi-layered polyethylene tape coated, or special tape coated as indicated in the Drawings or in the Project Manual, the cost for furnishing and installing the coating as specified in Section 7-12 shall be included in the unit contract price for "Valve, (Type), (Size)" as listed in the Bid Form.

When the Tapping Sleeve and Tapping Valve will be installed by the Seattle Water Department, payment at the unit bid price for the Tapping Sleeve and Valve shall include furnishing the sleeve and valve at the construction site designated, trench excavation, backfill with native material and compaction.

The unit contract price for "Valve Chamber, (Type) (Size)" and Shall include all costs required to furnish and install the precast concrete, brick and block, or cast-in-place chamber, including foundation, adjustment brick, castings and lid, ethafoam cushion, mortar plastering, valves, support piers, water proofing materials and steps or ladders.

The unit contract price for "Valve Box, Cast Iron" shall include all costs to furnish and install the valve box, including plastic foam cushion.

SECTION 7-13 VACANT

SECTION 7-14 HYDRANTS

7-14.1 DESCRIPTION

These Specifications are to be used in conjunction with the AWWA Standard C502 for dry barrel fire hydrants for ordinary water works service.

This work shall consist of furnishing, installing, and setting hydrant, hydrant tee, auxiliary valve, restraint system and shackles, gravel drain, concrete blocks, shear block, bleeder, hydrant connection, connection pipe, and hydrant vertical extension, retaining wall, and rock facing, coating, painting, excavation, backfilling, reset existing hydrant, move existing hydrant, furnishing tee and sleeve for connection to existing main, and other pertinent work as specified in other Sections of this Specification.

7-14.2 MATERIAL

Materials shall meet the requirements of Section 9-30.

7-14.3 CONSTRUCTION REQUIREMENTS

7-14.3(1) SETTING HYDRANTS

Where shown in the Drawings, hydrants shall be installed in accordance with the detail shown on Standard Plan No's. 310a through 314.. Hydrants shall not be installed within 3 feet of a traveled roadway. In addition, a minimum 3-foot radius unobstructed working area shall be provided around all hydrants. The sidewalk flange shall be set 2 inches above finished grade.

All hydrants shall be set on concrete blocks as shown in Standard Plan No's. 310a through 314. The hydrant drain shall waste into a pit of crushed stone or gravel situated at the base of the hydrant as shown in Standard Plan No's. 310a and 311a.

All hydrants shall be inspected in the field upon arrival to ensure proper working order. After installation, they shall be subjected to a hydrostatic test as specified in Section 7-11.

The Contractor shall also check the threads on the pumper and hose parts for proper pattern and service capability.

A concrete shear block, as shown on the hydrant detail, shall be constructed if the hydrant is not in a concrete sidewalk. Construction, materials, and finishing shall conform with Section 8-14, Cement Concrete Sidewalk. The shear block shall be set to the grade of the future sidewalk.

After all installation and testing is complete, the exposed portion of the hydrant shall be painted with one field coat. The type and color of paint will be designated by the Engineer.

Any hydrant not in service shall be identified by covering with a burlap or plastic bag.

7-14.3(2) HYDRANT CONNECTIONS

7-14.3(2)A GENERAL

Hydrant laterals shall consist of a section of 6-inch ductile iron pipe from the main to the hydrant and shall include an auxiliary gate valve set vertically and placed in the line as indicated in the Standard Plans.

7-14.3(2)B HYDRANT RESTRAINT

Hydrants shall be restrained with two 3/4 inch diameter steel shackle rods as shown on the Drawings. Threads will be cut at the ends, or where rod couplers are needed. "All Thread" rod will not be allowed. Shackle rods shall be completely coated pursuant to Section 9-30.15.

7-14.3(2)C AUXILIARY GATE VALVE AND VALVE BOX

All auxiliary gate valves and boxes shall conform to Section 7-12 except that the end connections shall be provided with lugs for shackling or the bells shall have sufficient clearance between the body of the valve and the hub to permit the installation of shackles.

7-14.3(3) RESETTING EXISTING HYDRANTS

Where, on the Drawings, an existing hydrant is shown for adjustment to conform to new street alignment or grade, the hydrant shall be reset without disturbing the location of the hydrant lateral tee at the main.

The hydrant shall be shackled as specified in Section 7-14.3(2)B.

This work shall be in accordance with the specifications for setting new hydrants.

7-14.3(4) MOVING EXISTING HYDRANTS

When an existing hydrant is shown on the Drawings to be moved, a new tee shall be inserted in the main, and the open part of the abandoned tee shall be securely plugged and shackled or blocked. The hydrant shall be shackled as specified in Section 7-14.3(2)B. The work shall be done in accordance with the specifications for setting new hydrants.

On charged mains, the furnishing and insertion of the new tee, and the plugging and blocking of the existing tee, will be by the Seattle Water Department as specified in Section 7-11.3(9)A.

7-14.3(5) RECONNECTING EXISTING HYDRANTS

When reconnecting existing hydrants is specified, the hydrants remain unchanged in their original position, but the existing hydrant connection is changed to connect with a new hydrant tee provided in a new main.

Hydrant reconnections shall meet all the requirements for new work.

Where existing hydrants were not shackled to the old main, the new connection shall be shackled with steel rods as shown in Standard Plan No's. 310a through 311b, or by such other shackling method as may be directed by the Engineer.

7-14.3(6) HYDRANT BARREL EXTENSIONS

The minimum requirements for hydrant barrel extensions, operating stems, and flanged adapters shall conform to AWWA C502 in design, material, and workmanship. The drilling of the flanges on the extensions shall match the drilling of the flanges on the hydrant.

7-14.3(7) NEW HYDRANT ON EXISTING MAIN (NEW TEE)

When a new hydrant is shown on the Drawings to be connected to an existing main, the new hydrant shall be installed as indicated. The hydrant shall be shackled as specified in Section 7-14.3(2)B. All work shall be in accordance with specifications for new work.

Connection and insertion of new tee and sleeve shall be by the Seattle Water Department as specified in Section 7-11.3(9)A.

7-14.3(8) NEW HYDRANT ON EXISTING MAIN (EXISTING TEE)

When a new hydrant is shown on the Drawings to be connected to an existing main at an existing hydrant tee, the hydrant shall be installed as indicated and shall be shackled as specified in Section 7-14.3(2)B. All work shall be in accordance with specifications for new work. The connection shall be by the Seattle Water Department as specified in Section 7-11.3(9)A.

7-14.3(9) RETAINING WALLS FOR HYDRANTS

Where indicated on the Drawings, the Contractor shall furnish and place a broken concrete slab wall around hydrants in accordance with Standard Plan No. 313. Rockery rock may be used in place of broken concrete.

The broken concrete slabs shall be a minimum of 3-1/2 inches in thickness and not less than 3 feet x 1.5 feet in size. The slabs shall be set in level layers of the same thickness, and the exposed faces shall be as smooth as the shape and size of the slabs will permit.

The backfill behind the wall shall be Mineral Aggregate Type 2, in accordance with Section 9-03.

7-14.3(10) HYDRANTS ON WATER MAINS THAT ARE POLYETHYLENE ENCASED, TAPED, OR SPECIALLY COATED

For hydrants installed on water mains that are polyethylene encased, taped, or specially coated, the following shall be required:

(a) Hydrant Connections (See Section 7-14.3(2)) shall have the same special coating as the water mains to which they are connected, and shall have Class B bedding in accordance with Section 7-10.3(9).
(b) Hydrant barrels below ground shall have the same special coating as the water main to which they are connected.
(c) Hydrant connection shall be installed as specified in Section 7-11.3(6).

7-14.3(11) HYDRANT SHOP PAINTING

All iron parts of the hydrant, shall be thoroughly cleaned and painted at the factory. All inside surfaces and the outside surfaces below the ground line shall be coated with asphalt varnish, Federal Specification TT-V-51a or J.A.N.P-450, unless otherwise specified. They shall be covered with two coats, the first having dried thoroughly before the second is applied.

Following installation, the hydrant shall be painted as follows:

(a) Prior to backfill, the extension below ground portion shall be painted with Asphaltic Varnish, Royston Roskote number 612XM or approved equal.
(b) After backfill the outside area of the hydrant, which is above the finished ground line when backfilling is completed, shall be thoroughly cleaned and then painted with one coat of hydrant green Enamel, Preservative Paint Co. No. 43-107, Farwest Paint Company number 40255 or approved equal.

7-14.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Retaining Wall for Hydrant" will be per square foot of face of wall constructed.

7-14.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-14 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Hydrant, 6-inch Connection, (Type)," per each.
(2) "Hydrant, 6-Inch Connection with Vertical Extension," per each.
(3) "New Hydrant on Existing Main (New Tee)," per each.
(4) "New Hydrant on Existing Main (Existing Tee)," per each.
(5) "Reset Hydrant," per each.
(6) "Move Hydrant," per each.
(7) "Reconnect Hydrant," per each.
(8) "Hydrant Extension, Vertical, 24-inch and Under," per each.
(9) "Hydrant Extension, Vertical, Over 24-inch," per each.
(10) "Retaining Wall for Hydrant," per square foot.

The unit contract price for "Hydrant, 6-Inch Connection, (Type)" shall include all costs for the work required to furnish and install the hydrant, including the hydrant tee, auxiliary valve, valve box, restraint system and shackles, gravel drain, concrete blocks, bleeder, coating, painting and shear block, the 6-Inch Ductile Iron pipe connecting the hydrant auxiliary gate valve to the water main and all the costs of the work to furnish and install the connecting pipe are included in the unit contract price for "Hydrant, 6-inch Connection, (Type)".

The unit contract price for "Hydrant 6-Inch Connection With Vertical Extension" shall include all costs for the work required for "Hydrant, 6-inch Connection, (Type)" plus all costs for the work necessary to furnish and install the required vertical extensions.

If the location of the hydrant differs from that shown in the Drawings and requires an increase of more than 5 feet of connection pipe, the length of pipe exceeding 5 feet will be paid for by either "Pipe, Water Main, Ductile Iron, Class 52, 6-Inch," if such a bid item is in the Bid Form or in accordance with Section 1-09.4 if not in the Bid Form.

The unit contract price for "New Hydrant on Existing Main (New Tee)" and "New Hydrant on Existing Main (Existing Tee)" shall include all costs for work and materials required to furnish and install the new hydrant as specified, the excavation, backfill, and new connection pipe.

The unit contract price for "Reset Hydrant" shall include all costs for the work required to reset the existing hydrant as specified, including shackling, painting and new connection pipe.

The unit contract price for "Move Hydrant" shall include all costs required to move the existing hydrant as specified, the excavation, backfill, and if required, furnishing of tee, sleeve, new connection pipe.

The unit contract price for "Reconnect Hydrant" shall include all costs for the work required to reconnect the existing hydrant, including new tee, shackles, painting, abandoning the existing tee and new connection pipe.

The unit contract price for "Hydrant Extension, Vertical, 24-inch and Under," and "Hydrant Extension, Vertical, Over 24-inch" shall include all costs necessary for the work to extend the hydrant to the required finished grade in a fully operational and finished condition and shall also include the casting, bolts, nuts, washers and gaskets.

The unit contract price for "Retaining Wall for Hydrant" shall include all costs for the work required to furnish and install the concrete slabs. Rock facing may be used in place of broken concrete.

All costs in connection with furnishing and installing coating as specified in Section 7-14.3(11) shall be included in the unit contract price of various bid items comprising this improvement.

Payment for bedding for polyethylene encased, multi-layered tape coated, or special tape coated hydrant connection pipe and hydrant barrel shall be in accordance with Section 7-11.5.

SECTION 7-15 SERVICE CONNECTIONS

7-15.1 GENERAL

The Seattle Water Department will, at no cost to the Contractor, make all taps for service connections, and for supplying, disinfecting, and installing the service pipe.

SECTION 7-16 FLOW CONTROL SYSTEMS

7-16.1 DESCRIPTION

This work shall consist of excavation, shoring, foundation preparation, bedding, jointing, backfilling and compacting for the construction of a flow control structure and detention pipe for storm water storage. The flow control structure shall consist of manhole structure with a flow control device.

7-16.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Manhole Components	9-12
Concrete Pipe	9-05
Corrugated Steel Pipe	9-05
Corrugated Aluminum Pipe	9-05
Frame and Grate	9-12
Flow Control Structure	9-12

Joint coupling bands for detention pipe shall be of the type specified in Section 9-05.1(2)B and 9-05.1(3)B.

7-16.3 CONSTRUCTION REQUIREMENTS

7-16.3(1) GENERAL

All work including excavation, foundation preparation, bedding, pipe laying and jointing, backfilling, compacting for the construction of detention pipe and flow control structure shall be in accordance with Section 7-05 and 7-17.

7-16.3(2) FLOW CONTROL STRUCTURE

The PVC orifice plate shall be fusion welded to the PVC cross with an orifice of the diameter indicated on the Drawings drilled in its center.

The PVC shear pin shall be 3/4 inch in diameter and shall be fastened with a PVC cotter pin and stainless steel washer.

One end of the shear gate chain shall be attached to the shear gate and the other end shall be attached to a galvanized anchor bolt embedded in the leveling block. The chain shall be slack when the gate is closed.

After pipe or castings have been placed in their final positions, openings in the walls of the flow control structure shall be grouted in place to present a smooth, flush inner and outer surfaces.

7-16.3(3) DETENTION PIPE

Seams in pipes and bands shall be gasketed in accordance with AASHTO Designation M196.

The end plate shall be welded to the end of the detention pipe with a watertight continuous weld.

The end of the detention pipe inside the flow control structure shall be ground smooth of all burrs and sharp edges.

Aluminum in contact with concrete shall be cleaned with a solvent to remove contaminants and then painted with two coats of paint as specified in Section 9-05.20.

Bedding for the detention pipe shall be Class B, using Mineral Aggregate Type No. 22 as specified in Section 7-17.3(1)B3.

7-16.3(4) TEE CONNECTION TO CORRUGATED PIPE

Drainage pipes connected to corrugated detention pipe shall be made through a shop fabricated tee as shown on the Drawings and shall be installed in accordance to Section 7-17.3(2)C2. Tee shall be made to conform to size of detention pipe and sized to accept only rubber joint pipe.

7-16.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Flow Control Structure, (Diameter)," shall be by each structure, complete in place.

Measurement for the "Pipe, Detention, (Material) (Size)," shall be by linear foot for the actual length of pipe installed.

Measurement for outlet pipe shall be in accordance with Section 7-08.

7-16.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-16 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Flow Control Structure, (Diameter)," each.
(2) "Pipe, Detention, (Material), (Size)," linear foot.

The unit contract price for "Flow Control Structure, (Diameter)," shall include all costs for the work required to furnish and construct the flow control structure including excavation, backfill, gravel bedding or foundation material, the PVC connection pipe and flexible adaptor coupling.

The unit contract price for "Pipe, Detention, (Material), (Size)," shall include all costs for the work required to furnish and install the detention pipe including excavation, backfill, the end plate, grinding smooth the detention pipe's end in the flow control structure, and cleaning and painting the aluminum, or steel surfaces as specified.

If an air vent is shown on the Drawings, all costs for fabricating and installing it shall be included in the unit contract price bid for "Pipe, Detention, (Material), (Size)."

The outlet pipe of the flow control structure will be paid as "Pipe, Catch Basin Connection (Material), (Class), (Size)" per Section 7-08.5.

Tees will be paid for under Section 7-17.

SECTION 7-17 STORM DRAINS AND SANITARY SEWERS

7-17.1 DESCRIPTION

This work shall consist of trench excavation, shoring, foundation preparation, bedding, pipe laying, jointing, backfilling, compacting and testing for the construction of storm drains, sanitary sewers, and combined sewers.

All references to "sanitary sewers" shall be construed to mean "storm drains, sanitary sewers, and combined sewers."

7-17.2 MATERIALS

7-17.2(1) GENERAL

Materials shall meet the requirements of the following Sections:

Concrete Sewer Pipe	9-05
Vitrified Clay Sewer Pipe	9-05
PVC Sewer Pipe	9-05
Ductile Iron Sewer Pipe	9-05
Steel Sewer Pipe	9-05
Aluminum Sewer Pipe	9-05
Joints	9-04

All sanitary sewer pipe shall have flexible gasketed joints unless otherwise specified.

It is not intended that materials listed are to be considered equal or generally interchangeable for all applications. The Engineer shall determine from the materials list those suitable for the project, and shall so specify in the Specifications or the Drawings.

All pipe shall be clearly marked with type, class, and thickness. Lettering shall be legible and permanent under normal conditions of handling and storage.

7-17.2(2) PROOF TESTS (PREQUALIFICATION)

The intent of this requirement is to pre-qualify a joint system, components of which meet the above requirements, as to the water tightness capability of that joint system. This proof test shall be understood to apply to sanitary sewers which are to be tested for water tightness prior toacceptance. Material and test equipment for proof testing shall be provided by the manufacturer. When approved by the Engineer, internal hydrostatic pressure may be applied by a suitable joint tester. Proof Tests shall meet the requirements of the following Sections:

Concrete Sewer and Drain Pipe	9-05
Vitrified Clay Sewer and Drain Pipe	9-05
PVC (Polyvinyl Chloride) Sewer and Drain Pipe	9-05
Ductile Iron Sewer and Drain Pipe	9-05
Steel Sewer Pipe	9-05
Aluminum Sewer Pipe	9-05
Joints	9-04

7-17.2(3) MATERIAL CERTIFICATION

The manufacturer or fabricator shall furnish appropriate certification, based on manufacturer's routine quality control tests, that the pipe meets the requirements of the pertinent ASTM or ANSI Specification.

7-17.3 CONSTRUCTION REQUIREMENTS

7-17.3(1) EXCAVATION AND PREPARATION OF TRENCH

7-17.3(1)A TRENCH EXCAVATION

7-17.3(1)A1 GENERAL

The length of trench excavation in advance of pipe laying shall be kept to a minimum and in no case shall exceed 150 feet unless specifically authorized by the Engineer.

The maximum permissible trench width between the foundation level and the top of the pipe shall be 40 inches for pipe 15 inches or smaller inside diameter; or 1-1/2 I.D. plus 18 inches for pipe 18 inches or larger (see Standard Plan No. 284). If the maximum trench width is exceeded without written authorization of the Engineer, the Contractor will be required to provide pipe of higher strength classification or to provide a higher class of bedding, as required by the Engineer.

Wherever a trench is excavated in paved roadway, sidewalk or other improved area, the surface improvement removal and restoration shall be limited to maximum pay width shown in Standard Plan No. 284 or to the requirements specified in Section 2-02.3(3), whichever is greater.

Vertical trench width in a paved roadway, sidewalk or other improved area shall not exceed the maximum trench width as shown on Standard Plan No. 284. If the Contractor exceeds this width, he will be required to provide any approved imported backfill material required outside the trench neat line limits.

Excess excavated trench material shall be removed and disposed of off-site per Section 2-01.2 and 2-01.5, or if deemed suitable by the Engineer, shall be placed elsewhere on the project in embankments or other improvements as directed by the Engineer.

The control of groundwater shall be such that softening of the bottom of excavations, or formations of "quick" conditions or "boils" during excavation shall be prevented. Dewatering systems shall be designed and operated so as to prevent removal of the natural soils.

During excavation and installation of pipelines, and placement of trench backfill, excavations shall be kept free of water. The Contractor shall control surface run-off so as to prevent entry or collection of water in excavations. The static water level shall be drawn down a minimum of 1 foot below the bottom of the excavation so as to maintain the undisturbed state of the foundation soils and allow the placement of any fill or backfill to the required density. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

Where trench excavation equals or exceeds a depth of 4 feet, the Contractor shall provide, construct, maintain and remove, as required, safety systems that meet the requirements of the Washington Industrial Safety and Health Act, RCW 49.17, including WAC 296-155. Additional safety requirements are specified in Section 1-07.1.

The Contractor's trench safety systems shall be designed by a qualified person and meet accepted engineering requirements (see WAC 296-155-660).

Before dewatering is started, the Contractor shall submit to the Engineer a statement of themethod, installation and details of the dewatering system he proposes to use. Open and cased sumps shall not be used as primary dewatering for excavations deeper than 3 feet below the static watertable.

The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines and sewers.

Excavation for manholes and other structures connected to the pipelines shall be sufficient to provide a minimum of 12 inches between their surfaces and the sides of the excavation.

All material excavated from trenches and piled adjacent to the trench shall be piled and maintained so that the toe of the slope is at least 2 feet from the edge of the trench. It shall be piled to cause a minimum of inconvenience to public travel, and provision shall be made for merging traffic where necessary. Free access shall be provided to all fire hydrants, water valves, and meters; and clearance shall be left to enable free flow of storm water in gutters, conduits, or natural watercourses.

The Contractor shall furnish, install, and operate all necessary equipment to keep excavations above the foundation level free from water during construction, and shall dewater and dispose of the water so as not to cause injury to public or private property or nuisance to the public. Sufficient pumping equipment in good working condition shall be available at all times for all emergencies, including power outage, and shall have available at all times competent workmen for the operation of the pumping equipment.

The Contractor shall shore trenches to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench. The Contractor may elect to use any combination of shoring and overbreak, tunneling, boring, sliding trench shield, or other method of accomplishing the work consistent with applicable local, state, or federal safety codes.

Shoring to be removed, or moveable trench shields or boxes, shall be located at least 2-1/2 pipe diameters away from flexible pipe if the bottom of the shoring, shield, or box extends below the top of the pipe, unless a satisfactory means of reconsolidating the bedding or side support material disturbed by shoring removal can be demonstrated.

Damages resulting from improper shoring or failure to shore shall be the sole responsibility of the Contractor.

That portion of cribbing or sheeting extending below the springline of rigid pipe, or below the crown elevation of flexible pipe, shall be left in place unless satisfactory means of reconsolidating bedding or side support, disturbed by cribbing, sheeting removal, can be demonstrated. If a moveable box is used in lieu of cribbing or sheeting, and the bottom cannot be kept above the springline of rigid pipe or the crown elevation of flexible pipe, the bedding or side support shall be carefully reconsolidated behind the moveable box, prior to placing backfill.

The use of horizontal strutting below the barrel of pipe or the use of the pipe as support for trench bracing will not be permitted.

All ledgerock, boulders, and stones shall be removed to provide a minimum of 6 inches clearance under all portions of the pipe.

When, after excavating to the foundation level, the material remaining in the trench bottom is unsuitable, as determined by the Engineer, excavation shall be continued to such additional depth as may be required by the Engineer. Unsuitable foundation materials shall be disposed of at an approved site.

Prior to installation of bedding and pipe, the trench bottom shall be brought to grade as indicated for the type of bedding specified, and strengthened as necessary by tamping, addition of foundation material, or by other means satisfactory to the Engineer, to provide a foundation capable of supporting the pipe in its proper position.

The trench bottom will be considered to meet this requirement, with or without stabilization, when it has strength sufficient to support a length of the pipe to be used without noticeable deflection when an additional weight equal to the weight of one length of pipe is placed on it.

Where foundation material is required, it shall consist of Mineral Aggregate Type 2, or such other material as directed by the Engineer. The maximum size of aggregate shall not exceed 1 inch per foot of pipe diameter up to a maximum of 3 inches. The material shall be placed to a minimum depth of 4 inches or as may be necessary to provide the required stabilization. Ballast material as herein described may be used as bedding, up to the bottom of the pipe.

Where it is determined by the Engineer that the native material is of such character that it is not likely to be transported by moving ground water, the requirements for gradation to assure minimum void space will not apply.

Where the trench bottom is found to be unsuitable by the Engineer, or when the pipeline grade is lowered in excess of 1 foot, or when the horizontal alignment of the pipe is changed more than 1 foot after the initial trench is excavated, the additional excavation shall be considered as extra excavation.

7-17.3(1)A2 UNEXPECTED OBJECTS

Unexpected objects, such as stumps, railroad ties, buried pavement, etc., encountered in the trench excavation shall be removed and disposed of by the Contractor. Removal of unexpected objects will be considered incidental to pipe installation unless one or more of the following conditions are met:

(a) The object(s) cannot be removed by the same equipment or excavation method at hand.
(b) The trench width or depth must be increased by 2 feet or more.

In the event that any of the above conditions are met, removal of the object will be paid in accordance with Section 1-09.4.

7-17.3(1)A3 TRENCH EXCAVATION IN SOLID ROCK

Solid Rock Excavation shall cover the removal and disposal of solid rock as defined in Section 2-03.1(2).

Materials removed shall be replaced with suitable excess excavated native materials from adjacent trenches, roadway excavation, or from imported mineral aggregate of the type specified by the Engineer.

7-17.3(1)A4 SURPLUS MATERIAL

Surplus material obtained from trench excavation and determined to be suitable material for use elsewhere on the project by the Engineer shall be used per Section 2-03.3(10).

Surplus material not needed elsewhere on the project and unsuitable material shall be wasted pursuant to Section 2-01.2.

7-17.3(1)B PIPE BEDDING

7-17.3(1)B1 GENERAL

Bedding, of the class or classes shown on the Drawings or described in the Project Manual, shall be installed in accordance with Standard Plan No. 285, and shall include all materials and work within the limits of the pipe zone as shown in Standard Plan No. 284. If no bedding class is shown for rigid pipe, Class B bedding shall be provided.

Bedding of whatever class shall provide uniform support along the entire pipe barrel, without load concentration at joint collars or bells. No blocking of any kind shall be used to adjust the pipe to grade except when used with embedment concrete. Bell holes shall be dug as required to ensure uniform support along the pipe barrel. Bedding disturbed by pipe movement, or by removal of shoring or movement of a trench shield or box shall be reconsolidated prior to backfill. Special care shall be taken to provide adequate bedding support at wye or tee connections and adjacent to manholes or other structures, so as to avoid bending or shearing stresses at these critical points. Compaction of bedding shall be as specified in the Standard Plans.

7-17.3(1)B2 BEDDING FOR RIGID PIPE

Bedding shall be classified as Class A, Class B, Class C, and Class D. The requirements and limits for the various classes of bedding are as shown in Standard Plan No. 285.

Where unauthorized excavation has been made below the established grade, the Contractor shall provide, place and compact suitable bedding material to the proper grade elevation.

All class beddings shall be placed in at least three lifts: The first lift (to provide at least a 4-inch thickness under any portion of pipe 27 inches in diameter and smaller, or 6 inches in thickness under any portion of pipe 30 inches in diameter and larger) shall be placed before the pipe is installed, and shall be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts, of not more than 6 inches in thickness, shall be brought up to a point 6 inches above the top of the pipe. Lifts shall be brought up together on both sides of

the pipe and shall be carefully worked under the pipe haunches by means of slicing with a shovel, vibration, or other procedure approved by the Engineer.

Class C bedding shall meet the requirements outlines for Class B bedding except that bedding material shall be to the spring line of the pipe.

Class D bedding shall consist of carefully excavating the trench to proper grade, overexcavating at the bell sections, and placing and compacting select native material around the pipe and backfilling in accordance with Section 7-17.3(3).

7-17.3(1)B3 BEDDING FOR FLEXIBLE PIPE

Material for bedding of flexible pipe such as PVC, ABS, and corrugated metal pipe shall be Class B with the bedding material consisting of Mineral Aggregate Type 22. Bedding shall be placed in more than one lift: The first lift, to provide at least 4 inches thickness under any portion of the pipe, shall be placed before the pipe is installed, and shall be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts of not more than 6 inches thickness shall be installed to the crown of the pipe and individually compacted to 90% density, as determined by ASTM D698-Method D. A further 6 inches lift of moderately compacted material shall be placed over the crown of the pipe.

7-17.3(2) LAYING SEWER PIPE

7-17.3(2)A SURVEY LINE AND GRADE

The Contractor may use any method, such as "swede line and batter board" and "laser beam" methods, etc., which would allow him to accurately transfer the control points provided by the Engineer in laying the pipe to the designated alignment and grade.

When using the "swede line and batter board" method the Contractor shall transfer line and grade into the ditch where they shall be carried by means of a taut grade line supported on firmly set batter boards at intervals of not more than 30 feet. Not less than three batter boards shall be in use at one time. Grades shall be constantly checked and in event the batter boards do not line up, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding with the work.

When using a laser beam to set pipe alignment and grade, the Contractor shall constantly check position of laser beam from surface hubs provided by the Owner to insure laser beam is still on alignment and grade. In the event the laser beam is found out of position, the Contractor shall stop work and make necessary corrections to the laser beam equipment and pipe installed.

7-17.3(2)B PIPE LAYING

After an accurate grade line has been established, the pipe shall be laid within reasonably close conformity to the established line and grade in the properly dewatered trench. Mud, silt, gravel, and other foreign material shall be kept out of the pipe and off the jointing surfaces.

All pipe laid in the trench to the specified line and grade shall be kept in longitudinal compression until the backfill has been compacted to the crown of the pipe. All pipe shall be laid to conform to the prescribed line and grade shown in the Drawings, within the limits that follow.

Sewer pipe shall be laid to a true line and grade at the invert of the pipe and the Contractor shall exercise care in matching pipe joints for concentricity and compatibility. In no case shall two pipes be joined together with ends having the maximum manufacturer's tolerance. The invert line may vary from the true line and grade within the limits stated to develop uniformity, concentricity, and uniform compression of jointing material provided such variance does not result in a reverse sloping invert. The limit of the variance at the invert shall not exceed plus or minus 0.03 foot at the time of backfill. Checking of the invert elevation of the pipe may be made by calculations from measurements on the top of the pipe.

The sewer pipe, unless otherwise approved by the Engineer, shall be laid up grade from point of connection on the existing sewer or from a designated starting point. The sewer pipe shall be installed with the bell end forward or upgrade. When pipe laying is not in progress, the forward end of the pipe shall be kept tightly closed with an approved temporary plug.

Where pipelines are to be laid on specified curves of sufficiently short radius to deflect the pipe joints in an amount greater than recommended by the manufacturer, the curves shall be achieved with a series of tangents and shop-fabricated bends, subject to the approval of the Engineer.

Clearances between sewer or drain pipe and water main shall be maintained per Section 1-07.17.

7-17.3(2)C PLUGS AND CONNECTIONS

7-17.3(2)C1 GENERAL

All fittings shall be capped or plugged with a plug of an approved material gasketed with the same gasket material as the pipe unit; or shall be fitted with an approved mechanical stopper; or shall have an integrally cast knock-out plug. The plug shall be able to withstand all test pressures without leaking, and when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

7-17.3(2)C2 FITTINGS

Unless otherwise specified, tee fittings shall be provided in the sewer and drain mains for side sewers, catch basin connections and service drains. Tees shall be 8 inches inside diameter except tees for side sewers, which shall be 6 inches inside diameter unless indicated otherwise in the Project Manual or on the Drawings. All fittings shall be of sufficient strength to withstand all handling and load stresses normally encountered. All fittings shall be of the same materials as the pipe, except when core drilling to insert a tee, which shall be per Section 7-17.3(2)C3. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

7-17.3(2)C3 CUT-IN TEE ON EXISTING PIPE

Where indicated on the Drawings, or by the Engineer, the Contractor shall perform required work to cut a hole and install a tee on an existing sanitary sewer pipe. Coring shall be done such that the cored out piece or other materials will not drop or fall into the pipe.

Coring shall be performed in accordance with the following:

(a) Concrete Pipe To Existing Concrete Pipe: Installing tee on Concrete Pipe shall be accomplished by core drilling a full size hole in one operation to accommodate an approved PVC tee insert with a coupling fitting, or a saddle type tee manufactured for that size of pipe which the tee is being installed.

Concrete tee may be installed on concrete pipe 18 inches or larger by placing a length of concrete pipe cut to size that can be placed in the core drilled hole with its bell end against the outside face of the existing pipe and the barrel end inserted just to the inside face of the existing pipe. The Contractor shall thoroughly clean the bonding areas between the tee and the existing pipe so that the surfaces are free of dirt or dust, grease, oil or other contaminants that may reduce the bond of the grout to the surfaces. Both surfaces shall be coated with Concresive 1001 LPL or an approved equal. The annular

space between the tee and the core drilled surfaces shall be tightly packed with non-shrink grout. The connection shall be neatly finished inside and outside the existing concrete pipe.

(b) Ductile Iron Tee To Existing Pipe: The existing concrete pipe shall be core drilled with a hole large enough to accommodate the barrel of the specified size of ductile iron pipe and provide a 1 inch space between the ductile iron pipe and the existing pipe for application of grout. A length of ductile iron pipe shall be cut so that it can be placed in the core drilled hole with its bell end against the outside of the existing pipe and the barrel not protruding beyond the inside face of the existing pipe. The Contractor shall clean the outside of the ductile iron pipe, removing loose particles (dust, dirt, oil, or film of any sort) that may reduce the bond of the grout to the pipe. After core drilling, the exposed surface of the existing concrete pipe shall be rough and clean. Both surfaces shall be coated with Concresive 1001 LPL or an approved equal. The annular space between the pipe and core drilled surfaces shall be tightly packed with non-shrink grout. The connection shall be neatly finished inside and outside the existing concrete pipe.

The existing ductile iron pipe shall be core drilled or using arc welding machine cutting a full size hole and mount a tapping saddle type tee manufactured for that size of pipe on which the tee is being installed. The contact area between the saddle and the pipe shall be thoroughly cleaned of all dirt, sand, grit, grease or other foreign matters to ensure continuous contact by the straps.

(c) Corrugated Metal Tee To Existing Corrugated Metal Pipe: In corrugated steel and aluminum pipes, a hole shall be sawcut to match a shop fabricated tee as shown on the Drawings.

The flange plate of the fabricated tee shall be corrugated to match corrugation of the pipe to which it is attached. A neoprene gasket or approved equal shall be inserted between the outside face of the existing pipe and the flange plate of the tee and connected by bolting. Corrosion protection shall be provided if the pipe section of the tee is non-corrugated aluminum pipe.

The incoming pipe and the tee shall be connected with stainless steel rigid walled flexible coupling. If the pipe section of the tee is aluminum, corrosion protection shall be provided by isolating the aluminum from the steel by extending the gasket 1 inch beyond the edge of the stainless steel coupling.

This work shall also include necessary excavation, shoring to expose the existing pipe, installing the fitting, backfilling and compaction of trench. All existing small diameter pipe made of non-reinforced concrete or vitrified clay shall be fully exposed for inspection.

The excavation shall be backfilled and compacted per Section 7-17.3(3). Maximum density shall be determined by compaction control test specified in Section 2-03.3(14)E.

The Contractor shall notify the Drainage and Waste Water Utility at 386-1230 at least 24 hours prior to beginning cut-in operations. Drainage and Waste Water Utility will inspect the existing pipe before drilling and the cut-in tee during installation.

If the exposed existing pipe is found cracked or deformed, Drainage and Waste Water Utility will either roll in a new pipe or repair the damage at no cost to the Contractor, provided the damage was not caused by the Contractor's operations. If Drainage and Waste Water Utility rolls in a pipe with a tee already on it, no fitting will be required.

7-17.3(2)D PIPE MARKINGS

On elliptically reinforced concrete pipe, the markings indicating the minor axis of the reinforcement shall be placed in a vertical plane (top or bottom) when the pipe is laid.

7-17.3(2)E GASKETED JOINTS

Pipe handling after the gasket has been affixed shall be carefully controlled to avoid disturbing the gasket and knocking it out of position, or contaminating it with dirt or other foreign material. Any gaskets so disturbed shall be removed, cleaned, replaced, and relubricated before joining the sections.

Care shall be taken to properly align the pipe before joints are entirely forced home. During insertion of the tongue or spigot, the pipe shall be partially supported by hand, sling, or crane to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned. Since most gasketed joints tend to creep apart when the end pipe is deflected and straightened, such movement shall be held to a minimum once the joint is home.

Sufficient pressure shall be applied in making the joint to ensure that it is home, as described in the standard installation instructions provided by the pipe manufacturer. Sufficient restraint shall be applied to the line to ensure that joints once home are held so, until fill material under and alongside the pipe has been sufficiently compacted. At the end of the work day, the last pipe shall be blocked in an effective way to prevent creep.

Where pipe must be deflected to accommodate required horizontal or vertical curvature, it shall first be joined in straight alignment and then deflected as required.

7-17.3(2)F JOINTING

Where it is necessary to break out or connect to an existing sewer during construction, only new pipe having the same inside diameter will be used in reconnecting the sewer. Where joints must be made between pipes with a mismatched wall thickness, the Contractor shall use a flexible gasketed coupling, adapter or coupling-adapter to make a watertight joint. Couplings shall be those manufactured by "Romac", "Smith-Blair", or approved equal for reinforcing pipes and Fernco or approved equal for non-reinforced pipes.

7-17.3(2)G SEWER LINE CONNECTIONS

Catch basin, service drain, or side sewer connections to trunks, mains, or laterals, shall be left uncovered until after the Engineer has inspected and approved the work. After approval of the connection, the bedding shall be completed to a point 6 inches above the top of the pipe and the trench backfilled.

7-17.3(2)H SIDE SEWER CONNECTIONS

Where a side sewer is as large or larger than the trunk, main, or lateral to which it is to be connected, the connection shall be made only at a standard manhole unless otherwise provided in the Drawings or in the Project Manual, or unless otherwise authorized by the Engineer.

Side sewers shall be laid below all watermains and shall meet the requirements for the minimum separation of sanitary sewers and watermains in accordance with Section 1-07.17.

7-17.3(2)I PROTECTION OF EXISTING SEWERAGE FACILITIES

All existing live sewers including septic tanks and drain fields shall be kept in service at all times. Provision shall be made for disposal of sewage flow if any existing sewers are damaged.

Water accumulating during construction shall be removed from the new sewers but shall not be permitted to enter the existing system. The Contractor shall be responsible for flushing out and cleaning any existing sewers into which gravel, rocks, or other debris has entered as a result of his/her operations, and shall repair lift stations or other facilities damaged by his/her operations.

The physical connection to an existing manhole or sewer shall not be made until authorized by the Engineer. Such authorization will not be given until all upstream lines have been completely cleaned, all debris removed, and where applicable, a pipe temporarily placed in the existing channel and sealed.

7-17.3(2)J JACKING, AUGERING, OR TUNNELING

Where indicated on the Drawings, the Contractor shall install the pipe by jacking, augering or tunneling, or installing the pipe in a casing pipe by a combination of these methods.

When use of a casing pipe is required, the Contractor shall be responsible to selecting the gauge and size required, unless otherwise indicated on the Drawings, and consistent with his jacking or augering operation, and shall be set to line and grade. During jacking or augering operations, particular care shall be exercised to prevent caving ahead of the pipe which will cause voids outside of the pipe. When the carrier pipe is installed within a casing pipe, the carrier pipe shall be skidded into position in an acceptable manner and to the line and grade as designated. The annular space between the casing and the pipe shall be filled with material as specified in the Project Manual.

The faces of the jacking pit shall be constructed by driving steel sheets, or installing timber lagging as the excavation proceeds. The sheets, or lagging, shall extend a minimum of 5 feet below the bottom of the pit except at the pipe sewer. Prior to jacking and augering activities, 5 sets of Shop Drawings describing these activities, including dimensioning of pit length and size of underground borings and complete description of shoring, shall be submitted to the Engineer for approval.

The approval of the procedure and equipment shall not relieve the Contractor of responsibility nor waive or modify any provisions of the Contract.

7-17.3(3) BACKFILLING TRENCHES

7-17.3(3)A GENERAL

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting. The Contractor shall backfill from the side of the trench to a uniform depth of 2 feet above the crown of the pipe before starting compaction. See Section 7-17.3(3)B for Compaction Requirements.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the pipe installation, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and persons.

The Contractor shall use suitable native excavated material for trench backfill unless notified by the Engineer that the native material is unsuitable. The Engineer will examine excavated native material at the time of excavation to determine its suitability for use as backfill. Native material will be considered suitable for trench backfill if it is:

(a) Capable of attaining the degree of compaction specified in Section 7-17.3(3)B.
(b) Within reasonable tolerance of optimum moisture content.
(c) Reasonably free of organic material, clay, frozen lumps, rocks or pavement chunks more than 6 inches in maximum dimension, or other deleterious matter.

Unsuitable backfill material shall be removed from the site, disposed of per Section 1-04.12, and replaced with Mineral Aggregate Type 17 or such other imported material as designated by the Engineer.

The Contractor shall take any necessary steps to protect the excavated material from becoming contaminated with excessive moisture.

Where it is required that a blanket of select material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation as shown on the Drawings, or as the Engineer may direct, and shall be leveled to provide for a uniform thickness of the borrow material. Compaction is required.

Sewer trenches shall be backfilled as soon after the pipe laying as possible. The Contractor shall not have more than 200 feet of trench open in which the sewer has been completed, except by permission of the Engineer. Backfilling of trenches in the vicinity of catch basins, manholes, or other appurtenances will not be permitted until the cement in the masonry has become thoroughly hardened.

Walking on the pipe shall not be allowed until at least 1 foot of earth has been placed upon it.

7-17.3(3)B COMPACTION OF TRENCH BACKFILL

Trench backfill shall be spread in layers and be compacted by mechanical tampers of the impact type approved by the Engineer. The backfill material shall be placed in successive layers with the first layer not to exceed 2 feet above the pipe, and the following layers not exceeding 12 inches in loose thickness, with each layer being compacted to the density specified below:

(a) Improved areas such as street and sidewalk areas shall be compacted to 95% of maximum dry density.
(b) Unimproved areas or landscape areas shall be compacted to 90% of maximum dry density.

Compaction control tests shall be performed as specified in Section 2-03.3(14)E.

The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of pipeline to be designated by the Engineer.

The Contractor shall excavate test pits in the backfill as directed by the Engineer for the purpose of testing the backfill compaction.

If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact using heavier compaction equipment or more passes. This process shall be repeated until the Contractor has established a procedure that will provide the required field density. The Contractor will then be permitted to proceed with backfilling and compacting the remainder of the pipeline under the approved compaction procedure.

In the event routine field densities taken during the course of construction show the specified compaction is not being obtained because of changes in soil types or for any other reason, the Contractor will be required to reestablish his compaction procedure. In no case will excavation and pipelaying operations be allowed to proceed until the specified compaction is attained.

7-17.3(4) CLEANING AND TESTING

7-17.3(4)A GENERAL

Sewers and appurtenances shall be cleaned and tested after backfilling by either the exfiltration or low pressure air method at the option of the Contractor, except where the ground water table is such that the Engineer may require the infiltration test.

All work involved in cleaning and testing sewer lines between manholes or rodding inlets as required herein shall be completed within 15 working days after backfilling of sewer lines and structures. Any further delay will require the written consent of the Engineer. The Contractor shall furnish all labor, materials, tools, and equipment necessary to make the test, clean the lines, and perform all work incidental thereto. The Contractor shall perform the tests under the direction and in the presence of the Engineer. Precautions shall be taken to prevent joints from drawing during tests, and any damage resulting from these tests shall be repaired by the Contractor. The manner and time of testing shall be subject to approval by the Engineer.

All wyes, tees, and stubs shall be plugged with flexible jointed caps, or acceptable alternate, securely fastened to withstand the internal test pressure. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

If the Contractor elects to test large diameter pipe one joint at a time, leakage allowances shall be converted from GPM per 100 feet to GPM per joint by dividing by the number of joints occurring in 100 feet. If leakage exceeds the allowable amount, corrective measures shall be taken and the line then retested to the satisfaction of the Engineer.

Testing side sanitary sewers shall be for their entire length from the public sewer in the street to the connection with the building's plumbing. Their testing shall be as required by the local sanitary agency but in no case shall it be less thorough than that of filling the pipe with water before backfilling and visually inspecting the exterior for leakage. The decision of the Engineer as to acceptance of the side sanitary sewer shall be final.

If any sewer installation fails to meet the requirements of the test method used, the Contractor shall determine the source or sources of leakage and shall replace all defective pipe. The complete pipe installation shall meet the requirements of the test method used before being considered acceptable. Replacement of defective pipe shall not commence until the Contractor has received approval of his plan from the Engineer.

7-17.3(4)B EXFILTRATION TEST

Prior to making exfiltration leakage tests, the Contractor may fill the pipe with clear water to permit normal absorption into the pipe walls provided, however, that after so filling the pipe he shall complete the leakage test within twenty-four hours after filling. When under test, the allowable leakage shall be limited according to the provisions that follow. Specified allowances assume pre-wetted pipe.

Leakage shall be no more than 0.28 gph per inch diameter per 100 feet of sewer, with a hydrostatic head of 6 feet above the crown at the upper end of the test section, or above the natural groundwater table at the time of test, whichever is higher. The length of pipe tested shall be limited so that the pressure at the lower end of the section tested does not exceed 16 feet of head above the invert, and in no case shall be greater than 700 feet or the distance between manholes when greater than 700 feet.

Where the test head is other than 6 feet, the measured leakage shall not exceed 0.28 gph per inch diameter per 100 feet times the ratio of the square root of the test head to the square root of 6.

$$\text{Leakage maximum} = 0.28 \times \frac{\sqrt{H}}{\sqrt{6}} = 0.114\sqrt{H}\ \text{gph/inch dia./100ft.}$$

When the test is to be made one joint at a time, the leakage per joint shall not exceed the computed allowable leakage per length of pipe.

7-17.3(4)C INFILTRATION TEST

Infiltration test leakage shall not exceed 0.16 gph per inch diameter per 100 feet, when the natural groundwater head over the pipe is 2 feet or less above the crown of the pipe at the upper end of the test section. The length of pipe tested shall not exceed 700 feet or the distance between manholes when greater than 700 feet.

Where the natural groundwater head is more than 2 feet, the measured leakage shall not exceed 0.16 gph per inch diameter per 100 feet times the ratio of the square root of the natural groundwater head to the square root of 2.

$$\text{Leakage maximum} = 0.16 \times \frac{\sqrt{H}}{\sqrt{2}} = 0.114\sqrt{H}\ \text{gph/inch dia./100ft.}$$

When a suitable head of groundwater exists above the crown of the pipe and when the pipe is large enough to work inside, acceptance may be based on the repair of visible leakage by means satisfactory to the Engineer.

7-17.3(4)D AIR PRESSURE TEST FOR SANITARY SEWERS CONSTRUCTED OF AIR PERMEABLE MATERIALS

(a) Pipelines may be tested with low pressure air by the pressure drop method, in lieu of water infiltration or exfiltration. The pressure drop shall be from 3-1/2 to 2-1/2 psig greater than the average back pressure of groundwater above the centerline of the pipe. At the Contractor's option, pipe may be tested without pre-wetting; however, the test allowances herein assume pre-wetted pipe.

(b) The allowable rate of air loss shall be .003 cfm. per square foot of internal pipe surface, but the total air loss shall be not less than 2 cfm nor more than 3.50 cfm.

(c) The test equipment to be used shall be furnished by the Contractor and shall be inspected and approved by the Engineer prior to use. The Engineer may at any time require a calibration test of gauges or other instrumentation that is incorporated in the test equipment.

(d) Safety Provisions. Plugs used to close the sewer pipe for the air test must be securely braced to prevent the unintentional release of a plug which can become a high velocity projectile. Gauges, air piping manifolds, and valves shall be located at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. (Four psig air pressure develops a force against the plug in a 12 inch diameter pipe of approximately 450 pounds.) Air testing apparatus shall be equipped with a pressure release device such as a rupture disk or a pressure relief valve designed to relieve pressure in the pipe under test at 6 psi.

(e) Pipe under 36 inches in diameter may be tested from manhole to manhole or such shorter lengths determined by the Contractor. Pipe 36 inches in diameter and over shall be tested one joint at a time. Each joint must show no appreciable loss of pressure when held for 30 seconds.

7-17.3(4)E AIR PRESSURE TEST FOR SANITARY SEWERS CONSTRUCTED OF NON AIR PERMEABLE MATERIALS

7-17.3(4)E1 GENERAL

When non air-permeable pipelines are subjected to the low pressure air test, all of the provisions of Section 7-17.3(4)D shall apply except that the pressure drop shall be from 3.5 to 3.0 psig greater than the average back pressure above the center of the pipe, and the minimum time shall be twice that computed as specified under Section 7-17.3(4)D.

7-17.3(4)E2 RECOMMENDED PROCEDURE FOR CONDUCTING ACCEPTANCE TEST BY PRESSURE DROP METHOD

(a) Plug all pipe outlets with suitable test plugs. Brace each plug securely.

(b) All gauge pressures in the test should be increased by the amount of groundwater pressure at the center of the pipe.

(c) Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.

(d) After an internal pressure of 4.0 psig is obtained allow at least 2 minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.

(e) After the 2 minute period, disconnect air supply.

(f) When pressure decreased to 3.5 psig, start stop watch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. This time interval should then be compared with the time required by specification as computed below.

(g) List size and length of all portions of pipe under test in table similar to the one that follows. The maximum reach to be tested in one operation shall be the reach between two consecutive manholes.

(h) By the use of Nomograph, compute K and C. Use scales d and L, read K and C, and enter these values in the table.

(i) Add all values of K and all values of C for pipe under test.

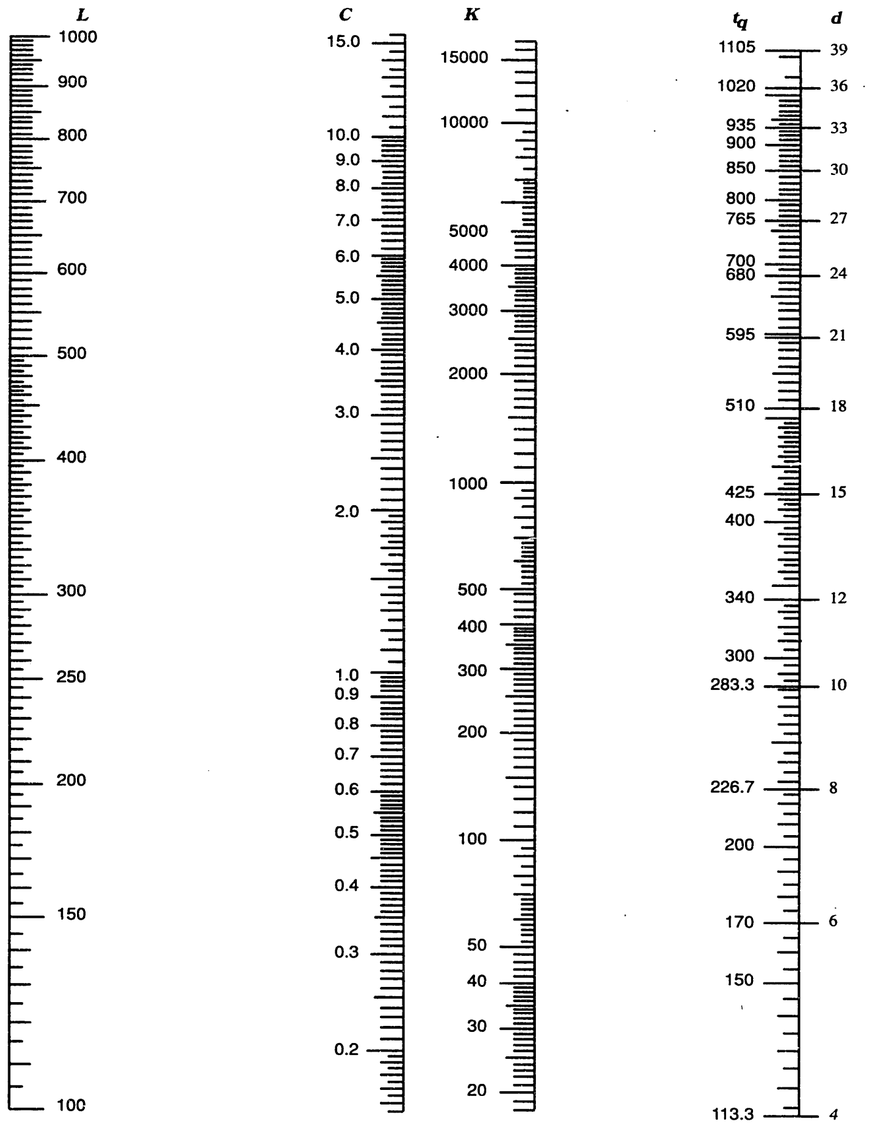
(j) If the total of all C values is less than one, enter the total of all K values into the space for "Time Required by Specification."

(k) If the total of all C values is greater than one, divide the total of all K values by the total of all C values to get t_q. To make this division with the nomograph, use scales C and D, and read t_q.

DIAMETER INCHES	LENGTH FEET	$K = .011\ d^2L$	$C = .0003882\ dL$

TOTAL K _____ TOTAL C _____

Time required by specification _____



NOMOGRAPH FOR THE SOLUTION OF K = .011d²L, C = .0003882dL, t_q = K/C

7-17.3(4)F OTHER TEST ALLOWANCES

All lateral or side sewer branches included in the test section shall be taken into account in computing allowable leakage. An allowance of 0.2 gallons per hour per foot of head above invert shall be made for each manhole included in a test section.

Upon final acceptance of the work all sewers, side sewers and fittings shall be open, clean, and free draining.

7-17.3(4)G PLUGGING EXISTING SEWER PIPE

Where shown in the Drawings or where designated by the Engineer, existing sewer pipes shall be plugged on the inlet end with Class 5 (3/4) concrete a minimumof 12 inches in length. Care shall be used in placing the concrete in the sewer to see that the opening of the pipe is completely filled and thoroughly plugged.

7-17.3(4)H DEFLECTION TEST FOR FLEXIBLE PIPE

All sanitary sewers constructed of flexible pipe shall be tested for deflection not less than 30 days after the trench backfill and compaction has been completed. Any diameter of the installed pipe shall not be decreased by more than 5 percent. The test shall be conducted by pulling a mandrel through the completed pipeline. Testing shall be conducted on a manhole-to-manhole basis and shall be done after the line has been completely flushed out with water. The Contractor shall be required to locate and repair any sections failing to pass the test and to retest the section. Pipe large enough to work inside of may be accepted on the basis of direct measurement.

7-17.3(4)I TELEVISION INSPECTION

The Engineer will inspect and videotape, using closed circuit television, all sanitary sewers 6 inches through 48 inches in diameter. Pipe larger than 48 inches in diameter will be inspected visually after testing. Inspection and videotaping will be performed at least twice: once as part of the final acceptance process, and a second time approximatcly 6 to 11 months after the final acceptance.

Approximately 1200 linear feet of mainline pipe can be videotaped and inspected per day. Except for projects having less than 1200 linear feet of mainline pipe, 1200 linear feet of pipe will be the minimum length of pipe per day the Engineer will schedule for TV inspection. On projects having more than 1200 linear feet of mainline pipe, television inspection shall be scheduled on the basis of one full day per 1200 linear feet of pipe to be inspected. Television inspection and videotaping will not be made until after manholes have been channeled and the pipe cleaned and air tested. On projects with less than 1200 linear feet of pipe, the entire work shall be substantially complete prior to the final acceptance videotaping and inspection.

On projects having more than 1200 linear feet of pipe, TV inspection may be performed prior to the work being substantially complete. The Contractor shall notify the Engineer when pipe sections are ready for TV inspection. The Engineer will require a minimum of 5 working days notice in order to schedule this inspection. The Contractor is requested to be present during all TV inspections and videotaping. The Contractor shall also provide whatever assistance may be necessary to ensure vehicular access and egress for the Owner's equipment when making TV inspections.

Should video inspection during the final acceptance process discover any pipe or appurtenance which has been laid or jointed in nonconformance with the Specifications, the Contractor shall, upon order of the Engineer, correct by repairing or by removing and replacing, at the Contractor's expense, that portion of the pipe found defective. After the Contractor has made the necessary corrections to the defective portion of the pipe, the repairs will be verified by additional television inspection. This process will continue, if necessary, until the entire work is finally accepted by the Engineer.

Six to eleven months after the final acceptance, the sanitary sewer will again be inspected and videotaped. This videotape will then be compared with the videotape made at final acceptance to determine whether or not any changes have occurred in the condition of the pipe since final acceptance. Should there be evidence of inconsistencies as compared to the original installation which, in the opinion of the Engineer, warrant replacement or repair, the Contractor shall, upon order of the Engineer, correct those defects as required under the Contractor's one-year guarantee. After the necessary corrections have been made by the Contractor, the corrections will be verified by additional television inspection.

7-17.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Extra Excavation" will be by the cubic yard of material actually removed below the pipe bedding, in accordance with the standard trench width neat lines shown on Standard Plan No. 284.

Measurement for "Bedding, (Class), (Size) Pipe" will be by the linear foot of pipe actually laid. Measurement will be from center to center of standard manholes or to the inside face of structures.

Measurement for pipe will be by the linear foot of pipe laid and successfully tested, and shall be along the centerline of the pipe through the tees. Measurements will be from center to center of new or rechanneled manholes or to the inside face of structures or manholes not channeled or to the end of pipe where it dead ends beyond manholes. Measurement will be to the nearest 0.1 foot.

No measurement will be made for trench excavation and backfill except for foundation material, extra excavation and imported backfill material.

Measurement for foundation material will be by the cubic yard of Mineral Aggregate Type 2 required to fill the void made by extra excavation and shall be based on neat line width of trench and depth and length as computed by the Engineer, per Section 1-09.1.

Measurement for imported Mineral Aggregate, when ordered for trench backfill in lieu of native material by the Engineer, will be by the cubic yard based upon the maximum neat line trench pay width as specified in Section 7-17.3(1) and the Standard Plan, and the depth designated by the Engineer. Imported Mineral Aggregate used beyond these neat line trench limits will be at the Contractor's expense. The quantity of backfill material shown in the Bid Form is an estimate only, and shall not, under any circumstances, be considered to indicate the quantity which may actually be required.

Measurement for "Safety Systems for Trench Excavation, Minimum Bid = $0.40 per Square Foot" will be by the square foot. The square foot quantity will be the area, calculated using the average end method, of the vertical plane along the centerline of the pipe between points that equal or exceed a trench depth of four feet. The measured depth will be from existing surface grade at the time of excavation to the pipe invert.

7-17.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-17 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Extra Excavation," per cubic yard.
(2) "Bedding, (Class), (Size) Pipe," per linear foot.
(3) "Pipe, (Use), (Material) (Class), (Size)," per linear foot.
(4) "Steel Casing Pipe, (Size), Tunneled, Jacked or Augered," per linear foot.
(5) "Pipe, (Material), Jack/Auger/Tunnel, (Size)," per linear foot.
(6) "Tee, (Material), (Size)," each.
(7) "Tee, (Size), Cut-In Existing (Material) Pipe," each.
(8) "Safety Systems for Trench Excavation, Minimum Bid = $0.40 per Square Foot," per square foot.

The unit contract price for "Extra Excavation" shall include all costs to remove excavated material, haul and dispose of the material.

The unit contract price for "Bedding, (Class), (Size) Pipe," shall include all costs for the work required to furnish and install the bedding to the cross section indicated.

The unit contract price for "Pipe, (Use), (Material) (Class), (Size)" shall include all costs for the work required to furnish and install the pipe of the type and size specified, and including the following:

(a) trench excavation (except "Extra Excavation"); haul, stockpiling, backfill, and compaction of native material,
(b) removal and off-site disposal of excess and/or unsuitable excavated native material, or placement of suitable excess excavated native material elsewhere on the project.
(c) dewatering; and
(d) removal and disposal of existing pipe encountered in required trench excavation and backfill.

The minimum unit price per square foot for "Safety Systems for Trench Excavation" and for "Safety Systems For Trench Excavation For Water Main", shall be forty cents ($0.40) per square foot. Should the Contractor determine that the cost for this work is greater then $0.40 per square foot the Contractor may bid a higher unit price by crossing out the minimum unit price and extension shown on the Bid Form, writing a higher unit price and extension on the Bid Form and initialing the change. Should a Contractor write in a unit price less than $0.40 minimum the $0.40 unit price shall govern and become part of the bid.

The unit contract price for "Safety Systems for Trench Excavation, Minimum Bid = $0.40 per Square Foot" shall include all costs for the work required to provide, construct, maintain and remove safety systems for trench excavation equal to or exceeding a depth of 4 feet as specified in Section 7-17.3(1)A.

Where unauthorized excavation has been made which increases the established trench depth which exceeds 4 feet, the Contractor shall meet the requirements specified in Section 7-17.3(1)A at no additional cost to the Owner.

The cost of the Owner's labor and equipment for the videotaping during the final acceptance process and the videotaping 6 to 11 months later to recheck the pipe condition will be borne by the Owner unless additional videotape inspection is necessary to verify corrections or replacement of deficient pipe. The cost of additional television inspection and videotaping to verify repairs or replaced pipe will be borne by the Contractor. The Contractor shall also be responsible for all costs incurred in any television inspection performed solely for the benefit of the Contractor.

The unit contract price for "Steel Casing Pipe, (Size), Tunneled, Jacked or Augered," shall include all costs for the work required to furnish and install complete work as specified in Section 7-17.3(2)J, including installation and removal of the jacking pit and shoring.

The unit contract price for "Pipe, (Material), Jack/Auger/Tunnel, (Size)," shall all costs for the work required to furnish and install the pipe as specified in Section 7-17.3(2)J.

The unit contract price for "Tee, (Material), (Size)" shall include all costs for the work required to furnish and install the tee as specified including plug when required.

The unit contract price for "Tee, (Size), Cut-In Existing (Material) Pipe," shall include all costs for the work to furnish and install the tee as specified in Section 7-17.3(2)C3. If Drainage and Waste Water Utility rolls in a pipe with a tee, no payment will be made.

Payment for imported material when ordered in lieu of native backfill material by the Engineer will be paid as Mineral Aggregate Type 17 or such other imported material acceptable to the Engineer per Section 4-01.5.

Foundation material when required on the Drawings, or directed by the Engineer, shall be paid as "Mineral Aggregate Type 2" or "Mineral Aggregate Type 14" per cubic yard, per Section 4-01.5.

Where foundation material is not shown on the Drawings and no bid item for "Mineral Aggregate Type 2" or Mineral Aggregate Type 14" is included in the Bid Form, and it is determined by the Engineer that the existing foundation is unsuitable, payment will be made in accordance with Section 1-09.4.

Dewatering of the trench shall be considered as incidental to bid items for the appropriate type of pipe listed in the Bid Form, unless otherwise provided in the Project Manual.

The work of cleaning and testing, except TV inspection, and furnishing caps and plugs for the tests shall be considered as incidental to the bid items for the appropriate type of pipe as listed in the Bid Form.

If the Contractor calls for an initial TV inspection, and the pipe is not clean or has so many deficiencies that the line cannot be fully inspected, the reinspection will be charged to the Contractor, and the cost withheld from monies due to the Contractor.

All work required in proof testing as specified herein shall be considered as incidental to the bid items for the appropriate type of pipe as listed in the Bid Form.

The Contractor shall provide all necessary water for construction and testing purposes, according to the requirements of Section 2-07.

If the Contractor damages or undermines the adjacent improvements outside the maximum pay width as described in Section 7-17.3(1)A1, he shall be required to remove and replace those areas at no cost to the owner.

Class D bedding shall be considered as incidental to the various items comprising the improvement.

No separate or additional compensation will be made for Plan submittals, or for material used in the jacking operations or for the cost of the backfilling operations, including compaction.

Any material that becomes unusable due to the Contractor's failure to take adequate measures to provide protection from moisture shall be replaced at the cost of the Contractor with Mineral Aggregate Type 17 or such other material as the Engineer will accept.

All costs in connection with excavating test pits and from standby time during field density test shall be considered as incidental to the backfill.

The Contractor shall, at his own cost, provide pipe of higher strength classification or higher class of bedding as required by the Engineer when the maximum trench width allowed as specified in Section 7-17.3(1)A1 is exceeded by the Contractor without prior written approval of the Engineer, and to furnish and install any approved imported backfill material required outside the trench neat line limits.

Unauthorized excavation below the established trench grade shall be made good by the Contractor at this own cost by providing, placing and compacting suitable bedding material to the proper grade elevation.

Any damage resulting from testing of the sewers and appurtenances as specified in Section 7-17.3(4)A shall be made good by the Contractor at his own cost.

All costs to determine the source or sources of leakage, and make good of all defective materials and/or workmanship of the sewer installation that failed to meet the requirements of the test method used as specified in Section 7-17.3(4)A shall be by the Contractor.

If the pipe fails the test as specified in Section 7-17.3(4)H, all costs to locate and repair the failed sections and retest the pipe shall be by the Contractor.

SECTION 7-18 SIDE SEWERS

7-18.1 DESCRIPTION

This work shall consist of excavation, shoring, foundation preparation, bedding, jointing, backfilling, compacting and testing for the construction of side sewers.

All references to "side sewer" shall be construed to mean "side sewer and service drain".

A side sewer is considered to be that portion of a sewer line that will be constructed between a main sewer line and a residence or other buildings in which the disposal of sanitary waste originates. It does not include any of the internal piping or connecting appurtenances, the installation of which is controlled by a municipal code, ordinance or regulation.

The general requirements for construction of sewers in other Sections of these Specifications shall apply for construction of side sewers unless they are inconsistent with any of the provisions of this particular section and the specifications shall apply alike to all side sewers on public rights-of-way and private property.

7-18.2 MATERIALS

Materials shall meet the requirements for the following Sections:

Concrete Sewer Pipe	9-05
Vitrified Clay Sewer Pipe	9-05
PVC Sewer Pipe	9-05
Ductile Iron Sewer Pipe	9-05
Joints	9-04

All pipe shall be clearly marked with type, class, and/or thickness, as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.

Approved jointing shall be flexible gasketing.

Flexible gasketing shall be construed to include rubber, synthetic rubberlike and plastic materials specially manufactured for the joint, pipe size, and use intended and shall be furnished by the manufacturer of the pipe to be used.

Tees, wyes, bends, couplers, adapters, and transition sections shall conform to the requirements of this Section.

7-18.3 CONSTRUCTION REQUIREMENTS

7-18.3(1) SIDE SEWER CONSTRUCTION

7-18.3(1)A GENERAL

Side sewers shall be constructed with a maximum joint deflection not to exceed the manufacturer's printed recommendations and in no case shall exceed 2 inches per foot in any joint. Larger changes in direction shall be made by use of standard 1/8-bends.

Side sewer construction shall conform to Standard Plan No. 283 and all applicable ordinances or regulations with respect to equipment, protective measures, size of pipe, depth of cover, number of users per pipe, permissible connections, inspection, and testing.

Side sewer locations shown on the Drawings shall be subject to relocation in the field after construction starts. Regardless of the Drawing location, the Contractor shall place the tee or wye branch in the main sewer line at the location designated by the Engineer.

The Engineer will stake and indicate the depth for the invert elevation of end pipe at the street margin or property line.

Side sewers shall be laid below the water main and shall meet requirements for minimum separation in accordance to Section 1-07.17.

7-18.3(1)B SIDE SEWERS NOT SHOWN ON THE DRAWINGS

In cases where side sewers are not shown on the Drawings, an abutting property owner may, upon approval of the Engineer, make application for side sewer, provided however, that he does so while construction is still underway and provided further that substantially all the necessary equipment for excavating, backfilling and compacting has not been removed from the block by the Contractor. In such cases the Contractor shall complete the side sewer construction at his unit contract prices.

The Contractor will not be required to construct side sewers for which applications are received after completion of construction and removal of equipment from the block containing the applicant's property. Under such a condition, the Contractor may construct the side sewer by negotiating the conditions and price with the applicant and look to him for payment.

If the Contractor elects to construct a side sewer after completion of work of the main line sewer in the block and after removal of his equipment therefrom, and do so at his bid price, payment will be made by the Owner in the normal manner under the Contract.

7-18.3(1)C SIDE SEWERS SHOWN ON THE DRAWINGS

7-18.3(1)C1 PROTECTION OF EXISTING SIDE SEWER

When a newly-constructed pipe line crosses above or beneath an existing side sewer which is shown on the Drawings, it shall be the responsibility of the Contractor to protect the existing side sewer from damage during the course of construction.

7-18.3(1)C2 REMOVE AND RE-LAY EXISTING SIDE SEWER

The Contractor shall complete the work in accordance with Sections 7-17. All jointing shall be made in accordance to Section 7-18.3(3)D.

7-18.3(2) EXCAVATION, BEDDING AND BACKFILL

Excavation, bedding and backfilling for side sewers shall conform to the requirements of Section 7-17, except that no backfill in excess of that required to hold the pipe in true alignment shall be placed prior to inspection.

7-18.3(3) PIPE LAYING AND JOINTING

7-18.3(3)A GENERAL

Pipe laying and jointing, except as hereinafter provided, shall conform to the requirements of Section 7-17 and Section 21.16 of the Seattle Municipal Code.

7-18.3(3)B LINE AND GRADE

Side sewers shall be laid to a line and grade between the main sewer tee branch or wye branch and the right-of-way margin, so as to best serve the property relative to the following conditions, as may be directed by the Engineer:

(a) Where a vacant property is level with or lower than the street grade, the invert elevation of the side sewer end pipe at the right-of-way margin shall be 1 foot higher than the elevation of the crown of the main sewer at the location of its tee or wye branch.

(b) Where an occupied property is higher than the street grade and where the slope will be greater than called for in (a) above, the maximum grade of the side sewer at the right-of-way margin will be established by the Engineer so as to place the side sewer pipe at an elevation that will be below the invert of any proposed storm drain pipe, unless other conditions prevent it. Where a storm drain pipe exists, the clearance between the crown of one and the bottom of the other shall be not less than 6 inches. In either of the above described conditions, the end pipe of the side sewer, when placed at the right-of-way margin, shall be such as to enable a backfill cover over the crown of the pipe of not less than 2-1/2 feet below the established street grade.

(c) Where an occupied property is level with or lower than the street grade, side sewer pipe shall be laid on a grade not less than 1/4 inch per linear foot wherever possible. If this is not feasible, the Engineer may authorize the laying of pipe on a grade as little as 1/8 inch per linear foot. In such case, the Contractor, prior to laying the side sewer pipe which has a grade less than 2 percent, shall obtain a "Grade Release" permit for the Street Use Section. Extreme care shall be exercised in the selection and placement of bedding, and the jointing of the pipe sections and fittings.

7-18.3(3)C PIPE LAYING

Bell and spigot pipe shall be laid with the bell end up grade. All pipe laying shall start and proceed up grade from the point of connection at the public sewer or other starting point.

Pipe shall be laid in a straight line at a uniform grade between fittings, or on a uniform horizontal or vertical curvature achieved by deflecting pipe joints within the limits recommended by the manufacturer of the pipe used.

7-18.3(3)D JOINTING

Where it is necessary to break out an existing side sewer during construction due to grade conflict with a newly constructed pipeline, only new pipe will be used in reconnecting the side sewer. Where joints cannot be made due to dissimilar pipe material or mismatched wall thickness, the Contractor shall use a flexible gasketed coupling to make a watertight joint. Couplings shall be those manufactured by "Romac", "Fernco", or "Smith-Blair" or approved equal.

7-18.3(4) FITTINGS

All fittings shall be factory-produced and shall be designed for installation on the pipe to be used. Fittings shall be of the same quality and material as the pipe used, except when installing a PVC insert on existing pipe.

The maximum deflection permissible at any one fitting shall not exceed 45 degrees (one-eighth bend). The maximum deflection of any combination of two adjacent fittings shall not exceed 45 degrees (one-eighth bend) unless straight pipe of not less than 2-1/2 feet in length be installed between such adjacent fittings, or unless one of such fittings be a wye branch with a cleanout provided on the straight leg.

Side sewers shall be connected to the tee, wye, or riser provided in the public sewer where such is available, utilizing approved fittings or adapters. Where no tee, wye, or riser is provided or available, connection shall be made by core drilling and installing an approved tee, as specified in Section 7-17.3(2)C2.

7-18.3(5) CLEANOUTS

Refer to Section 7-19.

7-18.3(6) INSPECTION AND TESTING

7-18.3(6)A INSPECTION

See Section 7-18.3(2).

Pipes installed and backfilled without visual inspection shall be excavated and exposed for inspection.

7-18.3(6)B TESTING

All side sewers shall be tested after backfill. Side sewers that are reconstructed or repaired to a length of 10 feet or more shall be tested for watertightness. Testing of newly reconstructed sections of side sewers consisting of a single length of pipe will not be required. Testing shall be performed in the presence of the Engineer in accordance with Section 7-17.3(4).

All side sewers constructed in conjunction with the main sewer shall, for purpose of testing as specified in Section 7-17.3(4), have a 6-inch tee fitting pipe placed at the point where the side sewer crosses the street or other public right-of-way margin. The tee opening shall be positioned perpendicular to the side sewer slope, unless otherwise directed by the Engineer.

When the new side sewer is connected to a new main sewer installed under the same contract, and the side sewer is not tested simultaneously with the test of the main sewer, the Contractor shall furnish and place, at his own expense, an additional 6-inch tee in the first pipe out of the main sewer tee, so that an inflatable rubber ball can be inserted for sealing off the side sewer and thus permit separate tests.

When the new side sewer is connected to an existing main sewer, the Contractor shall furnish and place 2 test tees: one immediately adjacent to the main sewer and a second where the side sewer crosses the street or right-of-way margin. Both test tees will be paid per Section 7-18.5.

The ends of side sewers or test tee openings shall be plugged watertight with materials and by method acceptable to the Engineer.

7-18.3(7) MISCELLANEOUS REQUIREMENTS

7-18.3(7)A PIPE AND CONNECTIONS

Side sewer in public right-of-way or utility easement shall be not less than 6 inches in diameter unless otherwise specified. Side sewers on private property shall be not less than 4 inches in diameter. No roof drain, area drain, or subsurface drain shall be connected to a side sewer which is connected to a separate main line sanitary sewer.

Roof drains or private service drains in areas of combined sewer systems shall be run in a separate pipe to the property line before connecting into the side sewer.

7-18.3(7)B PROXIMITY TO WATER SUPPLY LINES

Clearance between side sewers and water mains shall be maintained as specified in Section 1-07.17(2).

7-18.3(7)C PLUGS

Any unused openings to the side sewer shall be closed with a watertight plug fastened in place.

7-18.3(7)D SEPTIC TANKS AND CESSPOOLS

No side sewer shall be constructed through or adjacent to an existing cesspool or septic tank. If the conditions prohibit any other location, the Contractor shall abate the cesspool or septic tank by such means as the Engineer may direct, and by such payment as may be specified or agreed upon.

7-18.3(8) RESTORATION, FINISHING AND CLEANUP

The Contractor shall restore and/or replace all pavement, curbing, sidewalks, landscaping, or other disturbed surface improvements to their original condition in such manner as to meet the requirements of applicable sections. All surplus materials and temporary structures, as well as all excess excavation shall be removed and the entire site of Contractor operations shall be left in a neat and clean condition.

When the course of the work requires any disturbance of private property, the Contractor shall comply with the requirements of Section 1-07.24.

7-18.3(9) EXTENDING SIDE SEWERS INTO PRIVATE PROPERTY

Unless authorized by Section 21.16 of Seattle Municipal Code the property owners will not be permitted to extend side sewers onto their property or connect fixtures thereto.

7-18.3(10) END PIPE MARKER

Location of side sewers shall be marked by the Contractor at the property line by a 2-inch x 4-inch wooden stake 4 feet long buried in the ground a depth of 3 feet. The lower end shall have a 2-inch x 4-inch cleat nailed to it to prevent withdrawal of the stake. The exposed 1 foot shall be painted traffic white and the depth to the side sewer or tee shall be indicated in black paint on the 2-inch x 4-inch. In addition, a length of 12 gauge galvanized wire shall be provided to extend from the plugged end of the side sewer or tee. The upper end shall emerge at the stake, but shall not be fastened to it.

7-18.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pipe, (Use), (Material) (Class), (Size)," will be along the pipe from the tee or wye of the main sewer through tees, wyes and other fittings to the street margin or right-of-way margin. Measurement will be to the nearest 0.10 foot.

7-18.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-18 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Pipe, (Use) (Material) (Class), (Size)," per linear foot.
(2) "Tee, Test, (Material), (Size)," per each.
(3) "Remove and Re-lay Side Sewer, (Material) (Size)," per linear foot.
(4) Cleanouts on side sewers shall be paid as pipe per linear foot.

The unit contract price for "Pipe, (Use), (Material) (Class), (Size)," and all the above bid items shall include all costs to provide and install the side sewer pipe, including the following items for each class, size, and type of pipe:

(a) trench excavation (except "Extra Excavation"), haul, stockpiling, backfill and compaction of native material, and removal and disposal of excess and/or unsuitable excavated native material,
(b) dewatering;
(c) removal and disposal of existing pipe encountered in required trench excavation and backfill, and
(d) temporary bypass of sewage, including pumping.

Payment for safety systems required for trench excavation work shall be in accordance with Section 7-17.5.

The unit contract price for "Tee, Test, (Material), (Size)," shall include all costs for the work to furnish and install the test tee as specified in Section 7-18.

The unit contract price for "Remove and Re-lay Side Sewer" shall include all costs for the work specified in Section 7-18.3(1)C2.

Payment for Foundation Material will be in accordance with Section 7-17.

Payment for Tees will be in accordance with Section 7-17.

Payment for Bedding will be in accordance with Section 7-17.

Pipe installed and backfilled without visual inspection shall be excavated and exposed for inspection at the Contractor's expense.

SECTION 7-19 SEWER CLEANOUT

7-19.1 DESCRIPTION

This work shall consist of the construction of sanitary sewer cleanouts in accordance with the Drawings, these Specifications, and Standard Plan No. 280 as staked by the Engineer.

7-19.2 MATERIALS

All materials incorporated into the total cleanout structure shall meet the requirements of the various applicable Sections of these Specifications.

7-19.3 CONSTRUCTION REQUIREMENTS

A cleanout shall be provided for each total change of 90 degrees of grade or alignment and in no case shall the spacing of cleanouts exceed 100 feet. No cleanout will be required at the connection of the side sewer to a riser on the public sewer. A suitably located cleanout in the house piping or plumbing may be considered as a cleanout for the side sewer. Cleanouts shall consist of a wye branch in the side sewer.

All cleanouts located in public rights of way shall be extended to grade.

The extension of cleanouts to grade on private property will be optional with the property owner. When extended to grade, cleanouts shall be full side sewer diameter and shall be extended to a point not less than 6 inches nor more than 12 inches below the finished ground surface and shall be plugged with a removable stopper which will prevent passage of dirt or water. When specified, the Contractor shall install an approved casting to provide ready access to the cleanout stopper. A 1/8-bend shall be used to deflect the side sewer upward as a cleanout where the terminal end of the side sewer lies upstream from the last point of connection.

Pipe joints shall be the type specified in Section 7-17.3(2).

The trench excavation shall be made in such a manner as to provide an undisturbed base upon which the pipe shall be placed. Bedding around the wye and under the pipe connecting to the wye shall be thoroughly tamped as directed. Construction shall otherwise conform to the requirements shown on Standard Plan No. 280.

7-19.4 MEASURMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Sewer Cleanout, (Size)," shall begin at the wye branch and extend to the lamphole casting, as shown on Standard Plan No. 280.

7-19.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-19 will be made at the unit contract prices bid only for the bid items listed or referenced below:

(1) "Sewer Cleanout, (Size)," per each.

The unit contract price per each for "Sewer Clean-out", shall be full compensation for furnishing and placing the wye, sewer pipe, pipe bands, pipe plug casting, and concrete collar as indicated on Standard Plan No. 280, and as specified herein in Section 7-19.

SECTION 7-20 ADJUSTMENT OF NEW AND EXISTING UTILITY STRUCTURES TO FINISH GRADE

7-20.1 DESCRIPTION

The work covered by this section consists of adjusting existing manholes, catch basins, inlets, valve chambers, water meter boxes, handholes, and similar utility structures encountered during the work to a new grade elevation. The work shall include adjustment by removing or installing ring extensions; by removing and installing adjustment brick; by removing or adding a vertical riser section to the utility structure; by removing and rebuilding a portion of the existing structure; or by any combination of the preceding methods.

Publicly-owned utility structures shall be adjusted to finished grade by the Contractor. Privately-owned utilities are generally in the streets and road rights-of-way pursuant to franchises or to rights claimed under the laws of the United States of America, or the State of Washington and, therefore, these utility agencies will be responsible for all adjustments and relocations of their own facilities. The Contractor shall schedule the work so that utility adjustments by others can be accomplished without undue delay.

The requirements of this section apply to utility structures constructed from precast concrete sections, masonry brick or blocks, and cast-in-place concrete.

7-20.2 MATERIALS

Material used in the adjustment of existing utility structures shall meet the requirements for new construction specified in the section applicable to the item being adjusted.

Adjustment ring extensions shall meet the requirements of Section 9-05 and Standard Plan No. 231.

Epoxy, used to secure manhole castings for ring extensions to existing frames shall be Sylvax 818, Manhole Casting Epoxy, or equal as approved by the Engineer.

7-20.3 CONSTRUCTION REQUIREMENTS

7-20.3(1) ADJUSTMENT OF MANHOLES, CATCH BASINS AND SIMILAR STRUCTURES

7-20.3(1)A GENERAL

The Engineer will establish approximate grade elevation for the tops of existing utility structures requiring adjustment. The final alignment and grade elevation shall be established from adjacent roadway surfaces, forms, or such offset hubs as may be provided by the Engineer.

Except where adjustment is to be made by ring extension the Contractor shall, as applicable in any particular case, remove the necessary pavement from around the casting; remove the casting and install or remove adjustment brick; or excavate from around the utility structure, remove such portion as may be necessary, and rebuild the structure to meet the new grade elevation. Pavement removal shall be kept to the minimum amount necessary to facilitate the adjustment. Adjustment to finished grade elevation by whatever method is required shall result in a finished structure meeting the requirements for new construction as specified in Section 7-05.3(1)P, and the overall distance between the top of the casting to the bottom of the adjustment brick shall be not more than 26 inches.

When ring extensions are specified the ring extension shall be epoxied securely to the existing frame. The surfaces of the frame and the ring extension that are to receive the epoxy shall be thoroughly cleaned prior to the application of the epoxy.

After the utility structure has been adjusted to grade, all voids around the structure shall be backfilled and compacted with selected native material or if ordered by the Engineer an imported mineral aggregate. Thereafter the casting shall be secured in place with a concrete or asphalt shim, as applicable, and the structure made watertight by plastering with a mortar cement.

Adjustment to finish grade of water meter boxes encountered within the planting strip and sidewalk area shall be made by the Contractor.

Should adjustment to a water meter box necessitate adjustment or relocation of the water meter, the water meter will be adjusted or relocated by the Seattle Water Department. The Contractor shall then make final adjustment of the meter box.

7-20.3(1)B UNPAVED STREET GRADING PROJECTS

New manholes, catch basins and similar structures constructed in conjunction with street grading projects which are to be surfaced with gravel or crushed stone shall be constructed to a point approximately 8 inches below the subgrade and covered with a temporary wood cover. Existing manholes encountered shall be cut off and covered in similar manner. The Contractor shall carefully reference each manhole so that they may be easily found upon completion of the street work.

After placing the gravel or crushed stone surfacing, the utility structures and utility castings shall be constructed to the finished grade of the roadway surface. Excavation necessary for bringing utility castings to grade shall center about the utility structure and be held to the minimum area necessary. At the completion of the utility structure adjustment, the void around the manhole shall be backfilled with native material, or if ordered by the Engineer, backfilled with an imported mineral aggregate and thoroughly compacted.

Where bituminous surface treatment is to be placed, the manhole castings shall be installed from 1/2 inch to 1 inch higher than the rock surfacing so that the top of the casting will match finished roadway surface.

7-20.3(1)C CEMENT CONCRETE PAVING PROJECTS

Manholes, catch basins and similar structures shall be constructed or adjusted in the same manner as outlined in Section 7-20.3(1)A except that the final adjustment shall be made and cast iron frame be set after forms have been placed and checked. In placing the concrete pavement, extreme care shall be taken not to alter the position of the casting in any way.

7-20.3(1)D ASPHALT CONCRETE PAVING PROJECTS

Utility structures requiring adjustment to match finish grade shall be adjusted prior to the start of the final paving operation.

The tops of existing utility structures shall be raised or lowered to match the finish grade. The Contractor shall temporarily shim each structure with asphalt immediately after adjustment to secure the casting at finish grade and to provide a safe and usable surface for traffic. The Contractor shall maintain the shims and shall furnish, install, and maintain warning signs and barricades in accordance with Section 1-07.23 Traffic Control. The Contractor shall remove the shims immediately prior to the start of the paving operations.

Inside surfaces of adjusted structures which are disturbed or damaged by the adjustment, as well as the new adjustment area, shall be plastered to give a smooth, watertight surface.

7-20.3(1)E ASPHALT RESURFACING PROJECTS

Adjustment of manholes, catch basins, and similar structures on asphalt resurfacing projects shall meet the requirement of Section 7-20.3(1)D. Unless adjustment rings for castings are provided for in the Project Manual or Bid Form, existing pavements shall be removed to the extent necessary to remove the castings.

7-20.3(1)F STORM AND SANITARY SEWER OR WATER PROJECTS

Manholes, catch basins, gate valve structures and other similar type structures being constructed in conjunction with sewer or water projects on graded or paved streets shall be brought to final grade as outlined previously in these Specifications.

7-20.3(1)G ESTABLISHMENT OF GRADE FOR TOP OF MANHOLE

The Owner will establish approximate grade for top of manholes, catch basins and similar structures for the various stages of construction; however, these grades will be approximate only. The Owner assumes no responsibility in this regard, except when the final grade is set.

7-20.3(2) ADJUSTMENT OF INLETS

The final alignment and grade of cast iron frames for new and old inlets to be adjusted to grade will be established from the forms or adjacent pavement surfaces. The final adjustment of the top of the inlet will be performed in similar manner to that described for manholes. On asphalt concrete paving projects using curb and gutters, that portion of the cast iron frame not embedded in the gutter section shall be solidly embedded in concrete also. The concrete shall extend a minimum of 6 inches beyond the edge of the casting and shall be left 1-1/2 inches below the top of the frame so that the wearing course of asphalt concrete pavement will butt the cast iron frame. The existing concrete pavement and edge of the casting shall be painted with hot asphalt cement.

Adjustments in the inlet structure shall be constructed in the same manner and of the same material as that required for new inlets. The inside of the inlets shall be plastered.

7-20.3(3) ADJUSTMENT OF MONUMENTS AND CAST IRON FRAME AND COVER

Monuments and monument castings shall be adjusted to grade in the same manner as for manholes.

7-20.3(4) ADJUSTMENT OF VALVE BOX CASTINGS

Adjustment of valve box castings shall be made in the same manner as for manholes.

7-20.3(5) FURNISHING CASTINGS

Where adjustment of existing utility structures is required and the Drawings or the Engineer direct the existing castings be replaced, the Contractor shall furnish new castings of the type specified. Salvaged castings shall be cleaned and delivered, as directed by the Engineer, to the utility which owns the casting.

7-20.3(6) ADJUST BY SHAFTING

Adjustment of existing utility casting and structure shall be by shafting when the casting remains the same and one of the following conditions exists:

(a) The utility casting will be raised and result in a total depth of the adjustment brick zone greater than the maximum allowable as indicated on the Standard Plans.
(b) The utility casting will be lowered by a depth in excess of the existing depth of the adjustment brick zone or in excess of 16 inches.

Work required shall include excavation, removal of the existing frame and cover, leveling bricks, cone section or flat slab of the utility structure. The Contractor shall add to or remove from the utility structure as appropriate, the vertical riser section having the least dimension, unless otherwise indicated on the Drawings, to allow the structure to be adjusted to the new grade elevation. The cone section or flat slab shall be reinstalled, adjustment bricks laid, and the existing frame and cover reset. The surrounding shall be backfilled and compacted in accordance with the applicable portion of Section 7-17.

7-20.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1. Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Adjust by Shafting," will be by the vertical foot of adjustment, from original grade to finish grade.

7-20.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-20 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Adjust Existing Manhole, Catch Basin or Valve chamber," each.
(2) "Adjust Existing Inlet," each.
(3) "Adjust Existing Monument Frame and Cover," each.
(4) "Adjust Existing Valve Box," each.
(5) "Adjust Existing Manhole, Catch Basin or Valve Chamber With Ring Extension," each.
(6) "Adjust Existing Inlet With Ring Extension," each.
(7) "Adjust Existing Monument Frame and Cover With Ring Extension," each.
(8) "Adjust Existing Valve Box With Ring Extension," each.
(9) "Adjust Existing Handhole," each.
(10) "Adjust By Shafting," per vertical foot.
(11) "Utility Casting, (Type)," each.

The unit contract price for "Adjust Existing (Item)" shall include all costs for the work specified in Section 7-20 except as provided for otherwise hereinafter in Section 7-20.5, necessary required to adjust the existing utility casting, and structure, from the original grade elevation to a new finished grade elevation, by removing or adding adjustment bricks to an overall distance equal to or less than 16 inches.

The unit contract price for "Adjust Existing (Item) with Ring Extension" shall include all cost for the work required for "Adjust Existing (Item)" plus all cost for the work necessary to furnish and install the required ring extension.

The unit contract price for "Adjust by Shafting," shall include the costs for all work required to modify the existing structure and complete the adjustment to the grade elevation as specified in Section 7-20.3(6).

The unit contract price for "Utility Casting, (Type)," shall include the costs for all work required to furnish and install new castings of the type specified when existing castings are to be replaced.

Costs for adjustment to finish grade of water meter boxes, excluding adjustment of the water meter itself, shall be included in the prices bid for the various bid items shown in the Bid Form, and no separate payment will be made.

If a bid item for adjusting existing utility structures is not included on the Bid Form and such work is performed, payment will be made per Section 1-09.4.

Mineral aggregate ordered as backfill in lieu of native material will be paid by the cubic yard per Section 4-01.5.

Restoration of the roadway surface shall be in accordance with the applicable section covering the work involved.

The costs for asphalt or cement concrete used to secure castings prior to paving shall be considered incidental to the work and no separate payment will be made.

All work required to adjust casting to finished street grade of all newly installed or rebuilt utility structures shall be considered to be incidental to the bid items for the appropriate type of utility structure listed in the Bid Form.

In asphalt resurfacing project as specified in Section 7-20.3(1)E, all costs to remove the pavement, asphalt concrete and/or cement concrete base, will be considered incidental to the work of adjusting the manhole.

DIVISION 8
MISCELLANEOUS CONSTRUCTION

SECTION 8-01 EROSION CONTROL

8-01.1 DESCRIPTION

This work shall consist of preparing slopes, placing and compacting topsoil, seeding, fertilizing, and mulching all graded and disturbed areas in accordance with these Specifications and as shown in the Drawings or as designated by the Engineer.

8-01.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Topsoil, Type A, Type B, and Type C	9-14
Seed	9-14
Fertilizer	9-14
Lime	9-14
Mulch and Amendments	9-14
Tackifier	9-14
Matting	9-14
Shear Boards	9-14
Water for Seeding	9-25

The terms "Planting Soil" and "Topsoil" as used herein shall be synonymous.

8-01.3 CONSTRUCTION REQUIREMENTS

8-01.3(1) PREPARATION OF AREA

8-01.3(1)A CULTIVATION

Areas to be cultivated shall be indicated on the Drawings or specified in the Project Manual. Areas shall be cultivated to a minimum depth of 6 inches and shall provide a reasonably firm but fryable seed bed. Cultivation shall take place no sooner than 2 weeks prior to seeding. When topsoil, fertilizer, or soil conditioners are required, they shall be incorporated into the top 6 inches of subgrade by rototilling.

Cultivation of the soil may be by rototilling, farm disc, harrow, or other suitable equipment approved by the Engineer. Cultivation shall be done at right angles to the natural flow of water on the slope unless otherwise ordered by the Engineer.

Prior to the cultivation, the Contractor shall remove all visible rocks, clods and debris 3 inches or larger in any dimension. Any exposed tree roots in cut slopes shall be cleanly cut at the finished grade of the slope.

8-01.3(1)B COMPACTION

In addition to the compaction that may be required elsewhere in the specifications, all areas to be seeded, including excavation slopes, shall be compacted and prepared unless otherwise specified or ordered by the Engineer. Unless seed is covered with soil during seed application, a cleated roller, crawler tractor, or similar equipment, approved by the Engineer, that forms longitudinal depressions at least 2 inches deep shall be used for compaction and preparation of the surface to be seeded. The entire area shall be uniformly covered with longitudinal depressions formed perpendicular to the natural flow of water on the slope unless otherwise approved by the Engineer. The soil shall be conditioned with sufficient water so the longitudinal depressions will remain in the soil surface until completion of the seeding. The area shall be compacted within three weeks of the time of seeding. Prior to seeding, the finished grade of the soil shall be 1 inch below the top of all curbs, catch basins, walks, driveways, and other structures.

8-01.3(1)C PREPARATION

All areas to be seeded shall meet the specified finish grades and shall be free of undesirable weed or plant growth and all clods, rocks, and debris 3 inches or larger in any dimension.

8-01.3(2) TOPSOIL

8-01.3(2)A GENERAL

Topsoil shall be evenly spread over the specified areas to the depth shown in the Drawings or as otherwise ordered by the Engineer. After the topsoil has been spread, all large clods, hard lumps, rocks 3 inches in diameter and larger, and litter shall be raked up, removed, and disposed of by the Contractor.

Topsoil shall not be placed when the ground or topsoil is frozen, excessively wet, or in the opinion of the Engineer, in a condition detrimental to the work.

8-01.3(2)B TOPSOIL TYPE B

When topsoil Type B is specified in the project, it shall be the Contractor's responsibility to perform the excavation operations in such a manner that sufficient material is set aside to satisfy the needs of the project.

Upon completion of the work, topsoil Type B remaining and not required for use on the project shall be disposed of by the Contractor.

Should a shortage of topsoil Type B occur and the Contractor has wasted or otherwise disposed of topsoil material, the Contractor shall furnish topsoil Type A to complete the work.

8-01.3(3) VACANT

8-01.3(4) SEEDING AND FERTILIZING

8-01.3(4)A SEEDING

The Contractor shall notify the Engineer not less than 48 hours in advance of any seeding operation and shall not begin the work until areas prepared or designated for seeding have been approved. Following the Engineer's approval, seeding of the approved slopes shall begin immediately.

Seeding shall not be done during windy weather or when the ground is frozen, excessively wet, or otherwise untillable. Unless otherwise specified in the Project Manual, seed of the seed mix specified shall be placed at the rate specified in Section 9-14.2. Seed may be sown by one of the following methods:

(a) An approved hydro-seeder which utilizes water as the carrying agent and maintains continuous agitation through paddle blades. It shall have an operating capacity sufficient to agitate, suspend, and mix into a homogeneous slurry the specified amount of seed and water or other material. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic discharge spray nozzles which will provide a uniform distribution of the slurry.

(b) Approved blower equipment with an adjustable disseminating device capable of maintaining a constant, measured rate of material discharge that will ensure an even distribution of seed at the rates specified.

(c) Approved hand seeders.

Areas in which the above methods are impractical may be seeded by approved hand methods.

Seed and fertilizer may be applied in one application provided that the fertilizer is placed in the hydroseeder tank no more than 30 minutes prior to application. The seed shall have a tracer added to visibly aid uniform application. This tracer shall not be harmful to plant and animal life. If wood cellulose fiber is used as a tracer, the application rate shall not exceed 250 pounds per acre.

Reseeding ordered by the Engineer and not considered the responsibility of the Contractor shall be performed by the Contractor.

8-01.3(4)B FERTILIZING

Unless otherwise specified in the Project Manual, fertilizer of grade 10-20-20 formulation shall be applied in accordance with the procedures and requirements for seeding in Section 8-01.3(4)A and applied at the rate specified in Section 9-14.3

8-01.3(4)C LIMING

Agricultural lime shall be applied when called for on the Drawings or the Project Manual, and at the rate specified in the Project Manual. The method of application shall be in conformance with all air pollution regulations and shall be approved by the Engineer.

8-01.3(5) MULCHING

Mulch of the type specified in the Project Manual shall be furnished, hauled, and evenly applied at the rates indicated, and shall be spread on seeded areas immediately after seeding unless otherwise specified.

Distribution of straw mulch material shall be by means of an approved type mulch spreader which utilizes forced air to blow mulch material on seeded areas. In spreading straw mulch, the spreader shall not cut or break the straw into short stalks.

Wood cellulose fiber utilized as mulch shall be applied with seed and fertilizer in one operation by approved hydraulic equipment. The equipment shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogenously mix a slurry of the specified amount of fiber, fertilizer, seed and water. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic discharge spray nozzles which will provide a uniform distribution of the slurry at the rate specified in Section 9-14.4(2).

Areas not accessible by mulching equipment shall be mulched by approved hand methods.

Mulch sprayed on signs or sign structures shall be removed the same day.

8-01.3(6) SOIL BINDER OR TACKING AGENT

When specified, soil binders and tacking agents shall be applied in accordance with the manufacturer's recommended requirements.

8-01.3(7) DATES FOR APPLICATION OF SEED, FERTILIZER, AND MULCH

Unless otherwise approved by the Engineer, seeding, fertilizing, and mulching of slopes shall be performed during the following periods of any year at the location shown:

(a) West of the summit of the Cascade Range–March 1 to June 15 and to September 15 to October 15. Where contract timing is appropriate, seeding, fertilizing, and mulching shall be accomplished during the spring period listed above.

(b) Written permission to seed after October 15 will only be given when completion of the project is imminent and the environmental conditions are conducive to satisfactory growth. Cover seed with environmental matting as specified in Section 9-14.5(2).

All roadway excavation and embankment slopes, including excavation and embankment slopes that are partially completed to grade, must be prepared and seeded during the first available planting period and shall not be allowed to sit idle for long periods of time without receiving the erosion control specified in the contract.

When environmental conditions are not conducive to satisfactory results from seeding operations, the Engineer may order the work suspended, and it shall be resumed only when the desired results are likely to be obtained.

When environmental conditions are conducive to satisfactory results, the Contractor may elect to perform roadside seeding operations outside of the time periods specified. Inspection of roadside seeding performed at the Contractor's option outside of the time periods specified will be made after one growing season has elapsed. Acceptance will be based on a uniform stand of grass at the time of inspection. The Contractor shall restore eroded areas, clean up eroded materials, and reseed, fertilize, and mulch the areas failing to show a uniform stand of grass.

8-01.3(8) PLACING EXCELSIOR MATTING OR CLEAR PLASTIC COVERING

Immediately following the establishment of the finished grade, excelsior matting shall be unrolled parallel to the flow of water. Seed and fertilizer shall be placed prior to the placing of excelsior matting. Where more than one strip of matting is required to cover the given area, it shall overlap the adjacent mat a minimum of 4 inches. The excelsior matting shall be placed adjacent to the preceding strip. The ends of both mattings shall overlap at least 6 inches with the upgrade section on top. The up-slope end of each excelsior strip of matting shall be staked and buried in a 6-inch deep trench with the soil firmly tamped against the mat. Three stakes per width of matting (one stake at each overlap) shall be driven below the finish ground line prior to backfilling of the trench. The Engineer may require that any other edge exposed to more than normal flow of water or strong prevailing winds be staked and buried in a similar manner.

Edges matting shall be buried around the edges of catch basins and other structures. Matting must be spread evenly and smoothly and in contact with the soil at all points.

The matting shall be held in place by approved wire staples, pins, spikes or wooden stakes driven vertically into the soil. Matting shall be fastened at intervals not more than 3 feet apart in three rows for each strip of matting, with one row along each edge and one row alternately spaced in the middle. All ends of the matting and check slots shall be fastened at 6-inch intervals across their width. Length of fastening devices shall be sufficient to securely anchor matting against the soil and driven flush with the finished grade.

Clear plastic covering meeting the requirements of Section 9-14.5 shall be installed on erodible embankment slopes as shown in the Drawings or as designated by the Engineer.

The clear plastic covering shall be installed immediately after completion of the application of roadside seeding and shall be in place before the fall rainfall begins.

The Contractor shall maintain the cover tightly in place by using sandbags or tires on ropes with a minimum 10-foot grid spacing in all directions. All seams shall be taped or weighted down full length. There shall be at least a 12-inch overlap of all seams. The Contractor shall be responsible to immediately repair all damaged areas.

8-01.3(9) PROTECTION AND CARE OF SEEDED AREAS

The Contractor shall be responsible for work described in accordance with Section 1-07.13 and the following requirements:

(a) Protect all areas involved against vehicle and pedestrian traffic by use of approved warning signs and barricades.

(b) Areas which have been damaged through any cause prior to final inspection, and areas failing to receive a uniform application at the specified rate, shall be regraded, reseeded, refertilized, and remulched.

8-01.3(10) INSPECTION

Inspection of any area will be made upon completion of seeding, fertilizing, or mulching. Areas not receiving a uniform application of seed, fertilizer, or mulch at the specified rate, as determined by the Engineer, shall be reseeded, refertilized, or remulched.

Acceptance of areas receiving seed, fertilizer and mulch, as required, shall be based on a uniform stand of grass at the time of Final Inspection. Areas failing to show a uniform stand of grass 90 days after the germination or a growing season, whichever is longest, or show damage through any cause prior to Final Inspection shall be reseeded. Uniform stand of grass shall be defined as any grass area with no bare spots greater than 6 square inches.

8-01.3(11) MOWING

When the Bid Form contains the bid item "Mowing" or mowing areas are defined, the Contractor shall mow all grass growing areas and slopes 2-1/2 to 1 or flatter except for naturally wooded and undergrowth areas. Trimming around traffic facilities, structures, planting areas, or other features extending above ground shall be accomplished preceding or simultaneously with each mowing by use of power-driven or hand-operated machinery and tools to achieve a neat and uniform appearance.

Each mowing shall be considered as one coverage of all grass areas to be mowed within a defined area. Prospective bidders shall verify the estimated acreage for mowing as shown in the Drawings, the topography, irregularity of the area, slopes involved, and access limitations to determine the appropriate equipment to use. Equipment and tools shall be provided such as, but not limited to, tractor-operated rotary or flail type grass cutting machines and tools or other approved equipment. Power driven equipment shall not cause ruts or deformation of improved areas. Sickle type grass cutters will be permitted only on slopes of drainage ditches, berms, or other rough areas. The equipment and tools shall be in good repair at all times and maintained so that a clean, sharp cut of the grass will result at all times. The actual number of mowings will be as determined by the Engineer based on the growth rate of the grass. The height of mowing will be 4 to 6 inches or as designated in the Drawings or in the Project Manual.

Grass cutting machinery shall be operated in such a manner and equipped with suitable guards as to avoid throwing rocks or debris onto the travelled way or off the right of way. Equipment which pulls or rips the grass or damages the turf in any manner will not be permitted. The Engineer will be the sole judge of the adequacy of the equipment, safeguards, and methods of use. The Contractor will not be required to collect or remove clippings from the project except on the travelled way, shoulder, walkway, or other improved areas.

8-01.3(12) SHEAR BOARDS

Where shear boards are required they shall be furnished and installed by the Contractor in accordance with the details shown on the Drawings. The top edge of the installed boards shall project 2 inches above the grade of the ground.

The shear board shall be spaced at intervals indicated on the Drawings and securely nailed to 2-inch x 4-inch stakes. Stakes shall have a minimum penetration into the soil of 2 feet.

8-01.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement of erosion control by seeding, hydro-seeding, mulching or, when required, the application of fertilizer, lime and soil binder or tacking agents will be by ground slope measurement in square foot of actual seeding, fertilizing, liming, mulching and applying a soil binder or tacking agent completed and accepted in accordance with the Contract Documents.

The work of seeding or mulching will not be measured for payment until a uniform distribution of the materials required is accomplished at the specified rate. Refer to Section 8-01.3(10).

Measurement of matting, including clear plastic covering, will be by the square foot measurement of surface area covered and accepted in accordance with the Contract Documents. Measurement will not be made for overlapping or folds.

Measurement of shear boards will be by the linear foot of 2-inch by 8-inch rough finished lumber installed.

8-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-01 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Erosion Control, Seeding," per square foot.
(2) "Erosion Control, Hydro-Seeding," per square foot.
(3) "Erosion Control, Mulching," per square foot.
(4) "Erosion Control, Matting (Type)," per square foot.
(5) "Erosion Control, Shear Boards," per linear foot.
(6) "Mowing", per square foot.

The unit contract price for "Erosion Control, Seeding" and "Erosion Control, Hydro-Seeding" shall include all costs for the work required to prepare the area for seeding as specified in Section 8-01.3(1) and to seed, fertilize and protect the seeded areas as specified in Section 8-01.3(4) and 8-01.3(9).

Payment for reseeding areas ordered by the Engineer and not considered the responsibility of the Contractor will be made at the unit contract price bid for the seeding bid item included on the Bid Form.

All costs for the work required to restore, reseed, refertilize or remulch areas failing to show a uniform stand of grass shall be at the Contractor's own expense.

The unit contract price for "Erosion Control, Mulching" shall include all costs for the work required to furnish and install mulch as specified in Section 8-01.3(5) and 8-01.3(9).

The unit contract price for "Erosion Control, Shear Boards" shall include all cots for the work required to furnish and install shear boards as specified in Section 8-01.3(12).

The unit contract price for "Mowing", shall include all costs for the work required to mow and trim the areas as specified in Section 8-01.3(11).

The unit contract price for "Erosion Control, Matting (Type)" shall include all costs for the work required to furnish and install matting as specified in Section 8-01.3(8). All costs to repair and maintain matting and coverings shall be included in this unit contract price.

Removal of clear plastic covering, when such material is specified as a method of erosion control, will be paid as Extra Work in accordance with Section 1-09.4.

Payment for sodding as a type of erosion control shall be in accordance with Section 8-02.5

Payment for furnishing and placing planting soil (topsoil) shall be in accordance with Section 8-02.5.

Material taken from roadway excavation, borrow, strippings, or other excavation items and used for topsoil will not be deducted from the pay quantities for the respective bid items.

When the Bid Form includes the bid item "Planting Soil, Type B," the Contractor shall furnish Topsoil Type A at no cost to the City if a shortage of Topsoil Type B occurs and the Contractor has wasted or otherwise disposed of topsoil material. Refer to Section 8-01.3(2)B.

SECTION 8-02 ROADSIDE PLANTING

8-02.1 DESCRIPTION

This work shall consist of furnishing, planting, and maintaining for a 365 calendar day landscape establishment period such trees, whips, shrubs, ground cover, seedlings, and sod as specified in the Contract Documents. Work shall be performed as shown on the Drawings and Standard Plan No's. 100, 101, 110 111 and 112, and in accordance with these Specifications, accepted horticultural practices, and as directed by the Engineer.

This work shall also consist of furnishing and installing such paver blocks, grid blocks, cedar edging, bollards, benches and tree grates as indicated on the Drawings or specified in the Project Manual. Work shall be performed as shown on the Drawings and in accordance with these Specifications, Standard Plan No. 130, and as directed by the Engineer.

Trees, whips, shrubs, ground covers, seedlings, and sod will hereinafter be collectively referred to as, "plants" or "plant material."

Plant material quantity, size and condition, and spacing shall be as indicated in the Drawings or Project Manual.

All landscaping work shall be performed by a licensed Landscaping Contractor registered in the State of Washington.

8-02.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Planting Soil, Type A, Type B, Type C and Type D	9-14
Planting Soil for Tree Pits	9-14
Seed	9-14
Fertilizer	9-14
Mulch	9-14
Plant Material	9-14
Sod	9-14
Irrigation Water	9-25
Paver Blocks	9-14
Grid Blocks	9-14
Cedar Edging	9-14
Bollards	9-14
Benches	9-14
Tree Grates	9-14

Nomenclature for plant names and varieties shall be in accordance with the latest edition of "Standardized Plant Names" as prepared by the American Joint Committee on Horticulture Nomenclature.

The terms "Planting Soil" and "Topsoil" as used herein shall be synonymous.

Planting Soil Type D shall be used unless otherwise specified on the Drawings or in the Project Manual.

The type of seed mix shall be as specified in the Project Manual.

Planting mulch shall consist of bark mulch unless otherwise specified on the Drawings or in the Project Manual.

The concrete mix for wood bollard footings shall be Class 5(3/4).

8-02.3 CONSTRUCTION REQUIREMENTS

8-02.3(1) RESPONSIBILITY DURING CONSTRUCTION

The Contractor shall provide adequate and proper care of all plant material and landscape work done on the project from the time of installation to the end of the 365 calendar day landscape establishment period. The 365 calendar day landscape establishment period will begin on the day the planting and other landscape-related work is declared complete, in writing, by the Engineer. Existing vegetation shall not be disturbed unless required by the Contract Documents or approved by the Engineer.

Adequate and proper care shall include, but is not limited to, keeping all plant material in a healthy growing condition by watering, cultivating, pruning and spraying; keeping all plant material crowns, runners and branches free from mulch at all times; keeping planted and landscaped areas free from insect infestation, weeds and grass, litter and other debris; retaining finished grades in a neat, tidy, uniform condition; adjusting to grade paver blocks which may have settled; and adjusting tree fasteners as needed to prevent strangulation or irrgular growth of plant material.

The Contractor shall have sole responsibility for the survival of all plant material from the time of installation to the end of the 365 calendar day landscape establishment period, with the exception of third party damage or vandalism occurring after the start of the 365 calendar day landscape establishment period.

On order of the Engineer dead, diseased, dying or broken plants occuring prior to the end of the 365 calendar day establishment period shall be removed and replaced with healthy plants of the same type and size. Replacement shall be planted within a 10-day period immediately following receipt of the order. Missing plants shall be replaced by the Contractor in the same manner.

8-02.3(2) VACANT

8-02.3(3) CHEMICAL PESTICIDES

Application of chemical pesticides shall be in accordance with the manufacturer's recommendations and by an experienced applicator. The applicator shall be licensed by the State of Washington for the class of pesticide utilized. The Contractor shall furnish the Engineer evidence that all operators are licensed and the pesticide used is registered in the State of Washington. The Contractor shall also furnish the Engineer a copy of the manufacturer's recommendations for each pesticide to be used.

The Contractor shall use extreme care to ensure confinement of chemicals within the areas designated. The Contractor shall assume all responsibility for rendering any ar ea unsatisfactory for planting by reason of chemical application. Damage to adjacent areas either on or off the right-of-way shall be repaired to the satisfaction of the Engineer, the property owner, or both. Chemicals which will leave any residue in the soil toxic to the plant materials specified in the contract for planting or those in adjacent areas shall not be used.

The Contractor shall notify the Engineer at least 48 hours prior to the application of any herbicide, giving the name of the material, rate of application, and where it will be used. Applications of herbicide shall be in accordance with the recommendations of the manufacturer.

Trees shall be sprayed with the proper insecticides as necessary to control disease, infestation by harmful insects and pests, including the complete control of caterpillars.

All chemicals shall be delivered to the job site in unopened containers.

No spraying shall occur within a 24 hour period of wet weather conditions.

8-02.3(4) PLANTING AREA PREPARATION

Areas to receive plant material shall be cleared, grubbed, cultivated and graded prior to planting. Planting areas shall be prepared so that they are weed and debris-free at the time of planting and until Acceptance by the Owner. Planting areas shall include all planting beds, areas around trees, and those areas indicated on the Drawings or designated by the Engineer.

Where it is necessary to establish the planting area's subgrade by any combination of excavation, fill or embankment construction, the work shall be performed in accordance with the requirements of Section 2-03. The elevation of the compacted subgrade shall take into account the requirements, if any, for adding and incorporating into the natural soil, fill or embankment material, the required quantities of planting soil and soil conditioners, plus 2 inches of mulch. Fills and embankments shall be placed in lifts not exceeding 12 inches, with each lift compacted to 90% maximum density, as determined by the compaction control test specified in Section 2-03.3(14)E.

Planting areas shall be graded to finished subgrade and cleaned of all debris including stumps, sticks, roots and rocks or lumps larger than 3 inches removed before topsoil is placed.

After the subgrade of the planting areas has been graded and cleaned, planting soil (and fertilizer and soil conditioners, when required) shall be applied over the planting area to a 3-inch depth and rototilled into the subgrade to a depth of 6 inches. Planting soil shall not be placed when the ground or planting soil is frozen, excessively wet or, in the opinion of the Engineer, in a condition detrimental to the work. Planting areas shall then be evenly sloped from the ridge line to a point 2 inches below the surrounding surfaces. The ridge line shall be the approximate centerpoint of the planting area as shown on the Drawings.

The finished grade of planting soil prior to the installation of plant material shall be 2 inches from the top of the sidewalks or curbs to allow for 2 inches of planting mulch.

8-02.3(5) LAYOUT OF PLANTING

Plants shall be placed at spacings and locations shown on the Drawings. Location layout and staking shall be the responsibility of the Contractor, subject to the approval of the Engineer, before planting or construction of each item begins.

The Contractor shall place the plants starting from the perimeter of the bed area and progressing to the center so that odd dimensions are adjusted at the centers of any planting bed as shown in the Drawings.

Trees to be planted in mowable grass areas shall be located a minimum of 10 feet from the edge of planting beds, fenced line structures, and unmowable ditches unless otherwise specified in the Drawings. Tree locations shown on the Drawings shall be considered approximate, unless shown with stationing and distance. Trees shall be adjusted in location to clear all overhead lines and structures. Where location of existing and new street improvements may require changing the tree locations, the following spacing from street improvements shall prevail:

(a) Minimum distance from street light pole.....20 feet
(b) Minimum distance from hydrant .....5 feet
(c) Minimum distance from driveway, alley crossing .1/2 feet
(d) Minimum distance from curb..... 3 1/2 feet

The distance given shall be measured from the centerline of the tree to the nearest face of the improvement.

8-02.3(6) PLANTING

8-02.3(6)A GENERAL

Plants brought to the planting site shall be bare root, balled burlap, or in containers, depending on how specified in the planting schedule on the Drawings or in the Project Manual for the particular type of planting material. No plant material shall be planted until it has been inspected and approved for planting by the Engineer. Plants shall not be planted during freezing weather or when the ground is frozen. Plants shall not be planted during excessively wet conditions. Plants shall not be placed in areas that are below finished grade.

Unless otherwise approved by the Engineer, planting shall be performed during the period between November 15 and April 1.

8-02.3(6)B TREES AND SHRUBS

Plants brought to the planting site in a bare root condition shall be protected at all times to prevent the roots from drying out during planting operation. Bare root plants shall set in the plant holes with roots spread out in a natural position. Planting soil shall then be worked in and around the roots, filling all voids. Firming or tamping of planting soil around roots shall be done in such a manner as to not damage the roots.

Drainage, conforming to the details shown on the Drawings, shall be provided for all trees and shrubs.

Plant material supplied in containers shall not be removed from the containers until the time of planting at the planting location. Roots of bare root stock shall not be bunched, curled, twisted, or unreasonably bent when placed in the planting hole. In their final position, the plants shall have the same relationship to the finished grade as when growing in the nursery or container.

The plant material shall be handled in such a manner that the root systems are kept covered and damp at all times. The root systems of container plant material shall be moist at the time of planting.

All burlap material shall have all strings or cords cut and the burlap laid back from the top half of the ball after the plant is placed in its final position, and before completion of backfill. The plants supplied in containers shall be removed from the containers in such a manner to prevent disturbances of the root system or material in which they were planted. The plants shall not be removed from the container by pulling on the main stem. Plants removed from their containers shall be planted without delay in the manner described for balled and burlapped plants. Trees protected in wire baskets shall be planted with the wire baskets in place. After the tree is set in place, the wire around the bare roots shall be cut on opposite sides at least one-half of the way down and folded back. Non-tapered containers shall have 2 vertical cuts the entire depth of the container, made with an approved can shear before the root ball is removed. Plant material supplied in containers shall not be removed from the container until the time of planting at the planting location.

Unless otherwise specified, planting holes for trees shall be dug 12 inches greater on all sides of the diameter of the root ball or natural spread of the roots, and 12 inches under roots or root ball. Holes for shrubs shall be 6 inches greater on all sides and under roots or root ball. Any glazed surface of the planting hole shall be removed by hand methods.

When trees are to be planted in cement concrete sidewalk areas, pits shall be dug at locations shown on the Drawings. The pits shall be a minimum of 4 foot diameter and have a depth of 3 feet.

Strings encircling balls and burlapped plants shall then be cut and the burlap laid back from the top half of the ball.

Immediately following completion of the backfill, ties and tree wrap shall be placed as specified in Section 8-02.3(7) and a rain basin constructed in accordance with the details shown on the Drawings and as specified in Section 8-02.3(4).

Where settlement occurs, additional backfill shall be placed over exposed roots on the same working day as planting settlement occurs. In their final position, the plants shall have the same relationship to the finished grade as when growing in the nursury or container.

8-02.3(6)C GROUND COVERS, PLANTS AND SEEDLING

Plants brought to the planting site in a bare root condition shall be kept moist at all times by a method approved by the Engineer.

Unless otherwise specified, planting holes for ground cover shall be 2 inches greater on all sides and under the roots or root ball.

Ground cover shall be removed from containers and planted so that the soil level of the plants is flush with the finished soil grade of the planting area. Roots of bare root stock shall not be bunched, curled, twisted, or unreasonably bent when placed in the planting hole. Fertilizer shall be placed as required and the soil shall be compacted around the root system by firmly pressing around the plant. Water shall be added when directed by the Engineer.

Bare root plants which cannot be planted within 24 hours after arrival at the project site shall be removed from shipping containers and heeled in temporarily in a protective medium such as moist peat moss or sawdust.

Where settlement occurs, additional soil shall be placed over exposed roots on the same working day as planting settlement occurs. In their final position, the plants shall have the same relationship to the finished grade as when growing in the nursery or container.

8-02.3(7) PRUNING, STAKING AND GUYING

All plants shall be pruned at the time of planting to remove any minor broken or damaged twigs, or branches. Pruning shall be done with proper pruning tools and shall be done in such a manner as to retain or to encourage natural growth characteristics of plants. Bare root stock shall have damaged or torn roots removed with a clean cut.

Deciduous trees shall be staked at the time of planting with a single 5/8 inch diameter deformed steel reinforcing bar 10 feet long. The bar shall be driven into the ground parallel to the tree and at a distance of from 3 to 6 inches from the tree trunk. The bar shall penetrate at least 1 foot of undisturbed soil in a tree pit 3 feet deep, more if tree pit is more shallow. The bar and the tree shall be joined by 3 tree ties formed of 12 gauge wire in one loop which crosses itself between the tree and the bar. Before placing, a suitable length of good quality rubber garden hose shall be slipped over the wire to serve as a tree trunk protector. The wire shall be tied tightly to the deformed bar so as to prevent vertical movement but shall be loosely applied around the trunk. A 1/4 inch space shall be allowed between the hose tie face and the tree trunk. The topmost tie shall be at a height of 5 feet 10 inches with 1 foot 3 inches vertical spacing between the three ties (plus or minus 1 inch).

All trees shall be staked or guyed by the Contractor in accordance with the tree planting details shown in Standard Plan No's. 100 and 101 and the following requirements. Evergreen trees shall be staked with rough-cut fir stakes 2 inches x 2 inches x 3 feet long, free from knots or splints. Stakes shall be pointed for driving. Stakes that are damaged by driving shall be removed and replaced. Any tree or shrub thrown out of plumb by wind action or any other cause shall be replanted by loosening the soil around the root system and re-plumbing the tree or shrub by adjusting the position of the root system. Adjustment shall not be made by pushing, pulling or restraining the trunk or stem. If, in the opinion of the Engineer, damage to the root system has occurred as a result of re- plumbing a tree or shrub, the tree or shrub shall be replaced by the Contractor.

Guying stakes shall be set away from the ball of the tree and driven firmly into the ground so that the point of the stake is 30 inches below the finish ground level. Each stake shall be set equidistant from each other. All stakes shall be driven to a 60 degree angle from ground level. Trees shall have ties of #12 galvanized braided wire and 1/2 inch soft black rubber hose. The soft rubber hose shall be interlooped around the tree at approximately two-thirds the height of the tree.

Alternate methods of staking will be considered, and if approved by the Engineer, may be used.

8-02.3(8) FERTILIZERS

Unless otherwise specified in the Project Manual, fertilizers for shrubs and ground cover shall be 14-14-14 formulation, slow-release type fertilizer thoroughly and uniformly mixed into the planting soil at the following rates:

RATE OF APPLICATION

SHRUBS	1/2 pound per shrub
GROUND	COVER 1/4 pound per plant

Other fertilizers may be considered as alternatives but shall only be used upon the approval of the Engineer.

8-02.3(9) PLANTING MULCH

Planting mulch shall be applied 2 inches in depth.

8-02.3(10) SOIL AMENDMENTS

Soil amendments of the type and quantities specified shall be applied where shown on the Drawings. The soil amendments shall be thoroughly mixed with topsoil to produce a uniform blend as indicated in the Drawings or Contract Documents. All amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis, and name. In lieu of containers, amendments may be furnished in bulk, and a certificate from the manufacturer indicating the above information shall accompany each delivery.

8-02.3(11) CULTIVATION AND CLEANUP

Upon completion of planting all excess material shall be removed and disposed of off the project site. Planting areas shall be brought to a uniform grade flush with walks, curbs, pavements and driveways.

8-02.3(12) LANDSCAPE ESTABLISHMENT

(a) **General:** Landscape establishment shall consist of providing adequate and proper care for all plant materials and landscape areas within the project limits during the 365 calendar day landscape establishment period to assure the resumption and continued growth of the transplanted material. The 365 calendar day landscape establishment period shall begin immediately upon written notification from the Engineer of the acceptance of initial planting for the entire project, and shall end 365 calendar days after acceptance of initial planting. The Contractor shall be held responsible for the loss of all plant material, whether dead or missing,

from the time of initial planting to the beginning of the landscape establishment period. The Contractor shall replace all dead or missing plants before the initial planting will be accepted.

The Contractor shall replace all plants stolen or damaged by acts of others. At the end of the plant establishment period, a plant which does not show normal growth will be rejected and shall be replaced by the Contractor.

(b) **Application of Herbicides and Insecticides:** Applications shall be as specified in Section 8-02.3(3).

(c) **Watering:** Plants shall be watered by the Contractor as needed to keep them in a healthy growth. For trees a minimum of 5 gallons per week is required. The Contractor shall be responsible for the watering patterns and timing, including setting any automatic sprinkler controls. Automatic irrigation systems shall be operated fully automatic during the plant establishment period. Automatic watering shall be performed during the time period of 4 a.m to 7 a.m. or as otherwise specified. If water restrictions are established, the Contractor shall develop watering schedules in consultation with the Engineer. The Contractor will not be permitted to use City hydrants for watering. Hydrants may be used to fill a water tank or truck pursuant to the requirements of Section 9-25.2. The Contractor shall furnish in writing a watering schedule to the Engineer. Any change in watering schedule shall require 24 hours advance notice to the Engineer. The Engineer shall also be notified immediately of any sprinkler system malfunctions. Sprinklers installed as part of the Work shall be maintained and operated by the Contractor as part of the Landscape Establishment work.

(d) **Mulch:** Mulch material shall be applied and replaced when ordered by the Engineer. The final mulch application shall be made 1 week prior to final inspection.

(e) **Fastenings:** Tree fastenings shall be kept intact and effective in maintaining firm support for plant material. Fastenings shall be adjusted as needed by the Contractor to prevent strangulation or irregular growth. Fastenings and stakes shall be removed at the completion of the establishment period.

(f) **Inspection of Work:** A general cleanup shall be made after any work performed by the Contractor at the project site during the landscape establishment period.

Plants and landscaped areas will be inspected regularly by the Engineer during the plant establishment period. Should the Engineer determine at any time that the Contractor is not providing adequate and proper care of plant material or is performing substandard landscape establishment work, the Engineer will order the Contractor in writing to correct and remedy such unsatisfactory work or practices. The Contractor shall make the necessary corrections within a 5-day period immediately following receipt of such notice. Notice may be made in writing, by telephone, or communicated in person to the Contractor or the Contractor's representative at the Project Site. Plant material listed as dead, missing, or unaceptable, shall, as applicable, be removed, disposed of, and replaced by the Contractor.

About 30 days before the end of the landscape establishment period, the Contractor shall accompany the Engineer or the Engineer's representative on a walking inspection of the project. Conditions found unsatisfactory by the Engineer shall be corrected by the Contractor within a 10 day period immediately following the inspection. Corrective work shall include replacement of dead, missing, or unacceptable plant material, weeding, pick-up of all litter, and repair or irrigation system.

8-02.3(13) PLANT REPLACEMENT

The Contractor shall be responsible for growing or providing enough plants for replacement of plant material rejected through the plant establishment period. Rejected plant material shall be removed and replaced as specified in Section 8-02.3(12) and 8-02.3(15).

All replacement plants shall be of the same species and quality as the plants they replace.

8-02.3(14) LAWN INSTALLATION

8-02-3(14)A GENERAL

Lawn installation shall be by sodding unless "Seeded Lawn Installation" is specifically included in the Bid Form.

In areas irrigated by a sprinkler system, lawn installation shall not begin until the sprinkler system is operational. The Contractor shall have the option of sodding in lieu of seeding for lawn installation. However, seeding in lieu of sodding will not be allowed.

Topsoil for both seeded or sodded lawns shall be placed at a uniform minimum depth of 2 inches. The topsoil shall be tilled, raked to a smooth even grade without low areas to trap water, and compacted.

Barriers shall be erected, with warning signs where necessary, to preclude pedestrian traffic from access to the newly placed lawn during the establishment period or as approved by the Engineer.

8-02.3(14)B SEEDED LAWNS

The following construction sequence and procedure shall be followed:

(a) Areas to receive seed shall be cleared and grubbed, and leveled to a depth of 3 inches below grade.

(b) After the topsoil has been spread to the depth specified, the area shall be mechanically tilled to a depth of 6 inches, then raked by approved hand or mechanical methods to remove all large clods, rocks, debris, and litter over 1 inch in any dimension which shall be disposed of by the Contractor.

(c) The area shall then be rolled in 2 directions; the second shall be done at right angles to the first rolling. The roller shall be of a standard, lightweight, waterfilled type.

(d) Rake the area to make it smooth and level. Add topsoil where necessary or as directed by the Engineer.

(e) The finished grade shall be 1 inch below all curbs, sidewalks, and/or other appurtenances. (f) Apply a 10-20-20 fertilizer at the rate of 12 pounds per 1,000 square feet. The fertilizer shall be applied by an approved hand or mechanical method. Application in one direction is sufficient.

(g) Rake the fertilizer into the surface soil to a depth of 1/2 to 1 inch.

(h) Roll the area in 1 direction.

(i) The seed mix and rate of application shall be as specified in the Project Manual.

8-02.3(14)C SODDED LAWNS

For sod installation, the following construction and sequence procedure shall be followed:

(a) Areas to receive sod shall be cleared and grubbed, and leveled to a depth of 3 inches below grade.

(b) Planting soil shall be placed in accordance with the requirements of Section 8-02.3(4).

(c) Planting soil shall be evenly spread over and cultivated into the top 6 inches of the existing soil, then raked by approved hand or mechanical methods to remove all

large clods, rocks, debris, and litter over 1 inch in any dimension. Such clods, rocks, debris, and litter shall be disposed of by the Contractor.

(d) The area shall then be compacted by rolling in two directions. The second shall be done at right angles to the first rolling. The roller shall be of a standard, light weight water-filled type. The grade after compaction shall be such that the root zone of the sod will be flush with the final grade.

(e) The area shall be raked to make it smooth and level. Topsoil shall be added when necessary, or designated by the Engineer.

(f) Immediately prior to placement of sod, a 10-20-20 fertilizer shall be raked into the soil at a rate of 12 pounds per 1,000 square feet. The fertilizer shall be applied by approved hand or mechanical methods. Application in one direction will be sufficient.

(g) The sod strips shall be placed within 48 hours after being cut. Soil shall be moistened by sprinkling prior to the laying of the sod. Sod shall be placed without voids, and have the end joints staggered. The root crown shall be set to the grade of the sidewalk or curb. Butt joints shall be staggered and tightly fitted. On sloped areas, sod shall be laid with the long dimension accross the slope, parallel to the top or toe of the slope.

(h) Following placement the sod shall be rolled with a smooth, water-filled type roller. After rolling, the sod shall be heavily watered by sprinkling. Lawn areas shall be uniformly level.

(i) When directed by the Engineer, the Contractor shall apply (surface dressing) slow-release form of nitrogen fertilizer derived from urea-formaldehyde at the rate of 0.5 pounds per 100 square feet.

(j) The Contractor shall commence watering immediately as specified in Section 8-02.3(15). Watering and fertilizing shall be the Contractor's responsibility during the lawn establishment period. Watering shall be scheduled to prevent drying of joints between the sod strips.

8-02.3(15) LAWN ESTABLISHMENT

Lawn establishment shall consist of providing adequate and proper care for all public and private lawn areas installed within the limits of the project. The lawn establishment period shall begin immediately after the lawn has been planted and accepted in writing by the Engineer and shall extend through a minimum 30-day period or until the Actual Completion Date, whichever comes first.

During the lawn establishment period the Contractor shall provide adequate and proper care to ensure the continuing healthy growth of the turf. Adequate and proper care shall include the labor, materials, and equipment necessary to keep the planted areas in a presentable condition including, but not limited to, mowing; trimming; removal of grass clippings, litter and debris; edging; fertilization; insecticide and fungicide applications; weed control; repair and reseeding damaged areas; and repairing and keeping in operation irrigation systems installed as part of the work.

During this period and as a part of the lawn establishment, the Contractor shall accomplish the following minimum requirements:

(a) Mowing and trimming shall be done as often as conditions dictate. Maximum height of lawn shall not exceed 3 inches. The cutting height shall be 1 1/2-inches with all cuttings removed.

(b) A slow-release form nitrogen fertilizer derived from urea-formaldehyde shall be applied at the end of the lawn establishment period at the rate of 4 pounds per 1000 square feet. Fertilizer applied between the period of November 1st and March 1st shall be a 15-10-25 formulation fertilizer. Fertilizer applied between March 1st and October 31st shall be a 24-4-16 formulation fertilizer. Fertilizer shall be thoroughly watered in.

(c) Water application shall be accomplished each week from March through September. Watering shall be done only at night or early morning. An even application of 1 inch of water minimum shall be required over all lawn areas per week. The rate and frequency of water application may be changed, as designated by the Engineer, depending on weather and soil conditions.

(d) Temporary barriers shall be removed after the grasses have developed into a heavy sod mat and only on written permission from the Engineer.

All work performed under lawn establishment shall be performed by qualified turf management personnel and shall comply with good turf management practices.

Acceptance of lawn planting as specified herein shall be based on a uniform stand of grass at uniform grade at the time of final inspection. Areas that are bare, have a poor stand of grass, or do not have a uniform grade through any cause shall be regraded, reseeded, or resodded and refertilized. Dead or dying sod or sod with brown spots will be rejected.

8-02.3(16) INSTALLING REMOVABLE PAVER BLOCKS IN TREE CUT-OUTS

The Contractor shall install exposed aggregate concrete paver blocks of the size and at the locations shown on the Drawings. Paver blocks shall be installed after the trees have been planted and the tree pits backfilled and compacted to a finished grade 3 inches below the top surface of adjacent sidewalk. A 1-inch bed of compacted sand shall be used as a setting bed for the pavers.

The top surface of the pavers shall be set flush with the adjacent sidewalk and all voids between pavers and sidewalk and between pavers filled with sand. Excess sand and dirt shall be swept up and disposed of off the project site. The Contractor shall ensure that sand and soil is kept out of the gutters and catch basins.

8-02.3(17) GRID BLOCKS

The Contractor shall install grid blocks of the type specified in areas shown on the Drawings or designated by the Engineer. Areas receiving grid blocks shall be excavated, graded and compacted to a minimum depth of 8-inches below the top surface of adjacent sidewalks and curbs. After the subgrade has been approved the Contractor shall install a sub-base of mineral aggregate type 1 to a compacted average depth of 6 inches. Compaction shall be to a 95% maximum.

Thereafter, a 2-inch sand setting bed shall be spread and tamped or rolled on top of the crushed rock base. The grid blocks shall then be placed on the sand bed and each block leveled with each adjacent block. The top of the blocks shall be laid flush with the top surface of adjacent sidewalks and curbs. After the blocks have been installed and leveled, Planting Soil Type D shall be spread and worked into all voids. The area receiving grid blocks shall thereafter be seeded with grass seed of the type and in the quantity specified in the Project Manual.

8-02.3(18) CEDAR EDGING

The Contractor shall install 2-inch by 4-inch cedar edging for each cut-out as required and indicated on the Drawings. Edgings shall be installed on edge with the top of the form is level with the top of the existing grades or the top of the existing adjacent concrete sidewalks and curbs. Forms shall be secured with 2-inch by 2-inch by 12-inch cedar stakes in

accordance with the detail shown on the Drawings, driven to the inside of the forms and attached to the cedar edging with eight penny galvanized common nails.

8-02.3(19) BOLLARDS

8-02.3(19)A GENERAL

The Contractor shall install bollards of the type specified on the Drawings. Bollards shall be installed where indicated on the Drawings or designated by the Engineer and in accordance with the requirements specified in the Project Manual and shown on the Drawings.

Bollards shall be installed true to line and grade and set in a plumb postion from all angles.

The Contractor shall furnish one padlock with each removable bollard.

8-02.3(19)B WOOD BOLLARDS

The tops of concrete footings for wood bollards shall be formed and troweled level with surrounding surfaces.

8-02.3(19)C CONCRETE BOLLARDS

The Contractor shall construct reinforced concrete bollards where shown on the Drawings. Bollards shall be of the size and shape indicated in the Drawings.

Bollards shall be set in excavated holes true to line and grade in a plumb postion with backfill thoroughly tamped around them.

8-02.3(20) BENCHES

The Contractor shall install benches of the type indicated on the Drawings and specified in the Project Manual. Benches shall be located where indicated on the Drawings or designated by the Engineer. Final location of benches shall be verified and approved by the Engineer prior to placement.

8-02.3(21) TREE GRATES

The Contractor shall install tree grates in locations indicated on the Drawings. Tree grates shall meet the requirements of Section 9-14.14 and Standard Plan No. 130.

Tree grates shall be installed with the joining line parallel to the curb.

When specified on the Drawings or the Project Manual, a concrete collar shall be constructed around each tree pit and separated from the surrounding sidewalk by a through joint. The collars shall be reinforced with two number four reinforcing bars on all sides and a 1-inch x 1-inch x 3/16-inch angle-ironed frame mitered and welded at the corners and imbedded in the concrete collar with welded-on concrete ties. The angle-iron frame shall be 48 1/2-inch x 48 1/2-inch inside measurement and shall allow for 1/4-inch clearance on all sides to receive the 48-inch x 48-inch tree grate.

8-02.3(22) RELOCATE TREE

The Contractor shall perform the work in accordance with good nursery practice. The tree shall be relocated while in a dormant state (after November 15 or first frost and before April 1).

The tree to be relocated shall be dug by hand or approved machine; use of backhoe will not be permitted. The Contractor shall exercise extreme caution when working within the drip line of the tree to avoid damage to the trunk, branches or root structure. The Contractor shall be held liable for damage to adjacent plant material. The root ball shall be formed with diameter per the following schedule in such a manner so as to encompass the fibrous root system.

Tree Trunk Size	Min. Root Ball Diameter
2 - 4 inches	2-1/2 feet
4 - 5 inches	4 feet
5 - 7 inches	5 feet
7 - 10 inches	6 - 7 feet

The depth of the root ball shall be no less than + of the diameter listed above. Exposed tree roots, 1-inch diameter and more shall be cut clean before wrapping root ball. The root ball shall be thoroughly wrapped with burlap and laced with 1/4 inch polypropylene rope.

Tree removal work shall be performed with the City Arborist present. The Contractor shall handle the tree by the root ball only. Under no circumstances will the Contractor be allowed to lift or remove the tree by the trunk. The tree shall be carefully reset into the designated tree pit and planted in the same manner as a new tree.

The requirements of landscape establishment of Section 8-02.3(12) shall apply to relocated trees. Replacement, if necessary, shall be as set forth in Section 8-02.3(13).

8-02.3(23) TREE ROOT PRUNING PROCEDURE

No construction work around trees maintained by the Seattle Engineering Department will be permitted without prior permission from the City Arborist's office. Call 684-5042 to apply for a permit to work around the tree root structure (aminimum of 72 hours notice must be given prior to actual work).

However, under no circumstances will root structure 2" or greater be cut. All tree roots 2" or greater shall be tunneled under. Roots must be cleanly cut. No ripping or tearing of the root structure will be allowed. See Section 1-07.16(3) regarding restoration of plant damage and soil stockpiling adjacent to trees.

8-02.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

The pay quantities for plant materials will be determined by count of the number of satisfactory plants in each category accepted by the Engineer.

Seeded lawn and sod installations will be measured by ground slope measurement in square feet of actual lawn completed, established, and accepted.

Measurement for "Planting Soil, (Type)" and "Mulch, Bark" shall be per cubic yard measured in the hauling conveyance at the point of delivery. The Contractor shall notify the Engineer at least 24 hours prior to material delivery to ensure the Engineer's presence for measurement at the time of delivery. No payment will be made for material deliveries not witnessed by the Engineer.

8-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-02 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Tree, (Type) (Size)," per each.
(2) "Shrub, (Type), (Size)," per each.
(3) "Ground Cover, (Size)," per each.
(4) "Landscape Establishment, Minimum Bid ($_____)," per lump sum.
(5) "Planting Soil, (Type)," per cubic yard.
(6) "Mulch, (Type)," per cubic yard.
(7) "Paver Block, (Size)," per each.
(8) "Grid Block," per square foot.
(9) "Edging, (Material)," per linear foot.

(10)"Bollard, (Type)," per each.
(11)"Bench," per each.
(12)"Tree Grate," per each.
(13)"Relocate Tree," per each.
(14)"Relocate Shrub," per each.
(15)"Relocate Ground Cover," per each.
(16)"Sodding," per square foot.
(17)"Seeded Lawn Installation," per square foot.

The unit contract price for trees, shrubs and ground cover plants shall include all costs for the work specified in Section 8-02 (not otherwise provided for hereinafter) to furnish, plant, fertilize, cultivate and maintain for 1 year the plant material.

The unit contract price for "Landscape Establishment, Min. Bid ($_____)" shall include all costs for the work required by Sections 8-02.3(2), 8-02.3(12), and all costs for the work required to remove and replace plant material in place, if necessary, as required by Section 8-02.3(13). To prevent unbalanced bids, the price bid for "Landscape Establishment" shall not be less than the minimum price noted in the Bid Form. Bids received on this contract which contain a cost for landscape establishment of less than the minimum bid will be rejected.

Payment shall be made at the rate of 25 percent of the bid item lump sum for "Landscape Establishment Min. Bid ($)" at the following periods: May 31, July 31, September 30 and the final 25% at the end of the landscape establishment period after the necessary corrections and replacements have been made. The Contractor shall submit a statement on the 25th of May, 25th of July and the 25th of September indicating that he has properly maintained the plantings during that period as required in the Specifications. In the event the Engineer finds the Contractor failing to perform any of the work required, the Owner may:

(a) Cause the work to be done by others and the costs thereof deducted from the Contractor's payment or payments. Should the money due the Contractor be insufficient to cover such costs, the Owner will have the right to recover the balance from the Contractor.
(b) Withhold a portion, or all, of the Contractor's payment. Money that is withheld for non-performance shall not be recovered by the Contractor. The amount withheld shall be determined by the Engineer.
(c) Terminate the contract.

The above remedies shall not waive the Owner's rights to pursue other corrective measures or remedies which may be permitted by law.

At the end of the plant establishment period, any plant which, in the opinion of the Engineer, does not show normal growth will be rejected. The final payment will not be made to the Contractor until all corrections and replacements have been made and approved.

Fertilizer and other soil amendments specified in Section 8-02 but not set forth in the Bid Form as a separate Bid Item shall be included in the unit contract price of the Bid Item for which its use was necessary.

The unit contract price for "Planting Soil, (Type)" shall include all costs to furnish and place the planting soil as specified.

The unit contract price for "Mulch, (Type)" shall include all costs to furnish and install the mulch as specified.

The unit contract price for "Paver Block, (Size)," shall include all costs to furnish and install the paver blocks as specified.

The unit contract price for "Grid Block," shall include all costs to furnish and place the grid including crushed rock base, sand setting bed, planting soil and seed as specified.

The unit contract price for "Edging (Material)" shall include all costs to furnish and install edging as specified.

The unit contract price for "Bollard (Type)" shall include all costs to furnish and install the bollard of the type and size specified.

The unit contract price for "Bench," shall include all costs for the work required to furnish and install bench of the type and size specified.

The unit contract price for "Tree Grate" shall include all costs for the work required to furnish and install the specified tree grates.

The unit contract price for "Relocate Tree," "Relocate Shrub," and "Relocate Ground Cover" shall include all costs for the work required to remove, protect, store and replant the tree, shrub, or ground cover.

Payment for clearing and grubbing shall be in accordance with Section 2-01.5

Payment for establishing the subgrade of planting areas prior to actual planting by excavation or embankment construction shall be in accordance with Section 2-03.5

Payment for fill material of the type specified shall be by the cubic yard in accordance with Section 4-01.5.

The unit contract price for "Seeded Lawn Installation," and "Sodding" shall include all costs for the work required to prepare the area, plant or sod the lawn, and establish lawn areas as specified in Section 8-02.3(14) and 8-02.3(15). No additional payment will be made for the work required to regrade, reseed, resod, or refertilize the area when directed by the Engineer to meet the requirements of Section 8-02.3(15).

When the bid item "Seeded Lawn Installation", is included in the Bid Form, sodding in lieu of seeding for lawn installation, in accordance with Section 8-02.3(14)A, shall be paid at the unit contract price bid for "Seeded Lawn Installation" and no additional payment will be made.

Any incidental work required to complete the seeded lawn installation or sod installation, as specified herein but not specifically mentioned, shall be incidental to, and all costs therefore shall be included in the unit contract price of the bid item.

Any incidental work required to complete the roadside planting specified herein, but not specifically mentioned in these specifications shall be incidental to the roadside planting, and all costs therefore shall be included in the unit contract prices of the bid items.

SECTION 8-03 IRRIGATION SYSTEM

8-03.1 DESCRIPTION

This work shall consist of furnishing and installing a sprinkler irrigation system in accordance with these Specifications and the details shown on the Drawings and Standard Plan No's. 120, 121 and 122..

The Contractor or subcontractor shall be a licensed lawn-sprinkler contractor. The sprinkler system shall be installed by a journeyman lawn-sprinkler mechanic or journeyman plumber. Electrical work shall be performed by a licensed electrical contractor or subcontractor.

The Contractor shall obtain a plumbing permit from the Seattle/King County Health Department.

8-03.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Irrigation System	9-15
Hose Bib	9-15

Sleeve	9-15
Valve Box	9-15
Electrical Materials	9-31

8-03.3 CONSTRUCTION REQUIREMENTS

8-03.3(1) GENERAL

Work shall conform to the local plumbing code having jurisdiction. The Contractor shall obtain all permits having to do with the work.

Scaled dimensions are approximate. The Contractor shall check and verify all dimensions on the site before proceeding with the work. Before starting work on the sprinkler system, the Contractor shall carefully note all finish grades. Finish grades changed in the course of the work shall be restored to the original grades and contours.

The Contractor shall furnish the necessary equipment for proper execution and completion of all irrigation work and shall make the connections to the water service. The Seattle Water Department will furnish and install service tap, meter and meter box. Thirty days notice is required for the service tap and the service tap shall be requested through the Engineer.

Where indicated on the Drawings, piping and wire shall be installed in sleeves of plastic pipe of sufficient inside diameter to permit easy withdrawal and reinserting of the piping or wire. Pipe sleeves shall have a minimum of 12 inches cover for water piping and depth according to the code for electrical wires.

8-03.3(2) LAYOUT OF IRRIGATION SYSTEM

The Contractor shall stake the irrigation system following the schematic design shown in the Drawings before the construction begins. Alterations and changes in the layout may be expected in order to conform to ground conditions and to obtain full and adequate coverage of water, however no changes in the system as planned shall be made without the prior authorization of the Engineer.

8-03.3(3) EXCAVATION

Pipe trenches shall be no wider at any point than is necessary to lay the pipe or install equipment. The top 6 inches of topsoil, when such exists, shall be kept separate from subsoil and shall be replaced as the top layer when backfill is made. Trench bottoms shall be relatively smooth and of sand or other suitable material free from rocks, stones, or any material which might damage the pipe. Trenches in rock or other material unsuitable for trench bottoms shall be excavated 6 inches below the required depth and shall be backfilled to the required depth with sand or other suitable material free from rocks or stones.

Care shall be exercised by the Contractor when excavating trenches near existing trees. Where roots are 2 inches and greater in diameter, except in the direct path of the pipe, the pipe trench shall be hand excavated and tunneled. When large roots are exposed, they shall be wrapped with heavy burlap for protection and to prevent excessive drying. Trenches dug by machines adjacent to trees having roots 2 inches and less in diameter shall have the sides hand trimmed making a clean cut of the roots. All roots 1/2-inch or greater in diameter that are cut and trimmed shall be treated with an approved tree wound dressing. Trenches having exposed tree roots shall be backfilled within 24 hours unless adequately protected by moist burlap or canvas as approved by the Engineer.

Detectable marking tape shall be placed in the trench directly above, parallel to, and along the entire length of all nonmetallic water pipes and all nonmetallic and aluminum conduits placed under existing or future pavement. The width of the tape shall be as recommended by the manufacturer for the burial depth encountered on the project.

8-03.3(4) PIPING

All lines shall be a minimum of 18 inches below finished grade measured from the bottom of the pipe or as shown in the Drawings. All live mains to be constructed under existing pavement shall be placed in conduits jacked under pavement unless otherwise noted in the Drawings. All PVC pipe placed under pavement shall be placed in conduit. The conduit shall extend a minimum of 1 foot beyond the edge of pavement. All jacking operations shall be performed in accordance with an approved jacking plan. Where possible, mains and laterals or section piping shall be placed in the same trench. All lines shall be placed a minimum of 3 feet from the edge of concrete sidewalks, curbs, guardrail, walls, fences, or traffic barriers.

All sleeves shall be capped and their locations marked with metal stakes and painted blue to provide reference for as-buit drawings upon completion of the work.

8-03.3(5) JOINTING

During construction, pipe ends shall be plugged or capped to prevent entry of dirt, rocks, or other debris.

All galvanized steel pipe shall have sound, clean cut, standard pipe threads well fitted. All pipe shall be reamed to the full diameter and burrs removed before assembly. Threaded joints shall be constructed using either a nonhardening, nonseizing multipurpose sealant or teflon tape or paste as recommended by the pipe manufacturer. All threaded joints shall be made tight with wrenches without the use of handle extensions. Joints that leak shall be cleaned and remade with new material. Caulking or thread cement to make joints tight will not be permitted.

PVC pipe, couplings, and fittings shall be handled and installed in accordance with the manufacturer's recommendation. The outside of the PVC pipe shall be chamfered to a minimum of 1/16 inch at approximately 22 degrees. Pipe and fittings shall be joined by solvent welding.

Solvents used must penetrate the surface of both pipe and fitting which will result in complete fusion at the joint. Use solvent and cement only as recommended by the pipe manufacturer.

On plastic to metal connections, work the metal connection first. Use a nonhardening compound on threaded connections. Connections between metal and plastic are to be threaded utilizing female threaded PCV adapters with threaded schedule 80 PVC nipple only.

Due to the nature of PVC pipe and fittings, the Contractor shall exercise care in handling, loading, unloading and storing to avoid damage. The pipe and fittings shall be stored under cover, and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat, so as not to be subject to undue bending or concentrated external load at any point. Any pipe that has been dented or damaged shall be discarded until such damage has been cut out and the pipe is rejoined with a coupling.

Solvent welded joints shall be given at least 15 minutes set-up time before moving or handling. Pipe shall be partially center-loaded to prevent arching and slipping. No water shall be permitted in pipe until a period of at least 10 hours has elapsed for solvent weld setting and curing.

Backfilling shall be done when pipe is not in an expanded condition due to heat or pressure. Cooling of the pipe can be accomplished by operating the system for a short time before backfill, or by backfilling in the early part of the morning before the heat of the day.

Before pressure testing, solvent welded joints shall be given at least 24 hours curing time.

8-03.3(6) INSTALLATION

Final position of turf heads shall be between 1/2 and 1 inch above finished grade measured from the top of the sprinkler. All sprinklers adjacent to walks, curbs, and pavement shall be placed as shown in the Drawings.

Shrub heads, unless otherwise specified, shall be placed on permanent risers approximately 12 inches above finished grade, or on 12-inch pop up risers when located adjacent to walks or driveways. All risers shall have triple swing joints.

Final position of valve boxes, capped sleeves, and quick coupler valves shall be between 1/2 and 1 inch above finished grade or mulch.

Drip irrigation emitters shall be installed in accordance with the manufacturer's recommendations.

8-03.3(7) ELECTRICAL WIRE INSTALLATION

Wiring between the automatic controller and automatic valves can share a common neutral. Separate control conductors shall be run from the automatic controller to each valve. A white colored wire shall be used for the neutral as specified in the National Electrical Code. Wire shall be installed adjacent to and attached to the irrigation mains by plastic tape or nylon tie-ups.

Wire shall be common to each valve in the system. A loop shall be provided at each valve in any wire that passes or terminates at that valve. Loop knot end of spare wire at valves where wire dead-ends.

Splice insulation shall consist of electrical conductors twisted and bonded by approved pressure connectors and contained in a rigid plastic epoxy-filled mold. Splices will be permitted only at junction boxes, valve boxes, pole bases or control equipment. A minimum of 2 feet excess of conductors shall be left at junction boxes and automatic control valves to facilitate splicing and inspection.

Electrical service shall be provided to controller enclosure as shown on the Drawings.

8-03.3(8) BACKFLOW PREVENTION DEVICES

When specified in the Drawings and the Project Manual or as required by the Seattle Water Department, backflow prevention devices meeting the requirements specified in Section 9-15.11 shall be furnished and installed. All backflow prevention device installations are subject to inspection by authorized county or municipal authorities.

8-03.3(9) FLUSHING AND TESTING

The Contractor shall notify the Engineer at least 24 hours before conducting pressure tests.

All gauges used in the testing of water pressures shall be certified correct by an independent testing laboratory immediately prior to use on the project. Gauges shall be retested when ordered by the Engineer.

Automatic controllers shall be tested by actual operation for a period of two weeks under normal operating conditions. Should adjustments be required, the Contractor shall do so according to the manufacturer's direction and test until operation is satisfactory.

Main Line Flushing: All main supply lines shall receive two fully-open flushings to remove debris that may have entered the line during construction: the first before placement of valves; the second after placement of valves and prior to testing.

Main Line Testing: All main supply lines shall be purged of air and tested with a minimum static water pressure of 150 psi for 60 minutes without introduction of additional service or pumping pressure. Testing shall be done with one pressure gauge installed on the line, where directed by the Engineer. An additional pressure gauge shall be installed at the pump when directed by the Engineer. Lines which show loss of pressure exceeding 5 psi at the ends of specified test periods will be rejected.

The Contractor shall correct rejected installations and retest for leaks as specified herein.

Lateral Line Flushing: All lateral lines shall receive one fully-open flushing prior to placement of sprinkler heads, emitters, and drain valves. The flushing shall be of sufficient duration to remove any dirt or debris that has entered the lateral lines during construction.

Lateral Line Testing: All lateral lines shall be purged of air and tested under operating line pressures with risers capped and drain valves closed. The operating line pressures shall be maintained for 30 minutes through open valves and pressure regulating devices. Lines which show leaks at the end of the specified test periods shall be rejected. When conditions exist which prevent effective visual inspection of lateral lines, the Engineer may require that the lines be tested by use of pressure gauges. In that event, static water pressure, equal to operating line pressure, shall be maintained in the lines for 30 minutes with valves closed and without introduction of additional service pressure. Lateral lines which show loss of pressure exceeding 5 psi at the end of specified test periods will be rejected.

The Contractor shall correct and retest lateral line installations that have been rejected. Throughout the life of the contract, the Contractor shall repair, flush, and test, all main and lateral lines that have sustained a break or disruption of service. Upon restoration of the water service, the affected lines shall be brought up to operating pressure. The Contractor shall then conduct a thorough inspection of all sprinkler heads, emitters, etc., located downstream of the break, disruption of service, and repair. This inspection is required to ensure that the entire irrigation system is operating properly.

8-03.3(10) ADJUSTING SYSTEM

Before final inspection, the Contractor shall adjust and balance all sprinklers to provide adequate and uniform coverage. Spray patterns shall be balanced by adjusting individual sprinkler heads with the adjustment screws or replacing nozzles to produce a uniform pattern. Unless otherwise specified, sprinkler spray patterns will not be permitted on pavement, walks, or structures.

8-03.3(11) BACKFILL

Backfill shall not be started until all piping has been inspected, tested, and approved by the Engineer, after which backfilling shall be completed as soon as possible. All backfill material placed within 6 inches of the pipe shall be free of rocks, roots, or other objectionable material which might cut or otherwise damage the pipe. Backfill from the bottom of the trench to approximately 6 inches above the pipe shall be by continuous compacting in a manner that will not damage pipe or wiring and shall proceed evenly on both sides of the pipe. The remainder of the backfill shall be thoroughly compacted, except that heavy equipment shall not be used within 18 inches of any pipe. The top 6 inches of the backfill shall be of topsoil material or the first 6 inches of material removed in the excavation.

Trenches shall be compacted during backfilling.

Before complete backfilling, underground appurtenances, including risers, valves, vacuum breakers, drain valves, etc. shall remain exposed so that they can be located "as built" by the Engineer. The Contractor shall give 24-hour notice to the Engineer each time location or inspection is required. If, for any reason, any part of the sprinkler system is backfilled before being approved for location, testing, or inspection, it shall be uncovered and exposed until approved for backfilling by the Engineer.

8-03.3(12) AS BUILT DRAWINGS AND SYSTEM ORIENTATION

Upon completion of the work, the Contractor shall submit corrected shop drawings, schematic circuit diagrams, or other drawings necessary for the Engineer to prepare corrected Drawings to show the work as constructed. These drawings shall be on sheets conforming in size to the provisions of Section 1-05.3.

The Contractor shall conduct a training and orientation session covering the operation, adjustment, and maintenance of the irrigation system. The as built drawings shall be reviewed and all features explained. At this session, the Contractor shall provide the Engineer with parts lists and service manuals for all equipment. The Contractor shall notify the Engineer in writing two weeks prior to the training and orientation session. The date and time of the session shall be subject to approval of the Engineer.

8-03.3(13) SYSTEM OPERATION

The irrigation system shall be completely installed, tested, and automatically operable prior to planting in a unit area except where otherwise specified in the Drawings or approved by the Engineer. The Contractor shall be fully responsible for all maintenance, repair, testing, inspecting, and automatic operation of the entire system until all work is considered complete as determined by the final inspection specified in Section 1-05.11.

This responsibility shall include, but not be limited to, draining the system prior to winter and reactivating the system in the spring and at other times as ordered by the Engineer.

For the life of the contract, the Contractor shall be responsible for having annual inspections and tests performed on all cross connection control devices as required and specified by the Department of Social and Health Services, Health Services Division.

8-03.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

8-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-03 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Irrigation System, Automatic," per lump sum.
(2) "Irrigation System, Manual," per lump sum.
(3) "Hose Bib Assembly," per each.
(4) "Sleeve, PVC (Schedule), (Size)", per linear foot.
(5) "Valve Box, Plastic", per each.

The unit contract price for "Irrigation System, Automatic" shall include all costs for the work required to furnish, install, and test a complete working system and including excavation, backfill, controller, valves, sleeves, conduit, wiring and piping.

The unit contract price for "Irrigation System, Manual" shall include all costs for the work required to furnish, install and test a complete working system and including excavation, backfill, valves, sleeves, and piping.

The unit contract price for "Hose Bib Assembly," shall include all costs for the work required to furnish and install the type and size of hose bid assembly specified.

The unit contract price "Sleeve, PVC (Schedule), (Size)," shall include all costs for the work required to furnish and install sleeve of the type and size specified.

The unit contract price for "Valve Box, Plastic," shall include all costs for the work required to furnish and install value box of the type and size specified.

All costs of annual inspections and tests performed on cross connection control devices during the life of the contract shall be included in the unit contract prices for the complete irrigation system as shown in the Drawings or as directed by the Engineer.

SECTION 8-04 CEMENT CONCRETE CURB, CURB AND GUTTER

8-04.1 DESCRIPTION

This work shall consist of constructing cement concrete curb, and curb and gutter in conformance with the Drawings, these Specifications and with Standard Plan No's. 410 and 411.

8-04.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Portland Cement	9-01
Concrete Aggregate	9-03
Reinforcing Steel	9-07
Premolded Joint Filler	9-04
Curing Compounds	9-23

The portland cement concrete shall meet the requirements of Section 5-05. Concrete mix for curbs shall be Class 5 (1-1/2). When doweled curb is constructed, concrete shall be Class 5 (3/4). Slump of the concrete mix shall not exceed 3-1/2 inches.

Grout for dowelling curb on existing pavement shall be one part portland cement and two parts clean sand.

Dowels and reinforcing steel shall be #3 deformed steel billet bars, ASTM A615, Grade 60.

Forms may be of wood or metal or any other material at the option of the Contractor, provided that the forms as set will result in a curb, or curb and gutter of the specified thickness, cross section, grade and alignment shown on the Drawings.

8-04.3 CONSTRUCTION REQUIREMENTS

8-04.3(1) GENERAL

8-04.3(1)A ERECTING FORMS

Before erecting forms, the subgrade shall be properly compacted to the specified grade.

Forms, wood or steel, shall be staked securely in place, true to line and grade.

Sufficient support shall be given to the form to prevent movement in any direction, resulting from the weight of the concrete or the concrete placement. Forms for Type 410A and 410B Curbs shall not be set until the subgrade has been compacted within 1 inch of the established grade. Forms shall be clean and well oiled prior to setting in place. When set, the top of the form shall not depart from grade more than 1/8 inch when checked with a 10-foot straightedge. The alignment shall not vary more than 1/4 inch in 10 feet. Immediately prior to placing the concrete, forms shall be carefully inspected for proper grading, alignment and rigid construction. Adjustments and repairs as needed shall be completed before placing concrete.

8-04.3(1)B PLACING CONCRETE

The subgrade shall be properly compacted and brought to specified grade before placing concrete. The subgrade shall be thoroughly dampened immediately prior to the placement of concrete. Concrete shall be spaded and tamped thoroughly into the forms to provide a dense, compacted concrete free of rock pockets. The exposed surfaces shall be floated, finished and brushed longitudinally with a fiber hair brush approved by the Engineer.

The rate of concrete placement shall not exceed the rate at which the various placing and finishing operations can be performed in accordance with these Specifications.

If concrete is to be placed by the extruded method, the Contractor shall demonstrate to the satisfaction of the Engineer that the machine is capable of placing a dense, uniformly compacted concrete to exact section, line and grade.

8-04.3(1)C DOWELS

Dowels shall be placed in the pavement slab as detailed on Standard Plan No. 411.

The dowel bars shall be set while the concrete is still plastic enough to not require hammering them into place.

8-04.3(1)D STRIPPING FORMS AND FINISHING

The face form of the curb shall be stripped at such time in the early curing as will enable inspection and correction of all irregularities that appear.

Forms may be removed on the day following the pour if the concrete has set sufficiently to retain its true shape and removal causes no chipping or spalling. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with moist earth, or sprayed with curing compound. The face of the curb shall be troweled with a tool cut to the exact section of the curb and at the same time maintain the shape, grade and alignment of the curb. The exposed surface of the curb shall be brushed with a fiber hair brush.

8-04.3(1)E CURING

White pigmented or transparent curing compounds shall be applied to all exposed surfaces immediately after finishing. Transparent curing compounds shall contain a color dye of sufficient strength to render the film distinctly visible on the concrete for a minimum period of 4 hours after application.

If, at any time during the curing period any of the forms are removed, a coat of curing compound shall be applied immediately to the exposed surface. The curing compound shall be applied in sufficient quantity to obscure the natural color of the concrete. Additional coats shall be applied if the Engineer determines that the coverage is not adequate. The concrete shall be cured for the minimum period of time set forth in Section 5-05.3(13)B2.

8-04.3(1)F EXPANSION AND DUMMY JOINTS

Joints shall be constructed in the manner shown on Standard Plan No. 411 and at locations to match joints in concrete pavement. In no case shall joints exceed 15 feet center to center. They shall be cleaned and edged as shown on the Drawings and as further specified in Section 5-05. All expansion and construction joints shall extend entirely through the curb section above the pavement surface. Joint filler in the curb shall be normal to the pavement and in full butt contact with pavement joint filler. Joints shall match existing transverse joints or cracks in existing pavement.

8-04.3(1)G FINISHED WORK

The work shall be performed in a manner which results in a curb or curb and gutter constructed to specified line and grade, uniform in appearance and structurally sound. Curbs found with unsightly bulges, ridges, low spots in the gutter or other defects shall be removed and replaced by the Contractor if the Engineer considers them to be irreparable. When checked with a 10-foot straightedge, grade shall not deviate more than 1/8 inch, and alignment shall not vary more than 1/4 inch.

8-04.3(2) CURB BLOCK-OUTS AT CURB RAMPS

At intersections where new cement concrete curb is to be constructed and curb ramps are to be provided under the contract, the Contractor shall block out the new curb at the locations of the new curb ramps. The locations and limits of the depressed curb when other than shown on Standard Plan No's. 422a and 422b will be designated by the Engineer.

8-04.3(3) TYPE 410A CURB

Separate curb shall be constructed as shown on the Standard Plan No. 410.

8-04.3(4) TYPE 410B CURB AND GUTTER

Curb and gutter shall be constructed as shown on Standard Plan No. 410 on a compacted subgrade prepared in accordance with applicable subgrade specifications for cement concrete pavement in Section 5-05. The placing, consolidating, jointing, finishing and curing of the concrete shall comply with the requirements for concrete curb as specified in Section 8-04.3(1), except that the top of the gutter shall be steel troweled and fiber brushed parallel to the curb.

Curb and gutter may be constructed by the extruded method only if such construction is called for in the Project Manual. When extruded curb and gutter is called for in the Project Manual, it may be extruded as a unit, or the curb may be extruded upon the gutter section in which case steel dowels shall be provided as specified in Section 8-04.3(1)C.

8-04.3(5) TYPE 410C CURB

8-04.3(5)A CEMENT CONCRETE CURB ON EXISTING PAVEMENT

Cement concrete curb constructed on an existing pavement shall be dowelled onto the existing pavement where indicated on the Drawings or designated by the Engineer, as shown on Standard Plan No's. 410 and 411.

The dowel bar shall be 10 inches long placed at 18 inches on center using 1 inch drilled holes, 5 inches deep and placed in rigid portion of concrete pavement.

Holes shall be grouted with epoxy grout. When a hole is ready to be grouted, it shall be free from water, particles of concrete, and other foreign material. Care shall be taken in placing the grout to entrap as little air as possible. The grout shall be protected from rapid drying.

8-04.3(5)B CEMENT CONCRETE CURB ON NEW PAVEMENT

Dowelled curb on new pavement shall be constructed as shown on Standard Plan No's. 410 and 411.

The pavement width shall extend to the back of the curb. The pavement where the curb is to be placed shall be roughened or otherwise treated so that a permanent bond will be secured between the curb and the pavement.

Dowels, as detailed in Standard Plan No's. 410 and 411 shall be placed at 28 inches on center in the fresh concrete pavement.

8-04.3(6) MOUNTABLE CURB

Mountable curb for traffic circles shall be constructed with the alignment and configuration as shown on Standard Plan No. 415.

8-04.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for curb, or curb and gutter of the type specified will be by the linear foot along the front face of the curb for the length constructed, including that portion installed through driveways and curb ramps.

Where curb ramps or driveways are "cut in" areas of existing improvements where adjacent curb will remain, no measurement for curb will be made.

8-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-04 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Curb, Cement Concrete", per linear foot.
(2) "Curb, Cement Concrete, Mountable" per linear foot.
(3) "Curb and Gutter, Cement Concrete", per linear foot.

The unit contract price for "Curb, Cement Concrete", "Curb and Gutter, Cement Concrete", and "Curb, Cement Concrete, Mountable" shall include all costs for the work required to construct the curb or curb and gutter of the size and type specified, including dowels and drilling and expoxy grouting holes for dowels, when this work is required.

Curb does not include the pavement slab upon which it is placed. That portion of the pavement slab underneath the curb will be paid for as concrete pavement in accordance with Section 5-05.5.

SECTION 8-06 EXTRUDED CURB

8-06.1 DESCRIPTION

This work shall consist of constructing extruded concrete curb in accordance with these Specifications at locations shown on the Drawings and to the cross section shown on Standard Plan No. 412. Except as otherwise noted in this Section, all requirements for cement concrete curb and gutter shall apply to extruded cement concrete curb.

8-06.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Aggregates	9-03
Mineral Filler	9-03
Blending Sand	9-03
Asphalt	9-02
Portland Cement	9-01
Reinforcing Steel	9-07
Curing Compounds	9-23

Extruded asphalt concrete curb shall consist of a hot mix asphalt concrete Class B mix meeting the requirements of Section 5-04.

The concrete mix design for extruded cement concrete curb shall be the following:

Cement (Type II)	658 pounds
Fine Aggregate	1,800 pounds
Coarse Aggregate	1,260 pounds
Water	245 pounds
Air	5% plus or minimum 1-1/2%

Aggregate for cement concrete shall meet the requirements of Grading for Fine Aggregate as specified in Section 9-03.1(2)C. Transparent curing compound as specified in Section 9-23.3 shall be used. Air-entrained concrete shall be used as specified in Section 9-23.6 except that air content shall be a minimum of 3 percent and a maximum of 6 percent by volume.

Tie bars shall be deformed steel bars meeting the requirements of Section 9-07. The bars shall be free from rust, loose mill scale, dirt, grease or other defects affecting the strength or bond with the concrete.

8-06.3 CONSTRUCTION REQUIREMENTS

8-06.3(1) PREPARATION OF PAVEMENT SURFACE

8-06.3(1)A EXTRUDED ASPHALT CONCRETE CURB

The asphalt pavement shall be dry and cleansed of loose or deleterious material. Immediately after cleaning the pavement surface, a tack coat of cut-back or emulsified asphalt shall be applied to the asphalt curb area of the pavement at the rate of .08 to 0.20 gallons per 15 linear feet of curb area, depending on the width of curb and age of pavement. Care shall be taken to prevent applying too wide or too heavy a tack coat.

8-06.3(1)B EXTRUDED CEMENT CONCRETE CURB

The pavement shall be dry and cleansed of loose or deleterious materials prior to curb placement. At the Contractor's option, concrete curns shall be anchored to the existing pavement either by placing steel tie bars one foot on each side of every joint, or by using an adhesive.

8-06.3(2) VACANT

8-06.3(3) EQUIPMENT FOR LAYING CURB

8-06.3(3)A EXTRUDED ASPHALT CONCRETE CURB

The machine for laying the curb shall be of the self-propelled type equipped with a material hopper, distributing screw, and adjustable curb forming devices capable of laying and compacting the hot-mix asphalt concrete to the lines, grades and cross section as shown on the Drawings and Standard Plan No. 412, and in an even homogenous manner free of honeycombs.

8-06.3(3)B EXTRUDED CEMENT CONCRETE CURB

Extruded cement concrete curb shall be placed, shaped and compacted true to line and grade with an approved extrusion machine. The extrusion machine shall be capable of shaping and thoroughly compacting the concrete to the required cross section.

8-06.3(4) MIXING AND PLACING

8-06.3(4)A TIE BARS FOR CEMENT CONCRETE CURBS

At the Contractor's option concrete curbs shall be anchored to the existing pavement either by placing steel tie bars one foot on each side of every joint, or by using an adhesive.

Tie bars shall meet the dimensions shown on Standard Plan No. 412. Th adhesive shall meet the requirements of Section 9-26 for Type II epoxy resin.

8-06.3(4)B EXTRUDED ASPHALT CONCRETE CURB

The asphalt concrete mixture shall be homogenously mixed to conform with Section 5-04.3(8) and shall be delivered to the hopper of the laying machine at a temperature of not less than 200 degree F. nor more than 300 degree F. Each hopper load of the asphalt concrete mix shall be run through the curb laying machine, properly adjusted to form and properly compact the asphalt concrete curb.

8-06.3(4)C EXTRUDED CEMENT CONCRETE CURB

The cement concrete mixture shall be homogenously mixed to conform with Section 5-05 when delivered to the hopper of the curb machine. Each hopper load of the cement concrete mix shall be run through the curb laying machine, properly adjusted to form and properly compact the cement concrete curb.

8-06.3(5) JOINTS

8-06.3(5)A EXTRUDED ASPHALT CONCRETE CURB

Unless conditions warrant, asphalt concrete curb construction at the specified temperature shall be a continuous operation in one direction so as to eliminate curb joints. However, where conditions are such that this is not possible, the joints between successive days work shall be carefully made in such a manner as to ensure a continuous bond between the old and new sections of the curb. Contact surface of the previously constructed curb shall be painted with a thin, uniform coat of hot bituminous material immediately prior to placing the fresh asphalt concrete curb material against the old joint.

8-06.3(5)B EXTRUDED CEMENT CONCRETE CURB

Joints in the extruded cement concrete curb shall be spaced at 15-foot intervals or shall match existing transverse joints or cracks in existing pavement. Joints shall be cut vertically and to a depth of 5 inches as shown on Standard Plan No. 412. Joints shall not be placed in conflict with curb dowels.

8-06.3(6) CURING - EXTRUDED CEMENT CONCRETE CURB

Transparent liquid curing compound shall be used. Sufficient pigment shall be present so that the sprayed compound is easily discernible. Application shall be as specified in Section 9-23.3

8-06.3(7) BARRICADES AND SAFEGUARDS

8-06.3(7)A EXTRUDED ASPHALT CONCRETE CURB

The newly laid curb shall be protected from traffic by barricade or other suitable means until the heat of the asphalt concrete mixture has been dissipated and the mixture has attained its proper degree of hardness.

8-06.3(7)B EXTRUDED CEMENT CONCRETE CURB

The newly placed curb shall be protected from traffic by barricade or other suitable means until the cement concrete mixture has attained its required strength.

8-06.3(8) FURTHER PROVISIONS

8-06.3(8)A EXTRUDED ASPHALT CONCRETE CURB

Section 5-04 shall apply where specific details are required and where such provisions have not been included in Section 8-06.

8-06.3(8)B EXTRUDED CEMENT CONCRETE CURB

Section 5-05 shall apply where specific details are required and where such provisions have not been included in Section 8-06.

8-06.3(8)C SUBSTITUTIONS

The Contractor may substitute extruded cement concrete curb for asphalt concrete curb upon receiving written permission from the Engineer. There will be no charge in unit contract price if this substitution is allowed

8-06.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

The extruded concrete curb will be measured by the linear foot along the front face of the curb and returns.

8-06.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-06 will be made at the unit contract price bid only for the pay items listed or referenced below:

(1) "Extruded Curb, (Material)," per linear foot.

The unit contract price for "Extruded Curb, (Material)" shall include all costs for the work required to furnish and install extruded concrete curb as specified.

SECTION 8-07 PRECAST TRAFFIC CURB AND BLOCK TRAFFIC CURB

8-07.1 DESCRIPTION

This work shall consist of furnishing and installing precast cement concrete traffic curb and precast cement concrete block traffic curb, of the design and type specified in the Drawings, and in accordance with these Specifications and Standard Plan No's. 413 and 414. Traffic curb shall be installed in the locations indicated in the Drawings or as designated by the Engineer. The curb face shall be painted with approved traffic paint, either yellow or white, as specified on the Drawings or designated by the Engineer.

8-07.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Paint Formulas-General	9-29
Precast Traffic Curb	9-18
Block Traffic Curb	9-18
Water Repellent Compound	9-18
Sodium Metasilicate	9-18

8-07.3 CONSTRUCTION REQUIREMENTS

8-07.3(1) INSTALLING CURBS

The curb shall be firmly bedded for its entire length and breadth on a mortar bed composed of one part portland cement and two parts of concrete sand. The anchor grooves in the bottom of the curb shall be entirely filled with the mortar.

Before the cement mortar bed is laid, all dirt shall be cleaned from the pavement surface by washing.

All old pavements and any portion of new pavements constructed under this contract, which are covered with oil or grease within the curb limits, shall be further cleaned as follows:

(a) The pavement shall be flushed with water.
(b) While the pavement is still wet, sodium metasilicate, complying with the requirements as specified elsewhere herein, shall be evenly distributed over the pavement surface at a rate of 1 to 2 pounds per 100 square feet of pavement surface.
(c) The sodium metasilicate shall remain on the pavement for at least 15 minutes. Where patches of oil, tar, or grease occur, these areas shall be scrubbed with a brush or broom.
(d) The pavement surface shall then be thoroughly rinsed.

All joints between adjacent pieces of curb except joints for expansion and/or drainage as designated by the Engineer shall be filled with mortar composed of one part portland cement and two parts sand.

The joints between adjacent units of block traffic curb will not require mortaring.

The alignment and the top surface of adjoining sections of curb shall be true and even with a maximum tolerance of 1/16 inch.

For both types of traffic curbs, nosing pieces, connecting dividers, and radial sections as detailed in the Drawings, will be required at the ends of the curb lines, at transitions from Type 413C traffic curb to Type 413A traffic curb, and at Type 413A traffic curb installation with radii less than 10 feet.

8-07.3(2) PAINTING OF CURBS

Concrete traffic curbs shall be painted with 2 full coats of approved traffic paint in accordance with Section 9-29.

8-07.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for precast traffic curb and block traffic curb will be by the linear foot along the top of the curb and return. The nosing pieces and dividers will be measured as traffic curb.

8-07.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-07 will be made at the unit contract price bid only for the pay items listed or referenced below:

(1) "Curb, Traffic, Precast," per linear foot.
(2) "Curb, Traffic, Block," per linear foot.

The unit contract price for "Curb, Traffic, Precast" and "Curb, Traffic, Block" shall include all costs for the work required to furnish and install the precast traffic curb and block traffic curb as specified.

SECTION 8-08 PLASTIC TRAFFIC BUTTONS AND LANE MARKERS

8-08.1 DESCRIPTION

This work shall consist of furnishing and installing plastic traffic buttons and lane markers with an epoxy adhesive in accordance with these Specifications and Standard Plan No's. 700 and 710.

8-08.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Plastic Traffic Buttons	9-21
Lane Markers Type 1	9-21
Lane Markers Type 2	9-21
Adhesive	9-26

Color of traffic buttons and Type 1 lane markers, shall match the color of the pavement markings on which they are installed. The color of applicable pavement markings are set forth in Section 8-22.

8-08.3 CONSTRUCTION REQUIREMENTS

8-08.3(1) GENERAL

Location and spacing shall be as indicated on the Drawings or designated by the Engineer. The Engineer will provide necessary control points. The Contractor shall be responsible to do the preliminary spotting of the plastic buttons and lane markers from those control points prior to installation. Approval by the Engineer of the layout shall be obtained before traffic button or markers are installed.

8-08.3(2) SURFACE PREPARATION

Traffic buttons and lane markers shall be bonded to clean and dry pavement with an adhesive as specified herein.

All sand, dirt and loose extraneous material shall be swept or blown away from the marker lane location.

Surface dirt within areas to receive traffic buttons and lane markers shall be removed. Large areas of tar, grease or foreign materials may require sand blasting, steam cleaning or power brooming to accomplish complete removal. Application of traffic buttons and lane markers shall not proceed until the cleaned surface has been approved by the Engineer.

8-08.3(3) ADHESIVE PREPARATION

At the time of use the contents of Packages A and B as specified in Section 9-26, shall be thoroughly redispersed by mixing. One volume or weight of Package A shall be mixed with one volume or weight of Package B until a uniform gray color is achieved without visible streaks of white or black. Formulation may be revised, if approved by the Engineer.

Catalyst shall be added to the base just before use. Unused mixed adhesive shall be discarded when catalytic action has caused stiffening and reduction of workability or a small ball of jelled resin has formed in the center of the container.

The adhesive shall be maintained at a temperature between 60 degrees and 85 degrees F before use and during application.

8-08.3(4) APPLICATION PROCEDURE

Applications of traffic buttons and lane markers to pavement shall not be done if the ambient air temperature is below 40 degrees F.

The mixed adhesive shall be applied to the base of the traffic button and lane marker with a quantity sufficient to overfill all voids between the base of the traffic button, lane marker and the pavement, such that as the traffic button and marker is worked into final position, the excess adhesive is forced out to form a bead rim around the entire perimeter of the traffic button and lane marker.

Traffic buttons and lane markers shall be spaced and aligned as indicated on the Drawings or designated by the Engineer. A displacement of not more than 1/2 inch left or right of the established guide line will be permitted. Improperly placed buttons shall be removed and replaced at the Contractor's expense.

Bonding shall be considered satisfactory when adhesive develops a minimum bond strength of tension of not less than 10 pounds per square inch for 8-inch and 10-inch plastic traffic buttons, and not less than 2 pounds per square inch for lane markers Type 1 and Type 2. Traffic will not be allowed to pass over the traffic buttons and lane markers until the minimum bonding strength has been achieved.

Where required that both paint striping and Lane Marker Type 1 are to be installed on the same alignment, the Contractor shall install the lane markers prior to the application of the paint striping.

8-08.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

8-08.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-08 will be made at the unit contract price bid only for the pay items listed or referenced below.

(1) "Lane Marker, (Type)," per each.
(2) "Plastic Traffic Button, (Type)," per each.

The unit contract price for "Lane Marker, (Type)" and "Plastic Traffic Button, (Type)" include all costs for the work required to furnish and install the traffic buttons and lane markers as specified.

SECTION 8-09 VACANT

SECTION 8-10 GUIDE POSTS

8-10.1 DESCRIPTION

This work shall consist of furnishing and installing guide posts of the type specified in the Drawings in accordance with these Specifications and WSDOT Standard Plan NO. H-1, at the locations indicated in the Drawings or where designated by the Engineer.

8-10.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Posts	9-17
Aluminum Plate	9-17
Reflectorization	9-17
Hardware	9-17
Encapsulated Lens Reflective Sheeting	9-28

Aluminum plates for guide posts shall conform to either the specifications of sheet aluminum stock or precoated coil stock at the Contractor's option.

Flexible posts shall be selected from approved materials listed in the Project Manual.

8-10.3 CONSTRUCTION REQUIREMENTS

Guide posts shall be installed as shown in WSDOT Standard Plan No. H-1 or as specified by the Engineer. When in place, the posts shall not vary more than 1 inch in 40 inches from a vertical plane. Post No. 1 may be set and tamped in drilled holes or may be driven using a suitable driving head. Posts deformed by driving will be rejected and shall be replaced by the Contractor.

Flexible guide posts shall be installed according to the manufacturer's recommendations. A reasonable time prior to installation, the Contractor shall provide the Engineer with the manufacturer's recommended installation procedures. Only one type of flexible guide post shall be used on each project.

If the ground adjacent to the posts is disturbed in any manner, it shall be backfilled to the level of the existing surface and thoroughly compacted. The surface of the ground adjacent to the post shall be replaced with like materials, including bituminous treatment if previously existent.

8-10.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

8-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-10 will be made at the unit contract price bid only for the pay items listed or referenced below:

(1) "Guide Post", per each.
(2) "Flexible Guide Post", per each.

The unit contract price for "Guide Post" and "Flexible Guide Post" shall include all costs for the work required to furnish and install the guide posts of the type specified, including galvanizing, reflectorizing, fastenings, and any excavating and backfilling that may be required.

SECTION 8-11 GUARDRAIL

8-11.1 DESCRIPTION

This work shall consist of constructing guardrail and anchors of the kind and type specified in accordance with the Drawings, these Specifications and WSDOT C-Series Standard Plans, in conformity with the lines and grades as staked by the Engineer.

8-11.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Beam Guardrail	9-16
Rail Element	9-16
Posts and Blocks	9-16
Galvanizing	9-16
Hardware	9-16
Anchors	9-16
Inspection	9-16
Weathering Steel Beam Guardrail	9-16

8-11.3 CONSTRUCTION REQUIREMENTS

8-11.3(1) BEAM GUARDRAIL

8-11.3(1)A ERECTION OF POSTS

The posts shall be set to the true line and grade of the roadway and spaced as shown in the Drawings. When the Drawings require that the ends of a section of guardrail be curved outward or downward, the posts shall be set to

accommodate the curve. End treatment shall be in accordance with the appropriate Standard Plans or as shown in the Drawings.

Posts may be placed in dug or drilled holes. Ramming or driving will be permitted only if approved by the Engineer and if no damage to the pavement, shoulders, and adjacent slopes results therefrom.

In broken rock embankments, the pre-punching of holes will be permitted only prior to final shoulder or median compaction, surfacing, and paving.

The posts shall be protected from traffic at all times by attaching the rail elements or by a method approved by the Engineer.

8-11.3(1)B VACANT

8-11.3(1)C ERECTION OF RAIL

All metal work shall be fabricated in the shop. No punching, cutting, or welding shall be done in the field, except that holes for special details in exceptional cases may be drilled in the field when approved by the Engineer. The rail shall be erected so that the bolts at expansion joints will be located at the centers of the slotted holes.

Rail plates shall be assembled with the splice joints lapping in the direction of the traffic.

Galvanized rail plates shall be fastened to the posts with galvanized bolts, washers, and nuts of the size and kind shown in the Drawings. Weathering steel rail plates shall be fastened to the posts with weathering steel bolts, washers, and nuts of the size and kind shown in the Drawings and shall not be galvanized.

All bolts, except where otherwise required at expansion joints, shall be drawn tight. Bolts through expansion joints shall be drawn up as tight as possible without being tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least 1/4 inch beyond the nuts. Except where required for adjustments, bolts shall not extend more than 1/2 inch beyond the nuts.

After complete installation of weathering steel beam guardrail, the Contractor shall wash the rail with clean water under high pressure. If the rail is contaminated by oil or grease, sandblasting shall be used as necessary to clean the rail.

8-11.3(1)D ANCHOR INSTALLATION

All excavation and backfilling required for installation of anchors shall be performed in accordance with Section 2-09.

Bolts shall be tightened to the tension specified. The anchor cable shall be tightened sufficiently to eliminate all slack.

Where additional posts are required, field drilling of the rail will be permitted when approved by the Engineer.

Type 2 concrete anchors may either be pre-cast or cast-in-place at the option of the Contractor.

8-11.3(1)E PLANS

The Contractor shall submit for approval of the Engineer such additional detailed plans and shop drawings of rail punchings, fittings, and assemblies as may be required by the Engineer.

8-11.3(2) VACANT

8-11.3(3) ACCESS CONTROL GATES

Access control gates shall be placed to line and grade as shown in the Drawings or as staked by the Engineer. After the posts have been set, the holes shall be backfilled with suitable material and the material thoroughly tamped.

8-11.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement of beam guardrail will be by the linear foot measured along the line of the completed guardrail from end to end including transition sections, expansion sections, and terminal sections.

8-11.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-11 will be made at the unit contract price bid only for the pay items listed or referenced below:

(a) "Beam Guardrail, (Type)," per linear foot.
(b) "Weathering Steel Beam Guardrail, (Type)," per linear foot.
(c) "Beam Guardrail Anchor, (Type)," per each.
(d) "Post, Treated Timber, 10 Inch x 10 Inch," per each.
(e) "Post, CRT Treated Timber," per each.
(f) "Access Control Gate," per each.
(g) "Relocate Beam Guardrail," per linear foot.

The unit contract price for "Beam Guardrail, (Type)" and Weathering Steel Beam Guardrail, (Type)" shall include all costs for the work required to furnish and install the beam guardrail, including all standard posts which attach the guardrail to concrete masonary structures.

The unit contract price for "Beam Guardrail Anchor, (Type)" shall include all costs for the work required to furnish and install the anchor as specified, including excavation, backfilling, compaction, disposal of surplus excavated material, and surface restoration. Where Type 2 anchors are required, the additional depth of post embedment shall be included in the unit contract price of the anchor.

The unit contract price for "Post, Treated Timber, 10 Inch x 10 Inch" shall include all costs for the work required to furnish and install the 10-inch x 10-inch treated timber post or alternate W6 x 15 steel post and attachment to the guardrail, including surface restoration.

The unit contract price for "Post, CRT Treated Timber" shall include all costs for the work required to furnish and install the CRT treated timber post including drilling holes in the post at the specified locations.

The unit contract price for "Access Control Gate" shall include all costs for the work required to furnish and install the access control gate as specified, including excavating, backfilling, compacting and surface restoration.

The unit contract price for "Relocate Beam Guardrail" shall include all costs for the work required to remove and relocate the beam guardrail with posts.

SECTION 8-12 CHAIN LINK FENCE AND WIRE FENCE

8-12.1 DESCRIPTION

This work shall consist of furnishing and constructing chain link fence and wire fence of the types specified in accordance with the Drawings, these Specifications and Standard Plan No's. 450a, b, c and WSDOT Standard Plan No. L-1, at the locations shown in the Drawings and in conformity with the lines as staked by the Engineer.

8-12.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Concrete Class C	6-02
Chain Link Fence and Gates	9-16
Wire Fence and Gates	9-16

Chain link fence shall be of diamond woven wire mesh mounted on steel posts.

Wire fence shall be of barbed wire or barbed wire combined with wire mesh fastened to posts. Steel posts and steel braces, or wood posts and wood braces may be used, provided only one type shall be selected for use in any contract.

Gates shall consist of a steel frame or frames covered with chain link or wire mesh.

8-12.3 CONSTRUCTION REQUIREMENTS

8-12.3(1) GENERAL

Clearing of the fence line will be required. Clearing shall consist of the removal and disposal of all trees, brush, logs, upturned stumps, roots of down trees, rubbish, and debris.

For chain link type fences, the clearing width shall be approximately 10 feet. For wire type fences, the clearing width shall be approximately 3 feet. Grubbing will not be required except where short and abrupt changes in the ground contour will necessitate removal of stumps in order to properly grade the fence line. All stumps within the clearing limits shall be removed or close cut.

Grading of the fence line sufficient to prevent short and abrupt breaks in the ground contour that will improve the aesthetic appearance of the top of the fencing when installed shall be required. It is expected that in the performance of this work, machine operations will be required for chain link fencing, and hand work will be required for wire fencing except where sufficient width exists for machine work.

The fence shall be constructed close to and inside the right of way line unless otherwise directed by the Engineer or shown in the Drawings. Deviations in alignment to miss obstacles will be permitted only when approved by the Engineer and only when such deviation will not be visible to the traveling public or adjacent property owners.

8-12.3(2) CHAIN LINK FENCE AND GATES

8-12.3(2)A POSTS

Posts shall be placed in a vertical position and, except where otherwise directed by the Engineer, shall be spaced at 10-foot centers. Spacing will be measured parallel to the slope of the ground.

All posts, except line posts for Type 3 fence, shall be set in concrete to the dimensions shown in the Standard Plan No's. 450a and 450c. All concrete footings shall be crowned so as to shed water. Line posts on Type 3 fence shall be set in undisturbed earth either by driving or drilling, except as specified. Driving shall be accomplished in such a manner as not to damage the post. Voids around the post shall be backfilled with suitable material and thoroughly tamped.

Concrete footings shall be constructed to embed the line posts on Type 3 fence at grade depressions where the tension on the fence will tend to pull the post from the ground.

Where solid rock is encountered without an overburden of soil, line posts shall be set a minimum depth of 14 inches, and end, corner, gate, brace, and pull posts a minimum of 20 inches into the solid rock. The holes shall have a minimum width 1 inch greater than the largest dimension of the post section to be set. The posts shall be cut before installation to lengths which will give the required length of post above ground, or if the Contractor so elects, an even length of post set at a greater depth into the solid rock may be used.

After the post is set and plumbed, the hole shall be filled with grout consisting of one part portland cement and three parts clean, well graded sand. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall be crowned to carry water from the post.

Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set to the full depth shown in the plans unless penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be terminated. Concrete footings shall be constructed from the solid rock to the top of the ground. Grouting will be required on the portion of the post in solid rock.

Pull posts, as shown in Standard Plan No's. 450a and 450c, shall be braced to adjacent line posts and spaced at 1000 foot maximum intervals for Type 1, 3 and 6 fence and at 500 foot maximum intervals for Type 4 fence.

End, gate, corner, and pull posts shall be braced to the adjacent brace post(s) in the manner shown in Standard Plan No's. 450a and 450c. Changes in line amounting to 2 foot tangent offset or more between posts shall be considered as corners for all types of fence.

Steep slopes or abrupt topography may require changes in various elements of the fence. It will be the responsibility of the Contractor to provide all posts of sufficient length to accommodate the chain link fabric and ornamental tops adapted to receive the top rail.

All posts for chain link fence Types 1 and 6 shall be fitted with an approved top designed to fit securely over the post and carry the top rail. All round posts for chain link fence Types 3 and 4 shall have approved tops fastened securely to the posts. The base of the top fitting for round posts shall carry an apron around the outside of the posts.

8-12.3(2)B TOP RAIL

Top rails shall pass through the ornamental tops of the line posts, forming a continuous brace from end to end of each stretch of fence. Lengths of tubular top rail shall be joined by sleeve couplings. Top rails shall be securely fastened to terminal posts by pressed steel fittings or other appropriate means.

8-12.3(2)C TENSION WIRE

One continuous length of tension wire shall be used between pull posts. Sufficient tension shall be applied to avoid excess sag between the posts. Tension wires shall be tied or otherwise fastened to end, gate, corner, or pull posts by methods approved by the Engineer.

8-12.3(2)D CHAIN LINK FABRIC

Chain link fabric on Type 1, 3, 4, and 6 fence shall be placed on the face of the post away from the highway, except on horizontal curves where it shall be placed on the side designated by the Engineer.

Chain link fabric on Type 1, 3, 4, and 6 fences shall be placed approximately 1 inch above the ground and on a straight grade between posts by excavating high points of ground. Filling of depressions will be permitted only upon approval of the Engineer.

The fabric shall be stretched taut and securely fastened to the posts. Fastening to end, gate, corner, and pull posts shall be with stretcher bars and fabric bands spaced at intervals of 15 inches or less or by weaving the fabric into the fastening loops of roll-formed posts. Fastening to line posts shall be with tie wire, metal bands, or other approved method attached at 14

inch intervals. The top and bottom edge of the fabric shall be fastened with the wires spaced at 24-inch intervals to the top rail, or top and bottom tension wires as may be applicable.

Rolls of wire fabric shall be joined by weaving a single strand into the ends of the rolls to form a continuous mesh.

8-12.3(2)E CHAIN LINK GATES

Chain link fabric shall be fastened to the end bars of the gate frame by stretcher bars and fabric bands and to the top and bottom bars of the gate frames by tie wires in the same manner as specified for the chain link fence fabric, or by other standard methods if approved by the Engineer.

Welded connections on gate frames where the spelter coating has been burned shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked spelter removed. The clean areas shall then be painted with two coats of galvanizing repair paint, Formula A-9-73.

The drop bar locking device for the wire gates shall be provided with a 12 inch round by 18 inch deep footing of Class C concrete, crowned at the top and provided with a hole to receive the locking bar. The depth of the penetration of the locking bar into the footing shall be as specified by the manufacturer of the locking device.

8-12.3(3) WIRE FENCE AND GATES

8-12.3(3)A POSTS

Line posts shall be spaced at intervals not to exceed 14 feet. All intervals shall be measured center to center of posts. In general, in determining the spacing of posts, measurements will be made parallel to the slope of the existing ground, and all posts shall be placed in a vertical position except where otherwise directed by the Engineer.

Line posts may be driven in place provided the method of driving does not damage the post. Steel corner, gate, and pull posts shall be set in Class C concrete footings to the dimensions shown in WSDOT Standard Plan No. L-1 and crowned at the top to shed water.

Class C concrete footings shall be constructed to embed the lower part of steel line posts, and wood anchors shall be placed on wood posts at grade depressions wherever the tension on the line wires will tend to pull the post from the ground. The concrete footings shall be 3 feet deep by 12 inches in diameter and crowned at the top.

Where solid rock is encountered without an overburden of soil, line posts shall be set a minimum depth of 14 inches and end, corner, gate, and pull posts a minimum depth of 20 inches into the solid rock. The hole shall have a minimum dimension 1 inch greater than the largest dimension of the post section to be set. The posts shall be cut before installation to lengths which will give 4-1/2 feet of post above ground, or if the Contractor so elects, 6 foot posts set 18 inches into the solid rock may be used.

After the post is set and plumbed, the hole shall be filled with grout consisting of one part portland cement and three parts clean, well graded sand. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall be crowned to carry water away from the post. Where posts are set in the above manner, anchor plates and concrete footings will not be required.

Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set to the full depth of 2-1/2 feet unless the penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be terminated. When the depth of the overburden is greater than 12 inches, anchor plates will be required on the steel line posts, and concrete footings shall be constructed from the solid rock to the top of the ground on steel end, gate, corner, and pull posts. When the depth of overburden is 12 inches or less, anchor plates and concrete footings will not be required. Grouting will be required on the portion of the post in solid rock.

Steel braces shall be anchored to soil or loose rock with a Class C concrete footing not less than 18 inches on any one side and set in solid rock to a minimum depth of 10 inches in the same manner as specified above for posts. The braces shall be set on the diagonal as shown in the plans and connected to the post with an approved connection.

Wood braces shall be dapped 1/4 inch into the posts and shall be fastened to each post with three 20d galvanized nails.

Wire braces shall consist of a 9 gage wire passed around the wood posts to form a double wire. The wire shall be fastened to each post with two staples and fastened together to form a continuous wire. The wires shall then be twisted together until the wire is in tension.

Where the new fence joins an existing fence, the two shall be attached in a manner satisfactory to the Engineer, end or corner posts being set as necessary.

Pull posts shall be spaced not more than 1000 feet apart, but spacing shall be such as to use standard rolls of wire mesh with a minimum of cutting and waste.

Changes in alignment of 30 degrees or more shall be considered as corners, and corner posts shall be installed. Where it is deemed by the Engineer that a change in alignment of less than 30 degrees will materially lessen the strength of the fence, the line post at the angle shall be supported by the addition of braces or wires in a manner satisfactory to the Engineer.

8-12.3(3)B BARBED WIRE AND WIRE MESH

After the pull posts have been placed and securely braced, the barbed wire and mesh shall be pulled taut to the satisfaction of the Engineer, and each longitudinal wire shall be cut and securely fastened to the pull post with devices customarily used for the purpose. Wire or mesh shall not be carried past a pull post, but shall be cut and fastened to the pull post independently for the adjacent spans.

After the tensioning of the wire or mesh between two pull posts, all longitudinal wires shall be properly fastened at proper height to each intervening line post.

Wire mesh and barbed wire shall be placed on the face of the post which is away from the highway, except that on horizontal curves, the mesh and wires shall be fastened to the face on the outside of the curve unless otherwise directed by the Engineer.

Where unusual ground depressions occur between posts, the fence shall be guyed to the ground by means of a 9 gage galvanized wire attached to a deadman of approximately 100 pounds buried 2 feet in the ground. The guy wire shall be securely attached to each strand of barbed wire and to the top and bottom wires of the wire mesh fabric in a manner to maintain the entire fence in its normal shape. If necessary to guy the fence in solid rock, the guy wire shall be grouted in a hole 2 inches in a diameter and 10 inches deep. The operation of guying shall leave the fence snug with the ground.

8-12.3(3)C VERTICAL CINCH STAYS

Vertical cinch stays shall be installed midway between posts on both types of fence. The wire shall be twisted in such a manner as to permit weaving into the horizontal fence wires to provide rigid spacing. All barbed wires and the top, middle, and bottom wire of the wire mesh shall be woven into the stay.

8-12.3(3)D WIRE GATES

The wire mesh fabric shall be taut and securely tied to the frame and stays in accordance with recognized standard practice for wire gate construction.

Welded connections on gate frames shall be treated as specified for chain link fence gates.

The drop bar locking device for double wire gates shall be provided with a footing of Class C concrete 12 inches in diameter and 12 inches deep, crowned on top and provided with a hole to receive the locking bar. The diameter and depth of the hole in the footing shall be as specified by the manufacturer of the locking device.

8-12.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Chain link fence will be measured by the linear foot of completed fence, along the ground line, exclusive of openings.

8-12.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-12 will be made at the unit contract prices pay only for the pay items listed or referenced below:

(1) "Chain Link Fence, (Type)," per linear foot.
(2) "Chain Link Gate, Double 14 Ft. Wide," per each.
(3) "Chain Link Gate, Double 20 Ft. Wide," per each.
(4) "Chain Link Gate, Single 6 Ft. Wide," per each.
(5) "Wire Fence (Type)," per linear foot.
(6) "Wire Gate, Double, 20 Ft. Wide," per each.
(7) "Wire Gate, Single, 14 Ft. Wide," per each.

The unit contract price for "Chain Link Fence, (Type)" and "Wire Fence, (Type)" shall include all costs for the work required to furnish and install a complete fence including concrete footings, excavation, backfill and compaction.

The unit contract price for chain link gate and wire gate of the type specified shall include all costs for the work required to furnish and install a complete gate including concrete footings, excavation, backfill and compaction.

When there is no clearing and grubbing item included on the Bid Form, the work required to clear and grub the area around the proposed fence shall be included in the unit contract price for the fence or gate.

SECTION 8-13 MONUMENT CASES

8-13.1 DESCRIPTION

This work consists of furnishing and setting survey monument frame and cover castings, and removing and resetting monument castings which may be covered over, damaged, or otherwise rendered useless due to construction activities.

8-13.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Monument Frame and Covers	9-22

8-13.3 CONSTRUCTION REQUIREMENTS

8-13.3(1) REFERENCE POINTS

The Engineer will reference all monuments in advance of construction and will reset the points and grades at the proper time.

It shall be the responsibility of the Contractor to furnish materials and install required castings in accordance with the Drawings as and where directed by the Engineer. The Contractor shall carefully protect all reference points to the monuments and he shall give the Engineer reasonable notice of the schedule for monument work in order to avoid destruction of the points.

The monument will be furnished and set by the Engineer.

8-13.3(2) FURNISH AND PLACE MONUMENT CASTINGS

Where indicated on the Drawings or where designated by the Engineer, the Contractor shall furnish and install Type 020 monument frames and covers to the lines and grades established by the Engineer.

8-13.3(3) ADJUST EXISTING MONUMENT CASTINGS TO GRADE

Existing monument castings shall be adjusted to grades in accordance with Section 7-20.3(1).

8-13.3(4) RESET OR RELOCATE MONUMENT CASTINGS

When monument castings are required to be relocated or removed and reset, the Contractor shall give the Engineer a minimum notice of 2 working days to allow time for the Engineer to establish offset reference points.

The Contractor shall remove monument castings as required during construction and shall store the castings in a safe place.

Monument castings designed for removal and not reused on the project, shall be carefully removed and salvaged in accordance with Section 2-02.3(7)A.

The Contractor shall give the Engineer a minimum notice of 2 working days before resetting monument castings to allow time for the Engineer to set reference points for locating monument castings.

The monument castings shall be reset by the Contractor in the location designated by the Engineer and at the grade of the street.

The Contractor shall replace lost or damaged castings with new castings.

8-13.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

8-13.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-13 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Monument Frame and Cover," per each.
(2) "Reset Monument Frame and Cover," per each.
(3) "Relocate Monument Frame and Cover," per each.

The unit contract price for "Monument Frame and Cover" shall include all costs for the work required to furnish and set the monument castings.

The unit contract price for "Reset Monument Frame and Cover" shall include all costs for the work required to remove, store, and reset the monument castings.

The unit contract price for "Relocate Monument Frame and Cover" shall include all costs for the work required to remove, store and reset the monument casting in a new location.

Lost or damaged castings resulting from the Contractor's operations as specified in Section 8-13.3(4) shall be replaced with a new Type 020 casting at the Contractor's own expense.

SECTION 8-14 CEMENT CONCRETE SIDEWALKS

8-14.1 DESCRIPTION

This work shall consist of constructing cement concrete sidewalks, thickened edge for sidewalk, monolithic curb and sidewalk, curb ramps, and bus shelter pads, including excavation for the depth of the sidewalk and subgrade preparation, in accordance with these Specifications and as shown on the Drawings and Standard Plan No's. 420 through 423, or as designated by the Engineer.

8-14.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Cement Concrete Class 5(3/4)	5-05
Portland Cement	9-01
Aggregates	9-03
Premolded Joint Filler	9-04
Concrete Curing Materials and Admixtures	9-23

Slump of the concrete mix shall not exceed 3-1/2 inches.

Lamp black coloring agent for matching the color of newly constructed cement concrete sidewalks to the color of adjacent existing cement concrete sidewalks shall be added to the concrete during mixing in an amount not to exceed 1-1/2 pounds per cubic yard of concrete. No lamp black shall be used in curb ramps.

8-14.3 CONSTRUCTION REQUIREMENTS

8-14.3(1) GENERAL

The curb and gutter section shall be placed prior to the placement of the sidewalk section unless otherwise directed by the Engineer.

8-14.3(2) EXCAVATION AND SUBGRADE

Excavation for sidewalks shall be as described in Section 2-03. Where designated by the Engineer, unsuitable material in the subgrade shall be removed to a specific depth and then backfilled with selected native materials.

It is expected there will be sufficient suitable native material excavated from various portions of the improvement to fill low areas in the sidewalk subgrade and planting strip area when needed and no further payment will be allowed for fill material. Where there is insufficient suitable native material on the project site, the Contractor shall furnish, place and compact Mineral Aggregate, Type l0, pit run sand as required.

Embankments shall be compacted by Method B as specified in Section 2-03.3(14)D. In areas that are inaccessible to normal compaction equipment, approved tampers shall be used.

Before the forms are set, the subgrade shall be graded to within 1 inch of established grade and the area between the sidewalk and the adjacent private property line shall be shaped to line, grade, and section shown on the Drawings.

If the Drawings call for sidewalk drains or the Engineer directs sidewalk drains to be installed, they will be installed before forms are placed. Sidewalk drains shall be installed according to Section 7-01 and Standard Plan No. 281.

8-14.3(3) FORMS AND FINE GRADING

Forms shall conform to requirements specified in Section 5-05. Wood forms shall be 2" x 4" (nominal) in lengths of not less than 10 feet. Steel forms may be used upon approval of the Engineer. Forms shall be staked to a true line and grade. A subgrade template shall then be set upon the forms and the fine grading completed so that the subgrade will be a minimum of 3-5/8 inches below the top of the forms.

Low areas in the subgrade shall be backfilled with select materials or with suitable native material as directed by the Engineer. The backfill shall then be compacted to the satisfaction of the Engineer and any high areas in the subgrade shall be cut down to meet the subgrade requirements specified above. The subgrade shall be thoroughly dampened prior to the time the concrete is placed.

Forms shall be provided around all street name sign posts and traffic sign posts that are placed in concrete areas. Forms used for this purpose shall be 1 foot square or 1 foot minimum diameter cutout, as approved by the Engineer.

Forms for the curb section of the monolithic curb and sidewalk shall be as specified in Section 8-04.3(1)A.

8-14.3(4) PLACING AND FINISHING CONCRETE

The concrete shall be spread uniformly between the forms and thoroughly compacted with a steel shod strikeboard. Through joints and dummy joints shall be located and constructed in accordance with the Standard Plans. In construction of through joints, the premolded joint filler shall be adequately supported until the concrete is placed on both sides of the joint.

Whenever castings are located in the sidewalk area, joints shall be installed at the casting location to control cracking of the sidewalk. If spacing of joints or scoring is such that installation of joint material would be unsuitable the Contractor shall install rebar to strengthen the sidewalk section as required by Section 5-06 for castings in the pavement area.

Dummy joints shall be formed by first cutting a groove in the concrete with a tee bar of a depth equal to, but not greater than the joint filler material, and then working the premolded joint filler into the groove. Premolded joint filler for both through and dummy joints shall be positioned in true alignment at right angles to the line of the sidewalk and be normal to and flush with the surface. Where the sidewalk will be contiguous with the curb, it shall be constructed with a thickened edge as shown on Standard Plan No. 420.

After the concrete has been throughly compacted and leveled, it shall be floated with wood floats and finished at the proper time with a metal float. Joints shall be edged with a 1/4 inch radius edger and the sidewalk edges shall be tooled with a 1/2 inch radius edger.

Depending on the type, the sidewalk shall be divided into panels by scoring 1/4 inch deep in the manner indicated on Standard Plan No. 420 if designated by the Engineer to match existing adjacent sidewalk.

The surface shall be brushed with a fiber hair brush of an approved type in a transverse direction except that at driveway and alley crossings it shall be brushed longitudinally. The placing and finishing of all sidewalk shall be performed under the control of the Engineer, and the tools used shall meet with his approval. After brush finish, the edges of the sidewalk and all joints shall be lightly edged again with an edging tool to give it a finished appearance.

Additional requirements for placing and finishing concrete in cold weather shall be as specified in Section 5-05.3(14).

Placing concrete for the curb section of the monolithic curb and sidewalk shall be as specified in Section 8-04.3(1)B.

8-14.3(5) CURING AND PROTECTION

The curing materials and procedures specified in Section 5-05.3(13) shall prevail, except that white pigmented curing compounds shall not be used on sidewalks. The curing agent shall be applied immediately after brushing and be maintained for a period of 5 days.

The Contractor shall have readily available sufficient protective covering, such as waterproof paper or plastic membrane, to cover the pour of an entire day in event of rain or other unsuitable weather.

The sidewalk shall be protected against damage or defacement of any kind until it has been accepted by the Owner. Sidewalk which is not acceptable to the Engineer because of damage or defacement, shall be removed and replaced by the Contractor.

Additional requirements for curing in hot weather shall be as specified in Section 5-05.3(13)I. Additional requirements for curing in cold weather shall be as specified in Section 5-05.3(14).

Curing for the curb section of the monolithic curb and sidewalk shall be as specified in Section 8-04.3(1)E.

8-14.3(6) THROUGH AND CONTRACTION JOINTS

Standard locations for through joints for sidewalks are:

(a) At street margins produced and at 30-foot or 28-foot intervals.
(b) To separate concrete driveways, stairways, curb ramps and their landings from sidewalks.
(c) Around the vertical barrel of fire hydrants, around utility poles and large diameter underground utility cover castings when located in the sidewalk area.
(d) Longitudinally between concrete walks, curbs, paved planting strips and solid masonry or concrete walls where they abut.
(e) To match as nearly as possible, the through joints in the adjacent pavement and curb when sidewalk abutts curb.

Transverse contraction joints (dummy joints) shall be constructed with premolded material 1/4 inch by 2 inches wide, and set at approximately 15-foot intervals, or as decided by the Engineer. At no time will joint spacing exceed 15 feet.

Transverse and longitudinal through joints as shown on Standard Plan No. 420 shall be 1/2 inch thickness premolded non-extruding joint material, cut to a width equal to the full depth of the concrete where located, plus 1/2 inch. When installed, they shall be placed with top edge 1/8 inch below the finished surface of the concrete, in a perpendicular plane to the surface and with the bottom edge embedded in the subgrades. All joints shall be in straight alignment, except where placed in curved locations as required by the Drawings.

Construction joints for sidewalks shall conform to the applicable requirements for through joints for pavement except for thickness of joint material being 3/16 inch and width of 2 inches. The top edge shall be 1/8 inch below the finished surface of the sidewalk. At no time will joint spacing exceed 15 feet.

8-14.3(7) CURB RAMP, TYPE 1

Curb Ramp, Type 1 shall be installed at locations where the Drawings call for installation of curb ramps along with new sidewalk installed as a part of the same contract.

Curb ramp locations will be designated on the Drawings or marked in the field by the Engineer. Where curb ramps are to be constructed, the Contractor shall construct monolithic depressed curb and sidewalk as indicated on Standard Plan No. 422a. Curb ramps shall be constructed separately from the sidewalk to produce a definite break line between the ramp and the sidewalk. A 3/8 inch non-extruded through joint material shall be installed between the curb ramp and the sidewalk with edging as specified in Section 8-14.3(6).

The triangular shaped sidewing areas shall be brush finished with brushing parallel to the curb face. The adjacent sidewalk "V" groove scoring pattern shall not extend into the curb ramp sidewing areas. The inclined plane of the ramp shall have a coarse textured surface similar to the impression which is obtained through the use of a 3/4 inch x 9-ll flattened expanded metal mesh screen pressed into the fresh concrete. A sample of the screen material may be seen at the Construction Office, 600 Municipal Building. The long axis of the diamond shaped impression shall be perpendicular to the curb line.

Where possible, the back terminus of the ramp shall coincide with the street-side edge of the sidewalk or a line projected therefrom. The subgrade for curb ramps shall be graded, compacted and formed to provide a minimum concrete depth of 6 inches adjacent to the curb and tapering to a minimum depth of 3-5/8 inches at the back terminus.

Concrete for curb ramps shall not be colored, overlayed or topped. Curb ramps shall be considered as beginning at a point flush with the pavement and terminating at a point flush with the sidewalk or sidewalk landing. The sloping triangular shaped sidewings are considered part of the curb ramp.

8-14.3(8) CURB RAMP, TYPE 2

Curb Ramp, Type 2 shall be installed at locations where the Drawings require removal of existing improvements, and where no new sidewalk is required by the Contract Documents immediately adjacent to the new curb ramp.

Curb Ramp, Type 2 shall consist of the following:

(a) Saw cutting existing concrete sidewalk and curb required for curb ramp installation.
(b) Removal and disposal of all sidewalk, asphalt, sod, etc., plus required excavation in the area of the curb ramp.
(c) Removal and disposal of all curb, including pavement under the curb, from the area of the curb ramp.
(d) Removal and disposal of all pavement and asphalt overlay from the face of the curb to the cut line used to remove the curb.
(e) Installation of the curb ramp as described in Section 8-14.3(7).
(f) Replacement of all removed pavement to match existing.

8-14.3(9) BUS SHELTER PAD

The Contractor shall construct a bus shelter pad according to the details shown on Standard Plan No. 423 or as detailed on the Drawings. Prior to construction, the Contractor shall notify METRO so that the installation of the bus shelter by METRO forces shall be coordinated effectively.

8-14.3(10) DOWELS

Dowels for monolithic curb and sidewalk, when specified in the Project Manual or directed by the Engineer, shall be as defined in Section 8-04.3(1)C and as shown on the Standard Plans.

8-14.3(11) STRIPPING FORMS AND FINISHING

Stripping forms and finishing for the curb section of the monolithic curb and sidewalk shall be as specified in Section 8-04.3(1)D.

8-14.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Sidewalk, Cement Concrete" will be by the square yard for the surface of concrete walk placed. Deductions will be made for blocked out areas, castings, or other discontinuities in the sidewalk 9 square feet or larger.

Measurement for "Sidewalk, Thickened Edge" will be by the linear foot along the face of the thickened edge for the length constructed. Measurement for payment of thickened edge will not be made through curb ramps or driveways.

Measurement for mineral aggregate of the type specified to be used as fill for sidewalk subgrade will be by the ton as recorded on certified weight tickets per Section 1-09.1.

Measurement for monolithic curb and sidewalk shall be considered as three component sections as follows:

(a) The first component, "Sidewalk, Cement Concrete" shall comprise that portion of the combined section beginning 6 inches behind face of curb and shall be the actual square yards of sidewalk constructed.
(b) The second component, "Curb, Cement Concrete" shall comprise that portion of the combined section beginning at back of curb and extending to the face of the curb, and shall be the actual linear feet of curb constructed, as measured along the front curb face.
(c) The third component, "Sidewalk, Thickened Edge" shall comprise the triangular cross-section portion of the combined section below the bottom of sidewalk and butting the back of the curb section. The thickened edge shall be the actual linear feet of thickened edge constructed, as measured along the face of the thickened edge.

8-14.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-14 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Sidewalk, Cement Concrete," per square yard.
(2) "Sidewalk, Thickened Edge," per linear foot.
(3) "Curb Ramp, Cement Concrete, (Type)," per each.
(4) "Bus Shelter Pad," per square yard.

The unit contract price for "Sidewalk, Cement Concrete" shall include all costs for the work required to construct the sidewalk as specified including the earth work required to excavate material from the top surface of the sidewalk to the sidewalk subgrade, subgrade preparation, and furnishing and installing dowel bars where required.

Payment for the volume of earth work involved in excavating material above the top surface of the sidewalk will be made in accordance with Section 2-03.

All costs for reinforcing bars constructed around castings shall be included in the unit contract price for "Sidewalk, Cement Concrete."

The unit contract price for "Sidewalk, Thickened Edge" shall include all costs for the work required to construct the thickened edge where required.

The unit contract price for "Curb Ramp, Cement Concrete, Type 1" shall include all costs for the work required to construct the curb ramp as specified including the ramp, the sidewings, joint materials, and excavation.

The unit contract price for "Curb Ramp, Cement Concrete, Type 2" shall include all costs for the work required to remove existing improvement within area of new curb ramp and to construct the curb ramp at "cut-in" locations as specified in Section 8-14.3(8).

The unit contract price for "Bus Shelter Pad" shall include all costs for the work required to construct the bus shelter pads as specified.

Payment for imported mineral aggregate of the type specified for sidewalk fill will be made per ton in accordance with Section 4-01.5.

Payment for sidewalk drains will be made in accordance with Section 7-01.5.

Payment for monolithic curb and sidewalk or monolithic curb, gutter and sidewalk will be made for the individual bid items as described in Section 8-14.4.

Payment for relocations of signs will be made in accordance with Section 8-21.5.

SECTION 8-15 RIPRAP

8-15.1 DESCRIPTION

This work shall consist of furnishing and placing riprap protection of the type specified at the locations and in conformity with the lines and dimensions shown in the Drawings or established by the Engineer.

Riprap will be classified as heavy loose riprap, light loose riprap, hand placed riprap, sack riprap, and concrete slab riprap.

8-15.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Filter Blanket	9-03
Gravel Backfill for Drains	9-03
Heavy Loose Riprap	9-13
Light Loose Riprap	9-13
Hand Placed Riprap	9-13
Sack Riprap	9-13
Slab Riprap	9-13
Quarry Spalls	9-13

Filter blanket shall meet the gradation requirements for Ballast.

8-15.3 CONSTRUCTION REQUIREMENTS

8-15.3(1) EXCAVATION FOR RIPRAP

The foundation for riprap shall be excavated below probable scour or to the elevation shown in the Drawings, and no stone shall be laid or concrete placed until the footing is approved by the Engineer. Excavation below the level of the intersection of the slope to be riprapped and the adjacent original ground or the channel floor or slope shall be classified as ditch excavation in accordance with Section 2-10. Before placing riprap, the slopes shall be dressed to the lines and grades as staked by the Engineer.

8-15.3(2) LOOSE RIPRAP

Loose riprap shall be placed in such a manner that all relatively large stones shall be essentially in contact with each other, and all voids filled with the finer materials to provide a well graded compact mass. The stone shall be dumped on the slope in a manner that will ensure the riprap attains its specified thickness in one operation. When dumping or placing, care shall be used to avoid disturbing the underlying material. Placing in layers parallel to the slope will not be permitted. A 12 inch tolerance for loose riprap will be allowed from slope plane and grade line in the finished surface.

8-15.3(3) HAND PLACED RIPRAP

The stones shall be laid by hand on prepared slopes to such thickness as may be ordered by the Engineer. The riprap shall be started at the toe of the embankment by digging a trench and placing a course of the largest stones therein. Each stone shall be placed so that it shall rest on the slope of the

embankment and not wholly on the stone below, and it shall be thoroughly tamped or driven into place. The exposed face of all hand placed riprap shall be made as smooth as the shape and size of the stones will permit and shall not vary more than 3 inches from a plane surface on the required slope.

8-15.3(4) SACK RIPRAP

Sack riprap shall be deposited in the trench and on the slope of the embankment to be protected in accordance with the Drawings or as directed by the Engineer.

The concrete shall be placed in the sacks to a uniform volume leaving sufficient room for effectively tying the sacks. The sacks shall then be placed in longitudinal rows in the trench and on the slope to lie parallel with the slope. In placing the sacks on the slope, their outside faces shall be laid against a heavy timber header or screed so that each layer will be true to line and grade. The tied end of the sack shall be turned under and the sack firmly pressed into place against the header or screed. Sacks in the longitudinal rows shall be placed with the bottom of one sack adjacent to the top of the next sack. Joints shall be staggered in succeeding rows. Sack riprap shall not be placed in freezing weather, and work damaged by frost shall be removed and replaced by the Contractor.

8-15.3(5) CONCRETE SLAB RIPRAP

Concrete slab riprap shall consist of concrete placed in slabs 4 inches thick unless otherwise shown in the Drawings or directed by the Engineer.

A trench of the dimensions shown in the Drawings or as staked by the Engineer shall be dug at the toe of the slope. The forms shall be of the depth of the concrete to be placed.

The panel length shall be 10 feet unless otherwise shown in the Drawings, and the concrete shall be placed in alternate panels, care being taken not to injure the concrete in place when constructing the fill-in panels. Expansion joint material will not be required at the joints.

The concrete shall be placed and rodded true to the plane of the embankment and shall be finished smooth by troweling or other methods approved by the Engineer. The edges shall be tooled to a 1/2 inch radius.

The riprap shall be protected from flood waters and tides during the hardening of the concrete.

Weep holes shall be constructed every 10 feet. All material back of the riprap within 18 inches of weep holes shall be gravel backfill for drains.

8-15.3(6) QUARRY SPALLS

Quarry spalls shall be placed in ditches and on slopes to be in accordance with the Drawings or as directed by the Engineer. After placement, the quarry spalls shall be compacted by tracked equipment making a minimum of three passes.

8-15.3(7) FILTER BLANKET

When required, a filter blanket shall be placed on the prepared slope or area to the full thickness specified in the Drawings using methods which will not cause segregation of particle sizes within the bedding. The surface of the finished layer shall be even and free from mounds or windrows. Additional layers of filter material, when required, shall be placed using methods which will not cause mixing of the materials in the different layers.

8-15.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Loose riprap will be measured by the ton of riprap actually placed.

Hand placed riprap will be measured by the cubic yard of riprap actually placed.

Filter blanket will be measured by the cubic yard in the hauling conveyance at the point of delivery on the project.

Sack riprap will be measured by the cubic yard. The number of cubic yards of sack riprap placed shall be computed from the number of sacks of cement actually used in the concrete mix and the yield per batch of concrete as determined by the Engineer from actual predetermined measurement.

Concrete slab riprap will be measured by the cubic yard based on the dimensions of the slabs placed and accepted.

Quarry spalls will be measured by the ton of spalls actually placed.

8-15.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-15 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Heavy Loose Riprap," per ton.
(2) "Light Loose Riprap," per ton.
(3) "Hand Placed Riprap," per cubic yard.
(4) "Sack Riprap," per cubic yard.
(5) "Concrete Slab Riprap," per cubic yard.
(6) "Quarry Spalls," per ton.
(7) "Filter Blanket", per cubic yard.

The unit contract price for "Heavy Loose Riprap," "Light Loose Riprap," "Hand Placed Riprap," "Sack Riprap," and "Concrete Slab Riprap" shall include all costs for the work required to furnish and install the riprap of the type specified including all excavation and backfill above the level of the intersection of the slope to be riprapped and the adjacent original ground or the channel floor or channel slope as specified in Section 8-15.3(1). When it is necessary to dump and sort individual loads, payment will be made only for that portion accepted by the Engineer.

All costs in connection with constructing the weep holes and all costs in connection with excavation for and backfilling with gravel backfill for drains, as specified in Section 8-15.3(5), shall be included in the unit contract price for "Concrete Slab Riprap".

The unit price for "Quarry Spalls" shall include all costs for the work required as specified in Section 8-15.3(6).

The unit contract price for "Filter Blanket" shall include all costs for the work required as specified in Section 8-15.3(7).

Payment for ditch excavation as defined in Section 8-15.3(1) will be made in accordance with Section 2-10.5.

SECTION 8-16 CONCRETE SLOPE PROTECTION

8-16.1 DESCRIPTION

This work shall consist of constructing concrete slope protection, in accordance with these Specifications and the details shown in the Drawings, at the locations and in conformity with the lines, grades, and dimensions as staked by the Engineer.

8-16.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Concrete Class B	6-02
Concrete Slope Protection	9-13
Semi-Open Concrete Masonry Units Slope Protection	9-13
Poured Portland Cement Concrete Slope Protection	9-13
Pneumatically Placed Portland Cement Concrete Slope Protection	9-13

8-16.3 CONSTRUCTION REQUIREMENTS

8-16.3(1) FOOTING AND PREPARATION OF SLOPE

The footing for the slope protection shall be constructed in accordance with Sections 2-09 and 6-02.

The surface on which application is to be made shall be thoroughly compacted and neatly trimmed to line and grade as necessary to conform to the detail in the Drawings.

8-16.3(2) PLACING SEMI-OPEN CONCRETE MASONRY UNITS

The concrete masonry units shall be placed in a uniform plane and in such a manner that they rest firmly and evenly against the slope with no rocking. The concrete masonry units shall be placed in horizontal parallel courses, and successive courses shall break joints with the preceding course to form a running bond.

8-16.3(3) POURED IN PLACE CEMENT CONCRETE

The wire mesh shall lap a minimum of one mesh spacing, and laps shall be securely fastened at the ends. During the placement of the concrete, the reinforcement shall be held so as to provide a minimum of 1-1/4 inches of cover.

Where Class B cement concrete is to be placed upon the slope, the method of depositing and compacting shall result in a compact, dense, and impervious concrete which will show a uniform plane surface.

The newly constructed concrete shall be finished by means of a wood float and shall be striated with a rustication joint as shown in the Drawings.

Curing shall be performed in accordance with Section 5-05.3(13).

8-16.3(4) PNEUMATICALLY PLACED CONCRETE

(a) Workers: Only workers experienced in pneumatically placed concrete shall be employed; and satisfactory evidence of such experience shall be furnished when requested by the Engineer.

(b) Equipment: The Contractor shall furnish the Engineer with two copies of the manufacturer's specifications and operating instructions for the equipment used. Before placement of any portion of the slope protection, the type of equipment and method of operation shall be approved by the Engineer.

(c) Proportions of Materials: The sand/cement ratio shall be 4-1/2 parts sand to 1 part cement based on loose dry volume.

Water shall be maintained at a constant pressure which shall be at least 15 psi above atmospheric pressure at the nozzle. For lengths of hose up to 100 feet, pneumatic pressure at the gun shall be 45 psi or greater. Pressure shall be increased 5 psi for each additional 5 feet of hose required. A steady pressure shall be maintained.

(d) **Method of Application:** Portland cement and sand shall be mixed dry, passed through a cement gun and conveyed by air through a flexible tube, hydrated at a nozzle at the end of the flexible tube, and deposited in place by air pressure.

All surfaces are to be wetted, but application shall not be made on any surface on which free water exists.

(e) **Reinforcement:** The wire mesh shall lap a minimum of one mesh spacing, and laps shall be securely fastened at the ends. During the placement of the concrete, the reinforcement shall be held so as to provide a minimum of 1-3/4 inches of cover at the recess.

(f) **Finishing:** The newly constructed concrete shall be finished by means of a wood float and shall be striated with a rustication joint as shown in the Drawings.

(g) **Curing:** Curing shall be in accordance with Section 5-05.3(13).

(h) **Protection of Facilities:** During the construction, the Contractor shall protect all retaining walls, columns and structures from concrete splash or overspray. Suitable covering shall be provided if such protection is deemed necessary by the Engineer.

(i) **Test Cylinders:** Two test cylinders shall be made for each full day's operation. The Contractor shall furnish cylinders 6 inches in diameter and 12 inches high made of 3/4-inch mesh hardware cloth. The test cylinder shall be filled with concrete by utilizing the same pneumatic application described above.

The cylinders shall develop a minimum compressive strength of 3,000 psi at the age of 28 days.

8-16.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for concrete slope protection will be by the square yard and will include the actual area of the slope covered excluding the footings. The area will be computed on the basis of slope measurements.

8-16.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-16 will be made at the unit contract price bid only for the pay items listed or referenced below:

(1) "Concrete Slope Protection", per square yard.

The unit contract price for "Concrete Slope Protection" shall include all costs for the work required to construct the slope protection as specified in Section 8-16 including the work required to construct the footing.

SECTION 8-17 VACANT

SECTION 8-18 CEMENT CONCRETE STAIRWAYS, LANDINGS AND STEPS

8-18.1 DESCRIPTION

This work shall consist of constructing, on a prepared compacted subgrade, cement concrete stairways, landings, and steps, and such subsidiary work as may be necessary, including the construction of handrails, in accordance with these Specifications and in conformity with the lines, grades, and cross sections indicated on the Drawings, Standard Plan No's. 440, 441 and 442, or established by the Engineer.

8-18.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Non-structural Cement Concrete	5-05
Portland Cement	9-01
Aggregates	9-03
Joint Materials	9-04
Reinforcement	9-07
Curing Materials	9-23

The concrete mix shall be Class 6(3/4) for steps and stairways. Landings shall be Class 5 (3/4).

Galvanized steel pipe railing shall be fabricated from standard weight steel pipe meeting the requirements of ASTM Designation A 120. After fabrication the railings shall be hot-dipped galvanized per ASTM A 123.

Aluminum paint for handrails shall be Formula D-1-57 aluminum paint meeting the requirements of Section 9-08.2.

Wood for railings shall be as indicated on the Drawings.

8-18.3 CONSTRUCTION REQUIREMENTS

8-18.3(1) SITE PREPARATION AND GRADING

At locations where cement concrete stairways, landings, or steps are to be constructed the area shall be cleared, grubbed, excavated and graded in accordance with Sections 2-01 and 2-03 to the limits indicated on the Drawings or staked by the Engineer.

8-18.3(2) SUBGRADE PREPARATION AND FORMS

The necessary subgrade preparation and compaction required in the construction of cement concrete stairways, landings, and steps shall meet the requirements for pavement subgrade preparation set forth in Section 2-06.

Forms shall meet the requirements of Section 5-05.3(21) except that wood side forms shall be not less than 2 inches nominal in thickness and shall be free from warps or bends.

8-18.3(3) REINFORCING STEEL

Reinforcing steel for cement concrete stairways shall be placed as shown on Standard Plan No. 440. The steel shall be assembled and securely tied with annealed wire of not less than No. 16 gauge at each bar lap or crossing and be rigidly supported above the subgrade during the concrete placement.

8-18.3(4) HANDRAIL

Handrails shall be of welded steel pipe construction fabricated and installed as indicated on Standard Plan No's. 440 and 442 or the Drawings. Welds shall be made by certified welders and each weld shall be ground and buffed to a smooth surface. Rails shall be hot dip galvanized according to ASTM A 123-84 after fabrication. If field welds are required, they shall be coated with a zinc alloy solder to a minimum thickness of 2.0 mils per ASTM A 780.

Either the railing shall be placed completely assembled at the time when stairway concrete is placed, or recesses shall be provided in the concrete for grouting the railing posts after the concrete has been placed, finished, and cured. The installed railing shall be in true alignment, on proper grade, and with posts plumb.

8-18.3(5) PLACING CONCRETE, FINISHING AND CURING

Placing, finishing and curing shall conform to the applicable requirements in Section 5-05.3, as they would apply to cement concrete stairway construction.

Front and side edging of stair treads shall be to a radius of 1/2 inch.

Landings for stairways shall be marked as specified for concrete sidewalks in Section 8-14 except that transverse and longitudinal markings shall be modified as necessary to result in uniform size of squares in each landing. Where gutters are along the side of the stairways, the gutter portion of stairway landing shall be smooth finished without markings to conform with the stairway gutter.

8-18.3(6) GUTTER

Where Type 440 stairway is specified, or where a gutter is specified, a concrete gutter shall be constructed in accordance with the detail on Standard Plan No. 440. The gutter shall be constructed along the stairway, and adjacent to the concrete walk or landing that joins flights of stairs, connecting the stairway gutters.

8-18.3(7) STEPS

Steps shall be constructed in accordance with Standard Plan No. 441.

The largest tread run within any flight of stairs shall not exceed the smallest by more than 3/8 inch. The greatest riser height within any flight of stairs shall not exceed the smallest by more than 3/8 inch.

8-18.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Excavation for stairways, landings, and gutters will be measured by the cubic yard of common excavation in accordance with Section 2-03.

Measurement of "Steps, Cement Concrete" and "Stairway, Cement Concrete, Special" will be by the square foot of tread surface installed.

"Stairway, Cement Concrete, Type 440" will be measured by the linear foot for the horizontal distance from a point 2 feet 2 inches from the back of the top tread to a point 2 feet 2 inches from the face of the bottom riser.

Handrail of the type specified will be measured by the linear foot on the slope for the continuous length of the completed railing from the vertical centerline of the top post to the vertical centerline of the bottom post.

Concrete landings or walkways outside the stairway measurement limits will be measured as "Sidewalk, Cement Concrete" by the square yard in accordance with Section 8-14. Asphalt walks will be measured in accordance with Section 5-04.

Gutter will be measured by the linear foot on the slope for the gutter sections installed along stairways and along landings or concrete walks between stairways.

8-18.5 PAYMENT

Compensation for the costs necessary to complete the work described in Section 8-18 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Stairway, Cement Concrete, Type 440," per linear foot.
(2) "Stairway, Cement Concrete, Special," per square foot.
(3) "Handrail, (Type)," per linear foot.
(4) "Steps, Cement Concrete," per square foot.
(5) "Gutter, Cement Concrete, Type 440," per linear foot.

The unit contract price for "Stairway, Cement Concrete, Type 440" shall include all costs for the work described in Section 8-18, and not otherwise provided for separately hereinafter, necessary to construct a 5-foot wide concrete stairway in accordance with Standard Plan No. 440, including gutter.

The unit contract price for "Stairway, Cement Concrete, Special" shall include all costs for the work described in Section 8-18 and not otherwise provided for separately herein necessary to construct a stairway in accordance with Standard Plans for Type 440 Stairway, except with a width of other than 5 feet.

The unit contract price for "Handrail, (Type)" of the type specified shall include the costs for the work required to furnish, fabricate and install the handrail along the stairway or sidewalk as specified.

The unit contract price for "Steps, Cement Concrete" shall include all costs for the work required to construct concrete steps as specified.

The unit contract price for "Gutter, Cement Concrete, Type 440" shall include all costs for the work described in Section 8-18 to construct a gutter section along the edge of stairways in accordance with the cross section indicated on Standard Plans for Type 440 Stairway.

Payment for excavation required for stairways, landings, and gutter sections will be made as "Common Excavation" in accordance with Section 2-03.

Payment for concrete landings and walkways will be made as "Sidewalk, Cement Concrete" in accordance with Section 8-14.

Reinforcing steel shall be considered as incidental to the unit cost for stairway construction.

SECTION 8-19 CEMENT CONCRETE DRIVEWAY AND ALLEY RETURN

8-19.1 DESCRIPTION

This work shall consist of cement concrete driveway and alley returns constructed at the locations shown on the Drawings and where directed by the Engineer, and shall be in accordance with these Specifications and Standard Plan No's. 430 and 431.

The number of private driveways may be increased over that shown on the Drawings, if required by the Engineer. Sufficient notice of the additional installations will be given by the Engineer to enable the Contractor to schedule the private driveways along with other construction in the same general area without moving equipment back for the purpose.

The particular type of driveway or alley return to be used shall be that which is specified in the Drawings and included in the Bid Form.

Alley returns shall be constructed in all respects as specified and shown in Standard Plan No's. 430 and 431. The alley return thickness shall be 8 inches. The alley return and the curb shall be poured monolithically.

8-19.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Non-structural Cement Concrete	5-05
Portland Cement	9-01
Fire Aggregate	9-03
Coarse Aggregate	9-03
Joint Materials	9-04
Reinforcing Steel	9-07
Curing Materials and Admixtures	9-23
Water	9-25

The concrete mix shall be as specified for Class 6(1+), or Class 6(3/4) and the slump of the concrete shall not exceed 3+ inches.

8-19.3 CONSTRUCTION REQUIREMENTS

8-19.3(1) EXCAVATION AND SUBGRADE

Where directed by the Engineer, unsuitable material in the subgrade shall be removed to a specific depth and backfilled with select materials which shall be compacted by Method B, as specified in Section 2-03.3(14)D.

Subgrade preparation for driveways and the required compaction shall conform to the applicable requirements in Section 2-06.3(2) to provide a firm, unyielding subgrade, acceptable to the Engineer.

8-19.3(2) FORMS AND FINE GRADING

Forms for the straight sections of the driveway or alley return shall have a minimum thickness of 2 inches and be equal to the nominal depth of the concrete. Plywood or 1 inch lumber may be used on radii. All forms shall be securely staked and blocked to true line and grade.

A template shall be set upon the forms and the subgrade shall be fine graded to conform to the required section. The subgrade shall then be compacted to the approval of the Engineer. Prior to placement of the concrete, the subgrade shall be thoroughly dampened.

8-19.3(3) PLACING AND FINISHING CEMENT CONCRETE DRIVEWAY

The concrete shall be spread uniformly between the forms and thoroughly compacted with an approved type of strikeboard. Through joints and contraction joints shall be located and constructed in accordance with the Standard Plans. In the construction of through joints, the premolded joint filler shall be adequately supported until the concrete is placed on both sides of the joint.

Contraction joints (dummy joints) shall be formed with a tee bar by first cutting a groove in the concrete to a depth equal to, but not greater than the joint filler material and then working the premolded joint filler into the groove. Premolded joint filler for both through and dummy joints shall be positioned in true alignment and at right angles to the center line of the driveway or alley return.

After the concrete has been thoroughly compacted and leveled, it shall be floated with wood floats and finished at the proper time with a metal float. Joints shall be edged with 1/4 inch radius edger and the driveway or alley return edges shall be tooled with 1/2 inch radius edger.

The surface shall be brushed in a transverse direction in relation to the center line of the driveway or alley return with a fiber hair brush of approved type.

Driveways and alley returns shall not be constructed at the same time the pavement is placed unless authorized by the Engineer.

8-19.3(4) CURING AND PROTECTION

The curing materials and procedures specified in Sections 5-05 and 9-23 shall be used. The driveway and the alley return shall be protected against damage or defacement of any kind until acceptance by the Owner. Any driveway or alley return not acceptable, in the opinion of the Engineer because of damage or defacement, shall be removed and be replaced by the Contractor.

Before placing any concrete, the Contractor shall have on the job site enough protective paper to cover the pour of an entire day, in event of rain or other unsuitable weather conditions.

8-19.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for cement concrete driveway and alley return will be by the square yard for the class and thickness of driveway actually placed, measured from the back of the curb to the back of the sidewalk.

8-19.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-19 will be made at the unit contract prices bid only for the pay item listed or referenced below:

(1) "Driveway, Cement Concrete, (Thickness)," per square yard.
(2) "Driveway, Cement Concrete, HES, (Thickness)," per square yard.

The unit contract price for "Driveway, Cement Concrete, (Thickness)" and "Driveway, Cement Concrete, HES, (Thickness)" shall include all costs for the work required to construct the driveway as specified, including excavation and subgrade preparation.

Payment for alley return will be made as "Driveway, Cement Concrete, (Thickness)."

Payment for excavation below the prepared subgrade and additional selected materials will be made as "Common Excavation" in accordance with Section 2-03.5 and "Mineral Aggregate, (Type)" specified for ballast in accordance with Section 4-01.5. However, payment will not be allowed for over excavation nor for the additional material required below the set grade resulting from negligence of the Contractor.

SECTION 8-20 VACANT

SECTION 8-21 PERMANENT SIGNING

8-21.1 DESCRIPTION

This work shall consist of furnishing and installing new traffic signs and posts, street designation signs, installing City furnished street name signs, and bus zone signs, relocating existing traffic signs, street name signs, and posts in accordance with the Drawings, these Specifications, Standard Plan No's. 601b through 626, and as designated by the Engineer.

8-21.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Signing Materials	9-28

8-21.3 CONSTRUCTION REQUIREMENTS

8-21.3(1) SIGN INSTALLATION

8-21.3(1)A TRAFFIC SIGN

The multiple panel signs and sign structures shall be installed in accordance with the Drawings, the Standard Plans, and signing details included in the appendix of the Project Manual.

The sign shall be mounted level and face in the direction indicated on the Drawings or designated by the Engineer.

When mounting a sign on a wood post or wood pole, 5/16-inch x 3-1/4-inch galvanized or cadmium plated lagscrews shall be used, with 1/8-inch thick x one-inch O.D. nylon washers.

When mounting a sign on a steel pole 0.1793 inch or thicker, the "drill & tap" method or rivnuts shall be used, with 5/16-inch stainless steel bolts and 1/8-inch thick x 1-inch O.D. nylon washers. For a steel pole less than 0.1793 inch, 5/16-inch stainless steel rivnuts shall be used. On an aluminum pole, 5/16-inch bolts and aluminum rivnuts shall be used. Stainless steel sign banding shall not be used, unless approved by the Engineer.

Field repair of galvanized surfaces of drill holes shall be by galvanized repair paint meeting the requirements of Federal Specification MIL-P-21035 (Ships) paint, high zinc dust content, galvanizing repair.

When mounting a 9-inch x 12-inch or larger sign on a parking meter post, the Contractor shall use 1/4-inch x 3-1/2-inch galvanized bolts and nuts, and 1-inch O.D. nylon washers. A smaller sign on a parking meter post shall be mounted with 1/4-inch x 3/4-inch galvanized self-tapping screws with 1-inch O.D. nylon washers.

Signs mounted on span wire or mast arms shall be mounted as indicated on the Drawings and traffic signing details shown in Standard Plan No's. 601b and 612. Sag in the span shall be maintained between 5 percent and 8 percent. Clearance between the bottom of the sign and the roadway centerline shall be maintained at 17 feet. Use standard signal mounting hardwares & span wire assemblies, in accordance with Section 8-31. For mast arm mounting use aluminum C3X2.1 by "Drill & Tap" method.

8-21.3(1)B STREET NAME, STREET DESIGNATION, AND BUS ZONE SIGNS

Street name, street designation, and bus zone signs shall be mounted as indicated on the traffic signing details shown in the Standard Plans and in the appendix of the Project Manual.

8-21.3(2) SIGN POST INSTALLATION

Wood sign post holes shall be of sufficient dimensions to allow placement and compaction of backfill material completely around the posts. Selected backfill material shall be placed and compacted to meet the requirements of Section 2-03. The area disturbed during wood sign post installation shall be surfaced to match the surrounding surfaces. Where wood sign post is to be installed in existing paved concrete areas, a neat 12-inch x 12-inch cut-out shall be provided by saw cutting, or an 8-inch diameter hole shall be provided by core drilling.

Where new sidewalks or paved planting areas are to be constructed, the Contractor shall provide blockouts for installation of street name sign and traffic sign posts. Location of the sign posts shall be as specified on the Drawings or where designated by the Engineer. Blockout shall be 12-inch x 12-inch or 12-inch diameter, with a depth to match proposed paving.

After the post is installed, the cutout or blockout shall be capped with 3/4 inch to 1-1/2 inch material similar to the surrounding paved surface, with a crown of 3/4 inch to shed water away from the post. See Standard Plan No's. 620, 621 and 624 for details.

When required, parking meter posts shall be installed as indicated in the traffic signing details on the Drawings or in the Appendix of the Project Manual.

When required, street name sign and bus zone sign posts shall be installed in an 8-inch diameter post hole with Class 5 concrete base, as indicated in Standard Plan No's. 620 and 621.

8-21.3(3) SIGN COVERING

As indicated on the Drawings or when designated by the Engineer, the Contractor shall cover certain signs and uncover to facilitate and control the operation of the project. The covering shall be of sufficient size to entirely cover the sign unless otherwise designated by the Engineer, and shall extend over the edges of the sign and be fastened on the back. Adhesive tape shall not be used on the face of the sign. Other methods of covering may be used if approved by the Engineer.

8-21.3(4) SIGN RELOCATION

As indicated on the Drawings or designated by the Engineer, the existing sign and sign post shall be relocated to the new location. If temporary stockpiling of existing signs and posts is necessary prior to resetting, stockpiled signs and posts shall be protected from loss or damage. Removal of signs and posts required for sign relocation shall be in accordance with Section 2-02.

When existing street name post or bus zone post are to be relocated, all old concrete caps and bases shall be removed from the base of these posts.

Reinstallation of existing signs and posts required for sign relocation shall be in accordance with the requirements for new installation. A new sign post shall be installed where indicated on the Drawings or designated by the Engineer.

8-21.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Sign, Traffic" will be by the square foot of sign.

Measurement for "Sign, Street Name, (City Furnished), Street Name Post Mounted" will be by each. One unit of measurement will consist of all street name sign blades together with all block number plates for mounted on street name sign post.

Measurement for "Sign, Street Name, (City Furnished), Steel/Aluminum Pole Mounted" will be by each. One unit of measurement will consist of 2 street name sign blades together with 2 block number plates mounted on steel or aluminum pole.

Measurement for "Sign Covering" will be by the square foot of sign covered.

8-21.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-21 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Sign, Traffic," per square foot.
(2) "Sign, Street Designation," per each.
(3) "Sign, Street Name (City Furnished), Street Name Post Mounted," per each.
(4) "Sign, Street Name (City Furnished), Steel/Aluminum Pole Mounted," per each.
(5) "Sign, Bus Zone (City Furnished)," per each.
(6) "Post, Traffic Sign," per each.
(7) "Post, Parking Meter," per each.
(8) "Post, Street Name," per each.
(9) "Post, Bus Zone," per each.
(10) "Relocate Sign, Traffic," per each.
(11) "Relocate Sign, Street Name," per each.
(12) "Relocate Sign, Bus Zone," per each.
(13) "Sign Covering," per square foot.

The unit contract price for "Sign, Traffic" and "Sign, Street Designation" shall include all costs for the work required to furnish the sign and mounting hardware and mount the signs as specified.

The unit contract price for "Sign, Street Name (City Furnished), Street Name Post Mounted" shall include all costs for the work required to mount one unit of City furnished street name sign blades and block number plates. The City will furnish the sign mounting hardwares.

The unit contract price for "Sign, Street Name (City Furnished), Steel/Aluminum Pole Mounted" shall include all costs for the work required to mount one unit of City furnished street name sign blades and block number plates. The Contractor shall furnish the mounting hardwares as shown on Standard Plan No's. 622 and 623.

The unit contract price for "Sign, Bus Zone (City Furnished)", shall include all costs for the work required to mount the City furnished bus zone sign including the mounting hardware.

The unit contract price for "Post, Traffic Sign," "Post, Parking Meter," "Post, Street Name," and "Post, Bus Zone" shall include all costs for the work required to furnish and install the post as specified including foundation, select backfill and surface restoration.

The unit contract price for "Relocate Sign, Traffic," "Relocate Sign, Street Name," and "Relocate Sign, Bus Zone" shall include all costs for the work required to remove and relocate the traffic sign, street name sign or bus zone sign including posts as specified. If a new post is installed on the new location, the post will be paid for separately.

When relocating street name signs to a newly installed street name sign post, the relocation cost shall be incidental to the cost of installing the post. The unit contract price for "Post, Street Name" shall include all costs for installing City furnished street name sign as specified.

Where Drawing calls for relocating street name sign to an existing Steel or Aluminum Pole, the Contractor will be paid for relocating the street name signs under bid item "Relocate Sign, Street Name." This shall include removal of street name signs, mounting on the pole, and furnishing and installing mounting brackets and hardware in accordance with the Standard Plans.

The unit contract price for "Sign Covering" shall include all costs for the work required to furnish and install the covering material as specified. Removal of sign covering shall be considered incidental to the unit price bid for sign covering. Covering any signs for the convenience of Contractor's activities prior to new channelization shall be at the Contractor's expense.

Unless the Bid Form includes specific traffic control pay items for the work specified in Section 1-07.23, all costs for the erection and maintenance of temporary warning, and detour signs necessary to protect and safeguard the public from injury or damage shall be the responsibility of the Contractor, and shall be considered incidental to the construction and no separate payment will be made.

SECTION 8-22 PAVEMENT MARKING

8-22.1 DESCRIPTION

8-22.1(1) GENERAL

This work shall consist of furnishing and installing pavement markings upon the roadway surface at locations shown in the Drawings, or where designated by the Engineer, in accordance with these Specifications and Standard Plan

No's. 710, 711, 712, 720a&b and 721. Pavement markings shall be for channelization, warnings, instructions, or curb usages.

8-22.1(2) PAVEMENT MARKING DESIGNATIONS

Pavement markings are defined as follows:

ITEM DESIGNATION	DESCRIPTION	USAGE
I. PAINT		
L-1	Two parallel solid 4-inch yellow stripes with 4-inch space between stripes	Double center line (Major arterials)
L-2	Solid 4-inch yellow stripe	Median line
L-3	Dashed 4-inch yellow stripe (10 feet paint with 20 feet skip)	Center line (Minor arterials)
L-4	Solid 4-inch yellow stripe with parallel dashed 4-inch yellow stripe (10 feet paint with 20 feet skip) with 4-inch space between the two paint stripes	One side of two-way left turn lane
L-5	Dashed 4-inch white stripe (10 feet paint with 20 feet skip)	Lane line
L-6	4-inch white stripe	Approach line, edge line, guide line
L-7	4-inch white stripe	Parking stall line
L-8	8-inch white stripe	Barrier line, crosswalk and crosshatch
L-8A	16-inch white stripe	Stop bar
L-8B	24-inch white stripe	Stop bar
L-10	6-inch white curb stripe	Various zones
L-11	6-inch red curb stripe	Tow-away zone
L-12	6-inch yellow curb stripe	Various zones
L-13	6-inch combination curb stripe (3 feet red - 4 feet yellow - 3 feet red)	Bus zone
L-17	Left and right arrow combination	
L-18	Oblique left arrow	
L-19	Oblique right arrow	
L-20	Left arrow	
L-21	Right arrow	
L-22	Through arrow	
L-23	Left and through arrow combination	
L-24	Right and through arrow combination	
L-25	"ONLY" legend	
L-26	"OK" legend	
L-27	Pedestrian symbol	
L-28	Bicyclist symbol (include arrows)	
L-29	Disabled person symbol	
L-30	"Bus" legend	
L-31	"Lane" legend	
L-32	"Carpool" legend	
L-33	Diamond symbol	
L-35	"School" legend	
II. THERMOPLASTIC (DENOTED BY "T" SUFFIX)		
L-8T	8-inch white stripe Crosswalk	
L-8AT	16-inch white stripe	Stop bar (Stop sign)
L-8BT	24-inch white stripe	Stop bar (Signal)
L-17T	Left and right arrow combination	
L-18T	Oblique left arrow	
L-19T	Oblique right arrow	
L-20T	Left arrow	
L-21T	Right arrow	
L-22T	Through arrow	
L-23T	Left and through arrow combination	
L-24T	Right and through arrow combination	
L-25T	"ONLY" legend	
L-26T	"OK" legend	
L-27T	Pedestrian symbol	
L-28T	Bicyclist symbol (include arrows)	
L-29T	Disabled person symbol	
L-30T	"Bus" legend	
L-31T	"Lane" legend	
L-32T	"Carpool" legend	
L-33T	Diamond symbol	
L-35T	"School" legend	
III. PRESSURE SENSITIVE TAPE (DENOTED BY "S" SUFFIX)		
L-10S	4-inch white curb tape	Various zones
L-11S	4-inch red curb tape	Tow-away zone
L-12S	4-inch yellow curb tape	Various zones
L-13S	4-inch combination curb tape (3 feet red - 4 feet yellow - 3 feet red)	Bus zone
L-14S	4-inch white tape	Parking meter stall, motorcycle stall, barrier area

8-22.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Pavement Marking Materials 9-29

8-22.3 CONSTRUCTION REQUIREMENTS

8-22.3(1) PRELIMINARY SPOTTING

The Engineer will provide the preliminary layout for permanent pavement marking alignment following paving operations by the Contractor. Preliminary layout will consist of providing the Contractor with necessary control points, at intervals agreed upon with the Contractor, which will enable the Contractor to complete the preliminary spotting of the pavement marking alignment before painting begins. Control points for crosswalks will be marked near or adjacent to the curb. Control points for stop lines will be marked near or adjacent to the curb and at the center line. Control points for legend and symbols shall be the responsibility of the Contractor. Legend and symbols shall be located in accordance with Standard Plan No's. 720 through 722, Drawings, or as designated by the Engineer. Approval by the Engineer shall be obtained before installation begins. Preliminary spotting to guide the striping machine is required for all longitudinal lines except where a clearly visible separation is present.

Permanent pavement markings such as crosswalks, stop lines, center lines, legends and lane stripes shall be installed by the Contractor within 5 days, weather permitting, after preliminary layout of the control points has been completed by the Engineer. Temporary pavement marking tape for centerline or lane lines or other pavement markings, if required by the Engineer, shall be installed in accordance with Section 5-04.3(17). Temporary pavement marking tape shall meet the requirements of Section 9-29.4.

8-22.3(2) PREPARATION OF SURFACES

Surface dirt and all contaminants within the areas to receive pavement markings shall be removed. Large areas of tar, grease or foreign materials may require sandblasting, steam cleaning, power brooming, or chemical stripping to accomplish complete removal. Grass obstructing curb painting shall be trimmed to the back edge of the curb and the curbs cleaned of foreign material before painting.

Existing pavement markings shall be completely removed. Cleaning and removal methods used shall not damage the pavement surface to a depth or width greater than that required to provide adequate bond between the pavement and the pavement marking material. The pavement surface shall be approved by the Engineer before application of the markings.

8-22.3(3) PAINTED PAVEMENT MARKING

8-22.3(3)A GENERAL

Equipment used in the application of the pavement markings shall be designed and operated to produce painted pavement markings of uniform quality meeting the requirements specified.

Traffic paint shall be applied at a rate of not more than 100 square feet per gallon (approximately 15 mils wet thickness). This rate is effectively 16 gallons of paint per mile of SOLID 4-inch wide line, which will be the basis for the measurement of yield. A tolerance not to exceed minus 10 percent will be allowed for film thickness or yield in paint application.

On "ladder type" crosswalks, pedestrian and bicyclist symbols (including arrows), white sharp sand shall be spread over fresh paint at a rate of approximately 1 pound per 20 square feet.

8-22.3(3)B TOLERANCES FOR STRIPES

The allowable tolerances for line striping are as follows:

(a) Length of Stripe: The longitudinal accumulative error within a 30-foot length of lane line shall not exceed plus or minus 4 inches.

(b) Width of Stripe: The width of stripe shall not vary more than plus or minus 1/4 inch.

(c) Lane Width: The lane width, which is defined as the lateral width from the edge of pavement to the center of the lane line or between the centers of parallel and successive lane lines, shall not vary from the widths shown in the Drawings by more than plus or minus 4 inches.

8-22.3(4) THERMOPLASTIC PAVEMENT MARKING

8-22.3(4)A TYPE "A" INSTALLATION

The thermoplastic pavement marking shall be applied to an initially dry pavement surface after sufficient time has elapsed to insure that the primer, if required, has adequately dried and further curing of the primer will not adversely affect the thermoplastic material.

Thermoplastic material shall be applied in accordance with the manufacturer's recommended temperature ranges for ambient air temperature, pavement temperature, and temperature of the molten material.

Hot-laid thermoplastic material shall be applied to the pavement by a gravity or an extrusion method, or a combination of both. If the stripe width is obtained by more than one application, the adjacent applications shall be fused together with no apparent overlap or gap.

Glass beads shall be applied separately to the thermoplastic material as it is being placed. The glass beads shall be uniformly distributed over the entire width of thermoplastic material so that objectionable irregularities in the material's reflectorization will not be present. This independent application of beads shall be applied uniformly at the rate of 1 pound for every 50 square feet of pavement marking. The dispenser shall be located behind and controlled simultaneously with the pavement marking extrusion die such that the beads will be imbedded in the pavement marking to a depth of at least 1/2 the bead diameter.

8-22.3(4)B TYPE "B" INSTALLATION

Type "B" prefabricated thermoplastic material shall be applied to the pavement in a manner which will provide a uniform surface over the various widths required. At application, the ambient air temperature shall be within the range recommended by the manufacturer.

Type "B" thermoplastic material may be supplied complete with a precoated, factory applied adhesive or it may be furnished with separate adhesive as recommended by the manufacturer. Whether precoated or supplied separately, the adhesive shall be such as to allow the thermoplastic material to be repositioned on the pavement surface before permanently fixing it in its final position with a downward pressure.

When completed, the pavement markings shall not be less than 0.06 inches (1.5 millimeters) in thickness, exclusive of any precoated adhesive material, and shall have a uniform cross-sectional configuration.

If the required pavement marking width is 12 inches or more, it may be fabricated from 12-inch or 6-inch wide material. Longitudinal splices will be permitted, provided the gap at any splice does not exceed 1/16 inch.

Excess thermoplastic material left on the pavement shall be removed prior to continuation of the operation.

8-22.3(5) PRESSURE SENSITIVE TAPE PAVEMENT MARKING

Application procedures for pressure sensitive tape shall be as recommended by the tape manufacturer.

8-22.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pavement Marking, Paint, (Width) Stripe" will be by the linear foot of stripe, except dashed center lines and dashed lane lines will be measured as continuous lines with no deduction for the unpainted area caused by the skip pattern specified.

Measurement for "Pavement Marking, Paint, Legend/Symbol" will be by each legend or symbol.

Measurement for "Pavement Marking, Thermoplastic, 8-inch stripe" will be by the linear foot of 8-inch stripe actually placed.

Measurement for "Pavement Marking, Thermoplastic, Legend/Symbol" will be by each legend or symbol.

The legends "ONLY" and "OK" will be measured as 1 unit each.

The symbol "Bicyclist" with "Arrows" will be measured as 1 unit each.

Stop lines, 16 or 24 inches wide and comprised of multiple 8-inch wide stripes, will be measured by the linear foot of 8-inch stripe.

Measurement for "Pavement Marking, Pressure Sensitive Tape" will be by the linear foot of tape.

8-22.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-22 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Pavement Marking, Paint, (Width) Stripe," per linear foot.
(2) "Pavement Marking, Paint, Legend/Symbol," per each.
(3) "Pavement Marking, Thermoplastic, 8-inch Stripe," per linear foot.
(4) "Pavement Marking, Thermoplastic, Legend/Symbol," per each.
(5) "Pavement Marking, Pressure Sensitive Tape," per linear foot.

The unit contract prices for the above listed bid items shall include all costs for the work required to furnish and install the types of pavement marking as specified.

SECTION 8-23 VACANT

SECTION 8-24 VACANT

SECTION 8-25 VACANT

SECTION 8-26 ROCK PROTECTION FENCE

8-26.1 DESCRIPTION

This work shall consist of furnishing and constructing rock protection fence at the locations shown in the Drawings, or where directed by the Engineer, in accordance with these Specifications and the details shown in WSDOT Standard Plan No. D-8.

Rock protection fence shall be diamond woven wire mesh mounted on steel cable and steel posts.

8-26.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Rock Protection Fence	9-16

8-26.3 CONSTRUCTION REQUIREMENTS

8-26.3(1) POSTS

Posts shall be spaced as shown in WSDOT Standard Plan No. D-8. In determining the post spacing, measurement will be made parallel to the slope of the existing ground and all posts shall be placed in a vertical position except where designated otherwise by the Engineer.

All posts shall be set in concrete Class C, and the footings shall be crowned to shed water.

Where solid rock is encountered without an overburden of soil, posts shall be set a minimum of 18 inches into the solid rock. The hole shall have a minimum dimension one inch greater than the largest dimension of the post section to be set. The posts shall be cut before installation to lengths which will give 6 feet of post above ground.

After the post is set and plumbed, the hole shall be filled with grout consisting of one part portland cement and three parts clean, well graded sand. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall be crowned to carry water away from the post. Where posts are set in the above manner, concrete footings will not be required.

Where solid rock is covered by overburden of soil or loose rock or surfacing materials, the posts shall be set to the full depth of 3 feet unless the penetration into solid rock reaches the minimum depth specified above, in which case the depth of penetration may be terminated.

Positions B and C shall have anchors for each individual fence post as shown in WSDOT Standard Plan No. D-8. The anchor rods shall be laced on the uphill side of the fence and securely bolted to the fence. The length of the anchor rod required shall be determined by the Engineer and if there is any deviation in the anchor rod lengths for the various posts, the rods shall be marked to ensure that each rod occurs in its proper position. After the anchor has been placed in the ground, the hole shall be backfilled with the material removed and thoroughly tamped.

8-26.3(2) TENSION CABLE AND END ANCHORAGE

Tension cable shall be installed in the posts as shown in WSDOT Standard Plan No. D-8, care being taken to ensure that the cable will move freely in the hook bolt hangers. One continuous length of cable shall be used between anchorages. The end anchorage shall be installed with material removed for placing the anchor being thoroughly tamped in place after backfilling. The Contractor shall then tension the cable so there is a maximum of 1 inch sag on position A fence and 2 inches on positions B and C when the fence fabric is in place. The cable shall be passed through the eye of the turnbuckle on the thimble, and after full tension has been applied, two wire rope clips shall be placed around both cables and securely tightened. Any additional tension required will be taken up with the turnbuckles, care being taken to ensure that a mimimum of 4 inches takeup remains in the turnbuckle when full tension has been applied.

8-26.3(3) CHAIN LINK FABRIC

Chain link fabric shall be placed on the ditch side of the posts for position A and on the downhill side for position B and C. The fabric shall be secured to the tension cable with galvanized steel hog rings at 0.5 foot spacing. The fabric shall not be tensioned in any direction, but is to remain loose to increase its dampening effect on rolling rocks. The fabric is not to be fastened to the fence posts or any other part of the fence except as shown in the plan for end posts. The bottom 2 feet of fabric for position A and the bottom 6 feet for positions B and C shall rest on the slope as shown in WSDOT Standard Plan No. D-8. Rolls of wire fabric shall be joined by weaving a single strand into the ends of the rolls to form a continuous mesh.

8-26.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

The length of rock protection fence shall be the number of linear feet of completed fence in the position specified excluding the length of the end anchorages.

8-26.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-26 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Rock Protection Fence (Position)", per linear foot.

The unit contract price for "Rock Protection Fence (Position)" shall include all costs for work required to furnish and install rock protection fence as specified in Section 8-26.

SECTION 8-27 VACANT

SECTION 8-28 VACANT

SECTION 8-29 WIRE MESH SLOPE PROTECTION

8-29.1 DESCRIPTION

This work shall consist of constructing wire mesh slope protection in accordance with these Specifications and the details shown in WSDOT Standard Plan No's. D-7 and 7a and in conformity with the lines and dimensions shown in the Drawings or established by the Engineer.

8-29.2 MATERIALS

Materials shallmeet the requirements of the following Sections:

Wire Mesh Slope Protection	9-16

8-29.3 CONSTRUCTION REQUIREMENTS

8-29.3(1) ANCHORS

The Contractor shall install anchors of the type shown in conformance to the layout shown in the Drawings. The spacing and number of the anchors and cables as shown in the Drawings are approximate only, and the Engineer will arrange the spacing in such a manner as to hold the wire mesh against the slope. Backfill material shall be thoroughly compacted.

8-29.3(2) CABLE ASSEMBLY

The cable assembly shall be in place before the wire mesh is attached. The bottom cable shall not be tensioned. No cable splicing will be allowed.

8-29.3(3) WIRE MESH

The wire mesh shall be fastened to the completed cable assembly as shown in the plans and as directed by the Engineer. Hog rings on the vertical lap splices shall be placed in a single row centered on the splice. Horizontal splices joining two rolls of mesh shall be made by removing a horizontal end wire and reweaving through the ends of the fabric to form a continuous mesh. All top and bottom laps shall be made by folding the mesh to the outside, away from the slope, to avoid the possibility of falling material hanging up in the folds. The bottom of the mesh shall be located so that material dislodged under the mesh can drain freely from the bottom, yet will not flow or bounce onto the roadway. The ends of all tie wires shall be secured to the mesh with a minimum of 1-1/2 turns.

The wire mesh shall not be tensioned in any direction, but is to remain loose so as to increase its dampening effect on rolling rocks. The Contractor shall use care in the handling and installing of the wire mesh and cable. Any mesh or cable damaged due to the Contrator's operations shall be replaced by the Contractor.

8-29.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement of anchors will be per each for the completed anchor. Anchor types will not be differentiated.

Galvanized wire mesh will be measured by the square foot of the completed area.

Galvanized wire rope will be measured by the linear foot of wire rope actually used in the completed project.

8-29.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-29 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Wire Mesh Slope Protection Anchor," per each.
(2) "Galvanized Wire Mesh," per square foot.
(3) "Galvanized Wire Cable," per linear foot.

The unit contract price for "Wire Mesh Slope Protection Anchor" shall include all costs for the work required to furnish and install the anchors of the type required, as specified herein and as shown in the Drawings, including removing obstructions, excavating, drilling, backfilling and grouting.

The unit contract price for "Galvanized Wire Mesh" and "Galvanized Wire Cable" shall include all costs for the work required to furnish and install the wire mesh and cable, including all rings, U-bolts, thimbles, wire rope, clips, hog rings, and tie wire necessary to complete the wire mesh slope protection as set forth in these Specifications and as shown in the Drawings.

SECTION 8-30 ILLUMINATION AND ELECTRICAL SYSTEMS

8-30.1 DESCRIPTION

8-30.1(1) GENERAL

This work shall consist of furnishing and installing a complete and functional electrical/street lighting system as indicated on the Drawings and in accordance with these Specifications and Standard Plan No's. 543 and 570 through 573.

All final connections or energizing of electrical street lighting systems to overhead secondary or to secondary in vaults or handholes will be made by City Light.

Required permits for electrical work other than street lighting and signals shall be obtained by the Contractor at Construction and Land Use, 5th Floor Municipal Building, City of Seattle, in accordance with Section 1-07.6.

8-30.1(2) APPLICABLE CODES

The work shall be performed in accordance with the applicable provisions of the following codes:

(a) City of Seattle Department of Lighting Material Standards, Construction Standards, and Requirements for Electrical Service Connection.
(b) State of Washington Electrical Construction Code, Chapter 296-44 WAC.
(c) State of Washington Electrical Workers Safety Rules, Chapter 296-45 WAC.
(d) National Electrical Code.
(e) City of Seattle Electrical Code Supplement.
(f) Edison Electric Institute (EEI).
(g) National Electric Safety Codes.

The Contractor shall be familiar with wires and voltages present within the construction area in the application of these requirements.

8-30.1(3) SHOP DRAWINGS

The Contractor shall submit shop drawings for the following items in accordance with Section 1-05.3.

(a) Luminaires (Include photometrics and socket position)
(b) Lamps
(c) Photoelectric Cells
(d) Bracket Arms
(e) Wire
(f) MI Cable and Accessories
(g) Wire Connectors
(h) Ground Rods
(i) Ground Clamps
(j) Fuse Kits
(k) Splice Kits
(l) Switch Board Mat and encapsulent
(m) G.F.C.I. Outlets (Hospital grade)
(n) Cabinets/Panels (Shop drawings for electrical cabinets, panels, and enclosures shall include but not be limited to the following:

(1) Wiring schematic
(2) Size and layout, indicating approximate size and placement of equipment
(3) Full description of materials, including breakers and fuses
(4) UL/CSA Certification
(5) All vents shall be screened)

8-30.1(4) DEFINITIONS

All technical words and phrases used within these Specifications shall be interpreted as defined in the I.E.E.E. Standard Dictionary of Electrical and Electronic Terms.

8-30.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Illumination and Electrical Materials 9-31

All materials furnished by the Contractor shall be new, unused and free from defects.

Hardware shall be industrial/utility grade.

All steel shall be stainless or hot dipped galvanized.

All electrical equipment including luminaires, lamps, photoelectric cells, bracket arms, wire, etc. shall be permanently marked with manufacturer's name and appropriate ratings.

All material supplied under this Specification shall be guaranteed against defective workmanship and material for a period as indicated in Section 1-05.10. The Contractor shall be responsible for the return and replacement of any material or equipment found to be defective within the guarantee period, including labor, freight, shipping and delivery. All material returned to the supplier under the guarantee shall be repaired or replaced and returned to the City of Seattle within 30 days of receipt.

8-30.3 CONSTRUCTION REQUIREMENTS

8-30.3(1) GENERAL

The work required for installation of electrical/illumination system shall be done as shown on the Drawings, the Standard Plans, the construction standards and in accordance with the following provisions.

All galvanizing shall be in accordance with ASTM 123 and 153.

Only state certified electricians shall perform electrical work.

Wire clearances shall be according to Seattle City Light requirements and the City and State law.

To maintain safe traffic conditions, existing luminaires shall remain in service until cut-over to new luminaires can be accomplished. Roadways shall not be opened to traffic without all the required lighting system operating properly.

All welding of steel and aluminum structures shall be in conformance with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", Section 1.4.2 for Steel and Section 1.5.5 for Aluminum. All steel structures shall be protected as required in Section 1.4.3 of the above referenced book.

Field repair of galvanized surfaces shall be coated with a heated zinc alloy solder to a minimum thickness of 2 mils, in accordance with ASTM A780.

Where the wiring diagram indicates installation of a fuse or ground rod, in-line fuse holders and fuse or ground rod shall be installed as specified herein.

Bird guards shall be installed in compliance with Section 9-31.

All electrical terminations shall be tightened to their prescribed torque value.

8-30.3(2) LUMINAIRES

The luminaire glassware, reflector and lamp shall be thoroughly cleaned before installation on the tenon, on the bracket arm. The luminaire shall be secured and adjusted according to the manufacturer's recommendations. The luminaire refractor will be level in the transverse roadway axis and parallel to the roadway grade in the longitudinal roadway axis, after the pole has been plumbed with all loads added, according to Construction Standard D12-9.

Alignment of luminaires shall be approved by the Engineer prior to final turn-on at each location.

Date of installation shall be marked on the bottom of the photoelectric cell with indelible

marking pen. The lamp shall have the installation date etched in the metal base.

The photoelectric cell receptacle shall be adjusted such that the photoelectric cell faces north.

8-30.3(3) BRACKET ARMS

Bracket arms shall be installed at the locations indicated on the Drawings. Mounting point of the bracket on wood poles shall be located as necessary to provide the required mounting height of the luminaire above the pavement surface as indicated on Standard Plan No. 573. The mounting height shall be adjusted to provide required wire clearances.

Wood pole bracket arms shall be attached by one through bolt and two lag bolts. Through bolts on wood poles shall be cut off so no more than 4 threads nor less than 3 threads are left exposed beyond the captive nut. The exposed end shall be treated with galvanizing repair paint approved by the Engineer. This through bolt shall not be used to mount any other hardware.

At locations where the existing bracket arm is to be used, any yellow tape present on the arm shall be removed. (This tape was used to indicate luminaires intentionally disconnected in late 1977 to conserve energy.)

Bracket arms on steel poles shall be attached with galvanized steel bolts.

Bracket arms on aluminum shall be attached with stainless steel bolts.

8-30.3(4) RELOCATING EQUIPMENT

When equipment is to be relocated, the Contractor shall furnish and install the necessary materials, hardware and equipment required to complete the new installation. The new hardware required to complete the installation shall be of the same quality and type as hardware required in these Specifications for other new work.

8-30.3(5) WIRING, FUSING AND SPLICING

The Contractor shall provide wiring from luminaire terminal boards to in-line fuseholders and to the source of secondary power. (Note: for MI cable, refer to Section 8-30.3(6))

The Contractor shall coil 8 feet of wire at the source of secondary power to allow for connections by Seattle City Light. The Contractor shall coil 3 feet of excess conductor in all Type 1, 2, 3 or 4 Handholes.

Each "hot" conductor shall have an in-line fuseholder and fuse located as indicated on the Drawings. Poles fed underground shall be fused in the pole base and shall have sufficient slack wire so that the fuseholders can be withdrawn through the pole handhole for servicing.

Wire attached to the side of a pole, not enclosed in conduit, shall be covered with plastic molding.

Caution shall be exercised in working near and within City Light Vaults. Voltages present are as high as 26,000 volts, and the vault wiring will not be de-energized while the Contractor is working. City Light safety watch standards shall be adhered to while working in vaults. Call Seattle City Light at 386-1600 for Safety Watch 48 hours in advance of entry into a City Light Vault.

When conductors, either cable or single, are being installed, care shall be exercised not to exceed tension limitations recommended by the manufacturer. Conductors may be pulled directly by hand. If conductors are pulled by mechanical means, a dynamometer with drop-needle hand shall be used on every pull. On mechanical pulls, either the insulation shall be stripped off each conductor, and conductors formed into a pulling eye and firmly taped before pulling; or a cable grip shall be used. The pulling force shall be applied directly to the conductor.

Secondary insulator racks required for new construction shall be in accordance with Material Standard 6905.1 and installed in accordance with Construction Standard D9-8.

Where new cable will be installed in existing conduits which contain wire, the Contractor shall protect existing wiring from damage due to pulling new cable. Cable pulling compound shall be used to minimize cable pulling tensions and adverse effects on existing insulation, jackets and shields. Care shall be exercised in pulling cable into poles and pedestals since sharp metal edges may be present.

Aluminum wire and connectors shall be prepared and coated with an oxide-inhibiting compound.

Where triplex wire is installed overhead to feed only one street light, the two hot heads shall be tied together (brothered) at each pole.

Wire insulation shall be removed by a method that will not "ring" or notch the wire. "Ringing" shall be cause for rejection of the splice.

Spliced joints shall be made mechanically and electrically secure. Splices shall not be permitted inside conduit. Each individual splice or termination of extra leads shall be insulated and made waterproof.

All cables shall be marked in handholes or access points with feed point circuit number.

For above ground splices, the connector shall be torqued to the manufacturer's recommended level. The splice and termination of extra leads shall be covered with rubber base insulating and waterproofing tape as specified in Material Standard 7364.7. This tape shall be worked around the wire insulation to insure a water tight assembly. The splice assembly shall be protected with two layers of electrician tape.

For below ground splices, connectors shall be tightened or crimped in accordance with the manufacturer's specifications. Only approved crimping tools shall be used to compress crimp splices. The metal splice shall be centered in the enclosure. The encapsulant shall be mixed and installed in accordance with manufacturer's recommendation. The encapsulant shall completely fill the enclosure and be free of voids and impurities.

Where festoon outlets are installed on poles a separate circuit shall be provided.

8-30.3(6) MINERAL INSULATED (MI) CABLE

Mineral Insulated (MI) cable shall be installed as described in the NEC Section 330-B with the following exceptions:

(a) The cable shall be supported every 3 feet and within 12 inches of each gland. These measurements are along the wall and not along the cable. Supports shall be in line so as to support cable in a straight line.

In addition, unless noted otherwise in the Drawings, installation of MI cable shall be subject to the following requirements:

(b) The radius of the inner edge of the bend shall not be less than 10 cable diameters, unless instructed otherwise by the Engineer. At no time shall the bend be less than 5 diameters.

Attachment: The cable shall be attached using copper clips and 1/4" cinch bolts. Bolts sized for 1 inch penetration and all associated parts shall be stainless steel. The cable shall be spaced 1/4 inch out from walls by means of stainless steel or nylon spacers. More than one cable (of the same outside diameter) may be placed in a clip if they are dressed parallel and neatly.

Cable shall not be run on any removable surface or pump station ceilings unless so noted on the Drawings.

Polyethylene Jacket: Nicks and cuts in the polyethylene jacket shall be repaired as directed by the Engineer.

Protection: Cable ends shall be protected from moisture at all times.

Testing: All cable shall be tested with a megger after installation and prior to hook-up. The insulation resistance shall be greater than 10,000 Meg Ohms. The tests shall be conducted in the presence of the Engineer.

The test results shall be recorded on the Data Sheet. Example of Data Sheet is provided herein, and the test results shall be included in the O & M Manual.

Tools: All tools used to make up the cable glands shall be as specified by the cable manufacturer.

Expansion: Where cables may expand due to temperature changes, the cable run shall contain small bows or changes of direction as recommended by the cable manufacturer.

Vibration: The cable shall not be connected to any vibrating or moving device.

Tails: As noted in Section 9-31.4, the conductors exposed beyond the sheath shall be insulated. The insulating sleeves shall be PVC unless noted otherwise on the Drawings. Power and signal conductors shall be color coded per the NEC and if two or more circuits are in one sheath, they shall be identified by coded bands (not tape) or different colored sleeves.

Splices: MI cable may be spliced using glands and junction boxes when permitted by the Engineer.

Conduit: Conduit entering a pump station may be stubbed inside the wall and converted to MI cable. The cable shall be spliced to the external wiring in a condulet or J-Box.

Control Enclosure: MI cable entering control cabinets such as motor starter and pump control enclosures shall terminate on devices within 10 inches of the MI entrance or terminate on a terminal strip.

Circuit Breaker Panels: MI cable conductors shall be terminated at the neutral bus and at the circuit breakers. Extra long insulating sleeves may be required, as directed by the Engineer.

Motors: MI cable shall terminate in a J-Box or condulet with a minimum of 8 inches of flex and stranded wire continuing on to the motor.

Protection: Where MI cable may be damaged by sliding objects such as at the floor grate, it shall be protected by a 4" x 4" x 1/4" angle or other means as noted on the Drawings or directed by the Engineer.

8-30.3(7) GROUNDING AND BONDING

All metallic appurtenances containing electrical conductors, including cabinets, metallic conduit, metal poles, pedestals, and junction boxes, shall be made mechanically and electrically secure to form a continuous system which shall be effectively grounded.

Where conduit (including steel conduit) systems are used, all metallic appurtenances shall be electrically bonded by a separate insulated ground conductor.

Where parallel electrical circuits exist in an electrical conduit, the equipment grounding conductor shall be sized as determined by the rating of the largest overcurrent device serving any circuit contained in the conduit. Only one equipment grounding conductor is required in any conduit.

The equipment grounding conductor shall be sized as indicated on the Drawings. Minimum size shall be #8 copper.

All conduit runs with phase conductors (with the exception of the run from the riser to the first handhole) shall have a ground wire installed in the conduit unless noted otherwise on the Drawings.

A ground wire shall interconnect all ground rods in each circuit. Grounding of the equipment grounding conductors throughout the system shall be by approved ground clamps.

Metal conduit, ground wires and the service neutral shall be bonded and grounded at the service entrance point as required under the NEC and the City of Seattle Electrical Code.

Only one wire shall be installed under any ground clamp.

Ground rods shall be installed in firm undisturbed earth. In fill or in areas with poor soil conditions, extensions shall be added until the rod cannot be removed by hand. Minimum spacing between ground rods shall be 6 feet.

8-30.3(8) REMOVAL AND SALVAGE OF EXISTING EQUIPMENT

Refer to Section 2-02.3(3)G and 2-02.3(7)C.

8-30.3(9) FIELD TESTING

Prior to completion of the work, the Contractor shall make the following tests on all electrical circuits:

(a) Test for grounds in each circuit by physically examining the installation to ensure that all required ground jumpers, devices and appurtenances do exist, that they are mechanically and electrically firm, and that they meet the requirements of Article 250 of the National Electrical Code.

(b) Insulation resistance test (with all readings recorded when requested by the Engineer). The insulation test shall be performed after all field connections have been made.

(c) A functional test in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test shall be performed after all field connections are made.

8-30.3(10) FINAL INSPECTION

As soon as practicable after the completion of the entire work, it will be examined by the Lighting Department and the Engineer. The Contractor will be notified when the examination is to be made.

If the inspection reveals defects in the work, such defects shall be repaired or unsatisfactory work be replaced as the Engineer designates before final acceptance. No extension of the contract time will be granted because of the time required to remedy such defects.

M.I. CABLE TEST RECORD

DATE: _____

PROJECT: _____

STATION _____

CABLE DESCRIPTION	READING	TESTER	DATE

8-30.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

8-30.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-30 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Luminaire, High Pressure Sodium, (Wattage)," per each.
(2) "Luminaire, High Pressure Sodium, (Wattage), Underdeck Mounted," per each.
(3) "Luminaire, High Pressure Sodium, (Wattage), Wall Mounted," per each.
(4) "Bracket Arm, (Length)," per each.
(5) "Relocate Luminaire," per each.
(6) "Relocate Bracket Arm," per each.
(7) "Relocate Luminaire and Bracket Arm," per each.
(8) "Wiring, Street Lighting," per lump sum.

The unit contract price for "Luminaire, High Pressure Sodium, (Wattage)" shall include all costs for the work required to furnish and install the luminaire, including the fuse, hardware, photoelectric cell and wiring to the fuseholder at the secondary source or at the base of the pole.

The unit contract price for "Luminaire, High Pressure Sodium, (Wattage), Underdeck Mounted" and "Luminaire, High Pressure Sodium, (Wattage), Wall Mounted" shall include al costs for the work required to furnish and install these luminaire units specified in Section 9-31.1(6) and 9-31.1(7) including wiring to the condulet.

The unit contract price for "Bracket Arm, (Length)" shall include all costs for the work required to furnish and install the bracket arm, including hardware.

The unit contract price for "Relocate (Item)" shall include all costs for the work required to remove the item and reinstall the item at the new location, including hardware, and cleaning and relamping relocated luminaires.

The lump sum contract price for "Wiring, Street Lighting," shall include all costs for the work required to furnish and install wiring for the street light system as specified from the service point to the luminaire fuseholder, including taps, splices, tape, fuseholder, excess wire for connections, and any other material for a complete lighting system.

All final connections or energizing of electrical street lighting systems to overhead secondary or to secondary in vaults or handholes will be made by City Light at no cost to the Contractor.

All costs for the return and replacement of material or equipment found to be defective within the guarantee period shall be at the Contractor's expense.

All costs for furnishing and installing hardware not specifically called out, but required to complete the work shall be included in the unit contract prices for the bid items comprising the improvement.

The Contractor will be charged with the actual cost to the City due to any retesting made as required by the provisions in Section 8-30.3(10).

There will be no charge for the first safety watch on any contract, as specified in Section 8-30.3(5). All costs for additional safety watches shall be at the Contractor's expense.

SECTION 8-31 TRAFFIC SIGNAL SYSTEM

8-31.1 DESCRIPTION

8-31.1(1) GENERAL

This work shall consist of furnishing and installing a complete and functional traffic control system of controllers, signals and appurtenances as indicated on the Drawings and in accordance with these Specifications and Standard Plan No's. 500 through 523, 530a&b, and 600 through 601a.

The Contractor shall familiarize himself with the wires and voltages present within the construction area in the application of the requirements herein.

All final connections or energizing of signal systems to overhead secondary or to secondary in vaults or handholes will be made by City Light.

If, for any reason, one or more vehicular or pedestrian signals should go dark or fail to function properly as a result of the Contractor's work, the Contractor shall immediately call for and be responsible for any required Police control of the intersection. The Contractor shall also immediately notify the Engineer and the City Signal Maintenance Office (386-1206) of the nature of the problem. Unless otherwise designated by the Engineer, the Contractor shall immediately undertake the necessary repairs with qualified electrical workers. The Engineer may require the work to be done by City forces.

Required permits for electrical work other than street lighting and signals shall be obtained by the Contractor at Construction and Land Use, 5th Floor Municipal Building, City of Seattle, in accordance with Section 1-07.6.

8-31.1(2) DEFINITIONS

All technical words and phrases used within these Specifications shall be interpreted as defined in the I.E.E.E. Standard Dictionary of Electrical and Electronic Terms.

8-31.1(3) APPLICABLE CODES

All electrical work shall be done by state certified electricians. The work shall be performed in accordance with the applicable provisions of the latest edition of the following codes:

(a) City of Seattle Department of Lighting Material Standards, Construction Standards, and Requirements for Electrical Service Connection.
(b) State of Washington Electrical Construction Code, Chapter 296-44 WAC.
(c) State of Washington Electrical Workers Safety Rules, Chapter 296-45 WAC.
(d) National Electrical Code.
(e) City of Seattle Electrical Code Supplement.
(f) Edison Electric Institute (EEI).
(g) National Electric Safety Codes.

8-31.1(4) SHOP DRAWINGS AND REFERENCE MATERIALS

8-31.1(4)A SHOP DRAWINGS

The Contractor shall submit shop drawings in accordance with Section 1-05.3 for the following:

(a) Controller Assembly (components & cabinets)
  (1) Controller Wiring Schematic (Typical for each type)
  (2) Control Cabinet Wiring Diagram (Typical for each type)
  (3) Control Cabinet Size and Layout (Each type)
  (4) Full functional description of the controller including program diagram with instructions for program timing.
(b) Signal Heads and Mounting Assemblies
(c) Cable and Wire
  (1) Wire Connections
  (2) Fuse Kits
  (3) Splice Kits
(d) Pole Line Hardware
(e) Interior Illuminated Signs
(f) Miscellaneous
  (1) Telephone Station Protector
  (2) Pedestrian Push Button
  (3) Aerial Terminal Compartments
  (4) Ground Rods

The Contractor shall submit two "as built" wiring diagrams to the Engineer for each signalized intersection prior to requesting the Engineer's approval for turn-on or cut-over.

8-31.1(4)B REFERENCE MATERIAL

At or before delivery of the controller for testing, the Contractor shall deliver 5 complete sets of operation manuals, maintenance manuals, controller assembly wiring and program diagrams, and parts list with each controller assembly. 1 set of controller assembly wiring and programming diagrams shall be installed in a plastic envelope within each cabinet.

The method of programming the controller shall be completely detailed and shall include a description for making any changes or adjustments in the program. The Conditions under which the programming may be accomplished (i.e., flashing or full operation) shall also be detailed.

A complete description of all software shall be furnished for each model of controller proposed. The description shall include all steps of the various programs as well as all inputs and outputs.

8-31.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Signal System Materials	9-32

All materials to be furnished by the Contractor shall be new, unused and free from defects.

All work and equipment supplied by the Contractor under this Specification shall be guaranteed against defective workmanship and material as indicated in Section 1-05.10. The Contractor shall be responsible for the return and replacement of any material or equipment found to be defective within the guarantee period, including labor, freight, shipping and delivery. All equipment returned to the supplier under the guarantee shall be repaired or replaced and returned to the City of Seattle within 30 days of receipt.

Hardware shall be industrial/utility grade.

8-31.3 CONSTRUCTION REQUIREMENTS

8-31.3(1) INTERSECTION CHECK-OUT AND TURN-ON PROCEDURES

8-31.3(1)A TRAFFIC CONTROL

The Contractor shall provide uniformed Police control at any time an intersection is dark or inoperative, such as during controller change-out, cable installation, signal turn-on or cut-over, or similar circumstances. The Contractor shall have all traffic controls (i.e., pavement markings, channelization and signing) in place prior to requesting Engineer's approval for turn-on or cut-over.

To maintain safe traffic conditions, existing signals shall remain in operation until a simultaneous cut-over to the signal can be accomplished.

At the time of turn-on of new signals, temporary "SIGNAL AHEAD" signs shall be placed upstream on all approaches. These signs shall remain in place for not less than 7 nor more than 21 calendar days. All signs shall be highly visible and placed in a safe and secure location.

At the time of cut-over of revised signals having phasing which is different from the old signal operation (i.e., added phase, split phase, etc.) temporary "TRAFFIC REVISION" signs shall be placed upstream on all approaches. These signs shall remain in place for not less than 7 nor more than 14 calendar days. At a cut-over of revised signals having phasing which is the same as the old signal operation, no temporary signing is necessary. All signs shall be highly visible and placed in a safe and secure location.

8-31.3(1)B CHECK-OUT PROCEDURE

The Contractor shall call for an intersection check-out after completing the controller cabinet installation along with all other signal equipment complete with wiring connections. The Contractor shall be present and assist with the check-out by energizing each field circuit and assisting as necessary to verify completeness of the installation except for the controller unit and auxiliary units of the controller assembly. If the intersection is found to be in-complete or inadequate, the Contractor will be notified of the deficiencies to be corrected.

8-31.3(1)C TURN-ON/CUT-OVER PROCEDURE

Upon satisfactory check out of an intersection, the Contractor, after conferring with the Engineer, will tentatively schedule a cut-over from the old signals or a turn-on of a new installation. A request to "turn-on" new signalized intersection or "cut-over" modifications to existing signalized intersection shall be submitted in writing to the Engineer at least 3 working days prior to the proposed date of an existing signal cut-over, and 8 working days prior to the proposed date of a new signal turn-on. The Contractor shall submit an as-built wiring diagram to the Engineer prior to cut-over or turn-on.

Turn-ons and cut-overs will not be permitted on Friday, Saturday, Sunday, Monday, Holidays or a day before a holiday. Only one turn-on or cut-over will normally be permitted in a single day. Turn-on or cut-over work shall be scheduled and completed between the hours of 9:30 AM and 3:30 PM. The Engineer will confer with the Traffic Engineer and Signal Electrician Crew Chief before authorizing a cut-over or turn-on.

The City will deliver to the site and plug into the controller cabinet, the controller unit and the auxiliary units. The Contractor shall verify all connections and proceed with energizing the controller assembly. The signal timing for the controller unit will be done by the City. The Contractor shall not energize the signals until the Engineer is on site and has authorized the Contractor to proceed. To maintain safe traffic conditions, existing signals shall remain in operation until a simultaneous cut-over to the signal can be accomplished, unless an alternate procedure is approved in writing by the Engineer. New signals shall not obscure existing traffic controls.

The Contractor shall be present at such turn-on time, with materials and tools necessary to correct any malfunctions which may occur. Turn-on shall not take place if any subsequent work will necessitate turning off the signal system.

All new vehicular and pedestrian signals and illuminated signs shall be covered (sacked) completely with a 6 mil opaque polyethylene sheeting until the new signals are ready to be energized. A small diameter hole (i.e., 1 inch) shall be cut into the opaque plastic cover in front of each vehicular signal lens and a 1 inch by 3 inch slot in front of each pedestrian signal lens to allow for a visual check of indications during performance testing.

Immediately after turn-on or cut-over all existing vehicular and pedestrian signals that have been deactivated shall be sacked or removed. The old signal heads shall not obscure the new traffic controls at any time.

8-31.3(1)D TECHNICAL ASSISTANCE

The Contractor shall ensure that the Controller Assembly supplier shall provide technical assistance at the time of turn-on of the intersection, unless the controller has been supplied by the City.

Notice of 8 days shall be given by the Contractor to the manufacturer's representative prior to the time of turn-on of an intersection to enable attendance at the turn-on. Assistance by the manufacturer will not relieve the Contractor of responsibility of rendering whatever assistance may be necessary at the time the controller assemblies are tested by the City to correct any possible defects.

8-31.3(2) CONTROLLER ASSEMBLY

8-31.3(2)A GENERAL

The Contractor shall install the controller cabinet. Upon signal turn on or cut over the signal shop shall install the signal controller and auxiliary equipment.

Auxiliary equipment added to existing controller cabinets shall be installed as indicated on the Drawings and as specified herein. The Engineer shall be notified 48 hours in advance of energizing of the unit in order that he may be present.

After signing the City's functional test report, the Contractor shall pick up the controller cabinet at 1010 8th Avenue South for installation.

8-31.3(2)B CONTROLLER ASSEMBLY TESTING REQUIREMENTS

Controller assemblies will undergo testing by both the manufacturer and the City of Seattle Engineering Department. Certified testing by the manufacturer will not result in immediate acceptance of the equipment by the City nor will it indicate the Specifications have been met and approved.

8-31.3(2)C MANUFACTURER'S TEST PROCEDURE

The manufacturer shall perform the following testing on system equipment in the prescribed manner and certify that each complete controller assembly has successfully met or exceeded all the requirements set forth herein.

(a) Physical and functional testing of all controller units, system equipment, auxiliary equipment and the complete controller assembly. This shall include but not be limited to the items covered in the City of Seattle "Functional Test Procedure for Controller Assemblies" included in the appendix of the Project Manual.
(b) A minimum of 72 hours of burn-in of all controller units, controller assemblies and signal system control equipment including auxiliary equipment.

(c) Each controller assembly type shall be environmentally tested in accordance with NEMA Standards Number TS1 for Traffic Control Systems, Part 2 "Environmental Standards and Test Procedures". The Environmental test shall be made by an independent laboratory.

The Contractor shall submit the manufacturer's certified test results prior to delivery of the controller assembly to the City for functional testing.

If a failure occurs in any step of the testing, the manufacturer shall record the failure and take corrective measures. If a failure occurs in the same controller unit or any other major segment (i.e., signal conflict monitor unit, load switching unit, detector units, coordination units, etc.) of the controller assembly more than once, that unit or segment of the assembly shall be completely replaced by a new unit. Repairs shall be made as soon as practicable and testing shall resume to ensure the continuity of the test.

A failure shall be defined as any occurrence which results in other than normal operation of the equipment. A failure is considered to be, but not limited to the following:

(a) If the controller unit sequences improperly or exhibits improper interval or phase without proper call through remote switch, time clock or start-up routine.
(b) If indicator lights give false representation.
(c) If any timing is disrupted or deviates more than + 100 milliseconds from its setting.
(d) If any load switch produces an incorrect signal indication.
(e) If the conflict monitor, after receiving a simulated green-green and walk-walk conflict for each phase or other monitored anomalies, fails to perform in the prescribed manner.
(f) If any auxiliary equipment does not operate properly.

8-31.3(2)D CITY OF SEATTLE FUNCTIONAL TEST PROCEDURE

The functional test by the City of Seattle will require at least 3 working days of satisfactory operation.

The Contractor shall deliver the controller assembly to the City of Seattle Engineering Department Traffic Control Shop at 1010 - 8th Avenue South in Seattle. The City will then initiate a functional test using the City's "Functional Test Procedure for Controller Assemblies". The Contractor shall witness or acknowledge the final output test of the controller assembly by the City prior to accepting the cabinet for installation.

A failure shall be defined as any occurrence which results in other than normal operation of the equipment, and shall include but not be limited to the failure items listed under Section 8-31.3(2)C.

If any part of the controller assembly fails to meet the Specifications or operates in other than normal operation, the test shall be discontinued. The Contractor shall then make immediate arrangements to correct or modify the equipment within 5 days upon written notice from the City. If repairs or replacement cannot be made within 5 days the Contractor shall remove the controller assembly from the Traffic Control Shop and make repairs or replacements within 30 days. Upon return of the controller assembly and anytime thereafter the functional test will again be initiated. In addition, no extension of the contract time will be granted because of the time required to make repairs or replacements.

8-31.3(3) SIGNAL HEADS, VEHICLE AND PEDESTRIAN

8-31.3(3)A GENERAL

Signal heads shall not be installed at any intersection earlier than 14 calendar days prior to turn-on or cut over.

Mounting shall be bracket, mast arm, post top, span wire, or clamshell as indicated on the Drawings. Signals mounted on post tops shall utilize standard 4-inch slipfitters. Bracket-mounted signal heads shall utilize the signal bracket assembly and conform to mounting indicated on the Drawings. The bracket assembly shall be installed in line with the pole center line.

Attachments such as visors, backplates or adapters shall conform to and readily fasten to existing mounting surfaces without affecting the weatherproof and light integrity of the signal.

Electrical service shall be neatly formed to the supporting structure with only sufficient slack for wind effect when span wire mounted.

All new vehicular and pedestrian signals shall be covered (sacked) completely with a 6 mil black or blue polyethylene sheeting until the new signals are ready to be energized.

Alignment of vehicular and pedestrian signal heads shall be approved by the Engineer prior to final turn-on on each signalized location.

8-31.3(3)B VEHICLE SIGNAL HEADS

The bottom of the vehicle signals mounted on mast arms or span wire shall be 16-1/2 to 19 feet above street grade. On designated truck routes the minimum shall be 18 feet. Vehicle signals mounted on brackets or post top shall be 10 to 15 feet above sidewalk grade.

The signal shall mount to standard 1-1/2 inches fittings as a single section, as a multiple section head, or in combination with other signals. The signal section shall be provided with an adjustable connection that permits incremental tilting of at least 0 to 10 degrees above or below the horizontal while maintaining a common vertical axis through couplers and mounting. Terminal connection shall permit external adjustment about the mounting axis in 5-degree increments. The signal shall be mountable with ordinary tools and capable of being serviced without tools.

Signal heads located over the roadway shall not be in conflict physically or visually with trolley wires, span wires, electrical wires or any other hardware existing or proposed for the location. 3-foot, edge to edge, clearance shall be maintained between signal heads and trolley wires. Span wires and tether lines within 4 feet of trolley lines shall be properly insulated. If it becomes evident that a conflict will exist, the Contractor shall immediately notify the Engineer and allow 5 working days to resolve the problem.

When balance adjusters are required, the vehicular heads shall be adjusted in the field such that persons standing on the pavement, four times the speed limit in feet back from the stop bar, shall see the brightest image of the red section. Heads shall be plumbed as viewed from the direction in which they face.

Optically programmed type traffic signal heads shall be programmed before the traffic signal system turn-on. Programming shall be performed with a representative of the traffic signal head manufacturer present. The Contractor shall make arrangements with the representative to assure timely completion of the programming.

Vehicle signal heads shall be attached to the mast arm with a signal coupling unit as detailed. Mounts shall include elevator plumbizer units, between the red and yellow lenses, or as necessary to provide roadway clearance. The top (red) section of all heads on one mast arm shall be positioned to same distance from the center of the mast arm.

Vehicle signal heads shall be attached to the span wire by means of a cable clamp, balance adjuster when required, and suspension fittings as shown on the Span Wire Vehicular Signal Installation details. The sag in the span wire after loading shall be 6 percent plus or minus 1 percent of the total span. Span

wires shall be attached to the poles such that the signal head mounted at the lowest point on the span will not require a pipe extension. The top (red) section of all heads shall be level on the same span.

For optically programmed signals which are span wire mounted, a tether cable with connections and hardware as recommended by the signal head manufacturer shall be used to secure the bottom of the optically programmed signals. Tethering shall provide and maintain proper optical visibility of all indications. The tether cable clamp shall be designed and installed to release under severe wind loads and impact. The tether cable shall be insulated yellow and shall be installed a minimum of 18 feet above the roadway.

8-31.3(3)C PEDESTRIAN SIGNAL HEADS

Pedestrian signal heads shall be aligned to focus on the center of the far end of the crosswalk which it is associated with and at a point 5 feet above the sidewalk landing.

Pedestrian signal heads shall be mounted so the bottom of the housing is 8 feet above the sidewalk, unless otherwise noted.

The Contractor shall use a "Clamshell" type mounting assembly for neon pedestrian signals. Where horizontal orientation does not present a signal head conflict, both heads shall be mounted at the same elevation above grade.

8-31.3(4) PEDESTRIAN PUSH BUTTON AND SIGNS

The Contractor shall provide and install all pedestrian push buttons, signs and mounting hardware.

The sign and push button assembly shall be located on the pole shaft as shown on the Drawings. The sign shall point in the direction of the crosswalk for which the associated push button is intended.

8-31.3(5) DETECTOR LOOPS

8-31.3(5)A LOOP WIRE

Vehicle detector loops will be marked-out on the roadway by the Contractor as shown on the Drawings and as detailed in Standard Plan No's. 530a and b. The Contractor shall not saw cut for detector loops until the location has been verified by the Engineer.

At least 48 hours notice shall be given to the Engineer indicating when and where saw cutting is imminent.

One continuous unbroken length of loop wire shall be used to form a loop of the number of turns shown on the loop schedule in the Drawings. The loop wire shall be laid in a saw slot which has been cleared of debris and moisture by a jet of compressed air. The wire shall be placed by tamping it into the saw cut with a blunt wooden stick, using care to avoid abrading or damaging the insulation. In order to reduce abrasion of the loop wire in the saw cut, the following steps shall be taken:

(a) all corners of the saw cut that the loop wire is to be bent around shall first be rounded by filing.
(b) the loop wire shall be taped a minimum of two turns at each saw cut corner.

In concrete installations the saw cut shall be filled with a quick drying high strength highway concrete patching material, Jet Set, manufactured by Miller Manufacturing, Inc., or approved equal. No saw cuts shall be made closer than 2 feet to the edge or joint (unless crossing the joint) of a non-laterally supported concrete slab.

In asphalt installations, the loop wire shall be covered with 3M brand Detector loop sealant, or approved equal, per manufacturers installation instructions. Sealing shall not be performed when the pavement is damp.

At those locations where cuts are made on a slope and sealant runs and puddles, the Contractor shall, starting at the low end, pour the sealant and have a follower place 2-inch masking tape on the road surface over the cut to hold the sealant in place while the sealant sets. The masking tape shall be removed after the sealant becomes rigid.

When placing the loop across asphalt or concrete pavement joints or cracks, a 12-inch minimum length of 5/16 inch ID x 1/8 inch wall, pure gum natural tubing shall be sliced open, and shall be so placed as to envelop the loop wires where the loop wires intersect the roadway joint or crack. This must clear the joint or crack by 6 inches minimum on each side.

Where loop installation conflicts with existing operational loops, the new loops shall be installed no sooner than 24 hours prior to signal cut-over. The Contractor shall notify the Engineer 24 hours prior to cutting the existing loop so that phase can be placed in a recall mode.

Loop wire, from the loop to lead-in splice, shall be twisted a minimum of 3 turns per foot. Care shall be taken so that the twists are uniform.

A minimum of 48 inches of loop wire shall be brought into the handhole and spliced to the lead- in wire with a soldered, waterproof splice.

8-31.3(5)B LOOP LEAD-IN CABLE

Connections between the loop wire at the handhole and the detector amplifier unit in the controller cabinet shall be by means of a continuous unbroken length of loop lead-in cable.

The conductors of the loop lead-in cable shall be twisted together approximately 3 turns per foot. Connections of the loop wire to the lead-in wire shall be made only in a hand hole with a waterproof splice as indicated on Standard Plan No. 530b.

Each lane shall have its own shielded loop lead-in cable to the controller cabinet. Connections for parallel, series or series-parallel wiring of detector loops of the lane shall be made in the handhole and terminate in the cabinet per the wiring diagram.

The cable shield and drain wire shall be grounded to the system ground at the controller cabinet only. The cable shield between cabinet and splice shall be continuous throughout intermediate junction boxes and shall be insulated to prevent grounding in any junction box or in any conduit.

Each loop lead-in wire shall have a permanent cloth or plastic tag with the label number shown on the loop detector wiring chart. Tags shall be placed at all accessible points on the system.

The shielded loop lead-in cable splice to the loop wire shall be made in the nearest traffic handhole as indicated on the Drawings. No splices will be allowed except splicing the loop wire to the shielded lead-in cable in the traffic handhole. The splices between the loop wire and the lead- in shall be soldered, taped and encapsulated as indicated on the Standard Plan.

Adjacent loops connected to the same detector channel shall be connected to obtain magnetic fields of the same direction.

The loop magnetic polarity test may be used to determine the loop wire polarity if the loop winding polarity is not marked during installation. The Contractor shall be responsible for damage to the loop wires due to overheating during the loop magnetic polarity test.

8-31.3(5)C INDUCTANCE TESTING AT THE HANDHOLE

Before splicing the loop wire to the loop lead-in cable, an inductance test shall be performed by the Engineer to insure the inductance is within the acceptable range of plus or minus 15 percent of the calculated inductance. If the inductance does not fall in the acceptable range, then the Contractor shall make

such corrective measures as necessary and as directed by the Engineer until the desired readings are obtained. Inductance readings shall be recorded on the as-built drawings showing the reading for each loop and one copy filed in the controller cabinet.

8-31.3(5)D LOOP CONTINUITY TESTING

The completed loop and lead-in configuration after splicing shall be checked for continuity, using a suitable tester that will not exceed the voltage rating of the lead-in and loop wire rating.

The Contractor shall also perform a megger test on the loop and lead-in configuration to determine that the resistance to ground is 10 megohms or greater. If resistance to ground, prior to placing the sealant is less than 10 megohms, all splices and wires should be checked for insulation damage and corrective measures taken as directed by the Engineer. After the slot has been sealed, the Contractor shall perform the resistance and continuity tests again. If the continuity and resistance tests do not meet the previous requirements, the Contractor shall make such corrective measures as directed by the Engineer until the desired readings are obtained.

8-31.3(5)E INDUCTANCE TESTING AT THE CONTROL CABINET

After all splices are complete and the continuity test is complete, the Engineer shall test the inductance of the loop and loop lead-in cable at the controller cabinet to insure the inductance is within the acceptable range of plus or minus 15 percent of the calculated inductance. If the inductance does not fall in the acceptable range, then the Contractor shall make such corrective measures as directed by the Engineer until the desired readings are obtained. Inductance reading shall be recorded on the as-built drawings showing the reading for the total loop plus lead-in.

8-31.3(6) INTERIOR ILLUMINATED SIGN

Interior illuminated signs shall be covered (sacked) completely with a 6 mil opaque polyethylene sheeting until the sign is ready to be energized and the Engineer authorizes the Contractor to remove the sheeting.

The sign shall be mounted as indicated on Standard Plan No's. 600a and 600b. The sign shall be mountable with ordinary tools and capable of being serviced without tools. The bottom of the sign at the lowest point on the span shall be a minimum of 16-1/2 feet and a maximum of 19 feet above the roadway. On designated truck routes the minimum shall be 18 feet.

The sign shall be adjusted in the field as directed by the Engineer. Signs shall be plumb as viewed from the direction in which they face.

8-31.3(7) INTERIOR ILLUMINATED CROSSWALK SIGN

The Contractor shall call for an intersection check-out after completing the control unit cabinet installation along with all other equipment and wiring connections. The Contractor shall be present and assist with the check-out by energizing each field circuit and assisting as necessary to verify completeness of the installation. If the crosswalk sign unit is found to be incomplete or inadequate, the Contractor will be notified of the deficiencies.

The Contractor shall have all traffic controls (i.e., pavement markings, channelization and signing) in place prior to the Engineer approving the crosswalk sign for turn-on.

The crosswalk sign unit shall be provided with an adjustable connection that permits incremental tilting of at least 10 degrees above or below the horizontal while maintaining a common vertical axis through couplers and mounting. Terminal connection shall permit external adjustment about the mounting axis in 5 degrees increments.

The crosswalk sign unit shall be attached to the span wire by means of 2 cable clamps, balance adjusters and suspension fittings as indicated on Standard Plan No. 600a. The sag in the span wire after loading shall be 6 percent plus or minus 1 percent of the total span. Span wires shall be attached to the poles such that the Crosswalk Sign Unit mounted at the lowest point on the span will not require a pipe extension. The bottom of the Crosswalk Sign Unit at the lowest point on the span shall be a minimum of 16-1/2 feet and a maximum of 19 feet above the roadway. On designated truck routes the minimum shall be 18 feet.

Cable feeding the span wire mounted crosswalk sign unit shall be securely attached to the span wire by means of preformed lashing spaced no more than 18 inches apart. The preformed lashing rods shall be of the proper size to hold the cable snug against the span wire with no intervening gaps between the cable and the span wire and shall give a neat appearance without displaying obtrusive pigtails. Drip loops shall be left at the point of entrance to signal heads and conduit entrance fittings to allow moisture to drip from the cable rather than run down the cable into the entrances. Where the drip loop from the pole outlet to the span wire exceeds 18 inches, the cable shall be secured to the pole with large preformed lashing rods to give a neat appearance.

8-31.3(8) INTERCONNECT CABLE

8-31.3(8)A GENERAL

Aerial interconnect cable runs shall be installed 24-1/2 feet above street grade on the street side of the pole.

The Contractor shall match the sag as closely as possible with wires already on poles to ensure reduction of movement in windstorms and adjacent wire conflict.

All cable pulled through underground ducts shall be lubricated with an approved cable pulling compound.

The Contractor shall use grip or "come-along" to grip the jacketed messenger when pulling and tensioning. Pulling and tensioning shall be done in such manner as to not damage the jacket. When separating the messenger from the jacketed conductor assembly for dead-ending or splicing the web shall be split in the middle. Extreme care shall be used so as not to damage the cable jacket.

At corners and run ends, the messenger strand shall be dead-ended with either automatic strand vices or preformed guy grip dead-ends. When dead-ending with strand vises, the Contractor shall cut the strand and remove the jacket from the steel strand. Exposing enough strand so that the ends of the strand coming through the chuck of both strand vises can be overlapped and bonded together to form a continuous ground. A 1 bolt guy clamp shall be used to bond the strand ends together.

Interconnect cable shall not be spliced. Interconnect cable shall be run continuously between the terminal strip of one controller to the next controller, unless otherwise indicated on the Drawings. The messenger wire shall be removed from aerial figure 8 cable in pole risers and conduit.

The shield of all cables entering an aerial terminal compartment shall be terminated on a common terminal. The shield shall be connected on the terminal strip of the controller at the start of a system and then connected at alternate controls only along the route of the system.

The installation of controllers and the connection to the energized interconnect cable shall be done starting at the master control point and going to the end of the system. Where the interconnect cable branches at a subsequent intersection, the branch shall be completed before proceeding

past the branch point. When controllers are to be connected into new or existing systems, care shall be taken not to disrupt the integrity of the entire system.

Four feet of cable shall be pulled into the controller cabinet and coiled around the bottom of the cabinet before connections are made.

8-31.3(8)B TELEPHONE INTERCONNECT CONNECTION

The Contractor shall notify the Engineer at least 4 weeks, and not more than 6 weeks, in advance of the expected turn-on in order that the Engineer can request the Pacific Northwest Bell to install the two pair interconnect drop to the telephone station protector.

The Contractor shall have the telephone station protector and associated wiring complete to the controller so that the phone connection can be installed and tested when the request is made.

8-31.3(9) SIGNAL WIRING

8-31.3(9)A CONDUCTOR INSTALLATION

The Contractor is responsible for making all signal and lighting circuits fully functional after pulling in new cables.

Care shall be exercised in pulling cable into poles and pedestals since sharp metal edges may be present.

When conductors, either cable or single, are being installed, care shall be exercised not to exceed tension limitations recommended by the manufacturer. Conductors may be pulled directly by hand. However, if conductors are pulled by any mechanical means, a dynamometer with drop-needle hand shall be used on every mechanical pull.

On mechanical pulls, insulation shall either be stripped off the individual conductors, and conductors formed into a pulling eye and firmly taped before pulling; or a cable grip shall be used. The pulling force applied directly to the conductor; i.e., when pulling eyes are used or when the conductor is formed into a loop, shall be limited to 0.008 pound per circular Mil area of copper conductor. When a cable grip is applied over nonmetallic sheathed cables, the maximum pulling force shall be limited to 1,000 pounds; provided this is not in excess of the force as calculated above.

To limit the sidewall pressure at bends in duct and conduit runs, the pulling force in pounds shall not exceed 100 times the radius of the bend in feet or the manufacturer's recommendation, whichever is less. Adequate lubrication of the proper type to reduce friction in conduit and duct pulls shall be utilized. The grease and oil-type lubricants used on lead sheathed cables shall not be used on nonmetallic sheathed cables.

In existing conduits where new cable will be installed which contain existing traffic and street light wiring as noted on the Drawings, the Contractor shall protect existing wiring from damage due to pulling new cable. Cable pulling compound shall be used to minimize cable pulling tensions and adverse effects on existing insulation, jackets and shields. Special caution shall be observed with existing loop lead-in cable because of its small size.

Cable shall be pulled into controller cabinets to allow approximately 4 feet of cable to be stripped and coiled around the bottom of the cabinet before connections are made.

Cable feeding span wire mounted signal heads shall be securely attached to the span wire by means of preformed lashing spaced no more than 18 inches apart. The preformed lashing rods shall be of the proper size to hold the cable snug against the span wire with no intervening gaps between the cable and the span wire and shall give a neat appearance without displaying obtrusive pigtails. Drip loops shall be left at the point of entrance to signal heads and conduit entrance fittings to allow moisture to drip from the cable rather than run down the cable into entrances. Where the drip loop from the pole outlet to the span wire exceeds 18 inches, the cable shall be secured to the pole with large pre-formed lashing rods to give a neat appearance.

All electrical cable for traffic signal facilities passing through handholes, junction boxes, conduit bodies, vaults and manholes shall be properly identified. Each cable shall be identified as to its function by using 3 wraps of colored plastic tape. The color representation shall be as follows:

Cable Function	Tape Color
Vehicular Signal Circuits	Red
Detector Circuits	Yellow
Pedestrian Signal Circuits	Green
Push Button Circuits	Brown
Interconnect	White
Telephone Circuit	Two White (White-White)
Service	Orange
Fire Pre-empt	Blue (light)

Colored tape identification shall also apply to cables spliced in pole and pedestal bases and aerial splices. Each cable shall be identified with the appropriate colored tape within 6 inches of a splice.

Signal cable in handholes, junction boxes and conduit bodies shall be appropriately marked near the center of the enclosed section of cable.

Signal cable passing through Seattle City Light handholes, manholes and vaults shall be identified with stainless steel imprinted markers secured to the cable at each end of the marker by the appropriate colored tape. The markers shall be clearly visible and legible and shall be located at the center of the enclosed length of cable. In manholes and vaults, markers shall also be attached approximately 2 feet from each cable entry point. The cable marker shall indicate "SED SERVICE" for Traffic Signal Service cable, or "SED SIGNAL" for all other traffic signal cable usage.

Work in manholes and vaults shall be done in accordance with the National Electric Safety Code and City Light Standards. Cable being installed in manholes and vaults with existing power cable should be racked on the wall opposite the power cable. If cable must be racked on the same wall with power cable, it shall be mounted above the power cable, maintaining a 6-inch minimum separation. Every effort should be made to minimize any negative impact of power cable noise and transients upon the new communications cable, while adhering to all safety regulations.

Requirements for cable bending, training and racking shall be in accorance with City Light Construction Standard U4-2.8. Some of the requirements are:

(a) Rack opposite the primary.
(b) Maintain proper cable separation.
(c) Signal cable should be above all other existing cable.
(d) Elevation changes shall be made behind other cable.
(e) Use existing rack, if available or use stud gun for installation to wall at 4-foot spacing, with 2-foot spacing near cable entrances.
(f) NEMA boxes should be on an end wall, 2-feet from the ceiling and be visible from the manhole opening.

Care shall be exercised in working near and within any City Light Vaults. Voltages present are as high as 26,000 volts, and the vault wiring will not be de-energized while the Contractor is working. City Light safety watch standards shall be adhered to while working in vaults. Seattle City Light shall be called at 386-1600 for safety watch 48 hours in advance of any entry into any City Light Vault.

8-31.3(9)B SPLICES

Signal cable shall be spliced only in pole or pedestal bases or aerially within 2 feet of the poles as shown on the Drawings. Aerial splices shall be made by taping first with electrician friction tape, then with a layer of Aquaseal (Material Standard 7364.7), and then finally with a layer of electrician tape.

At those locations where the existing signal cables are being utilized, the traffic signal cables shall be spliced in pole or pedestal bases and each individual conductor shall be insulated and the entire splice shall be waterproof.

Each individual splice or termination of extra leads shall be insulated, taped and made waterproof.

Loop wire shall not be spliced, except for splicing with the loop lead-in wire within the handhole.

Service cable or master cable shall not be spliced except as indicated on the Drawings.

8-31.3(9)C TERMINATIONS

Except at a splice, conductors shall be terminated on a terminal strip or push on connectors at the signal equipment which it is serving. Only terminal strips with screw-type pressure binding posts shall be used. Stranded conductors shall use compression-type pressure fittings at the terminal strip. Single solid conductors shall attach directly to the screw post; otherwise compression - type pressure fittings shall be used when more than one conductor is attached.

All electrical terminations shall be tightened to their prescribed torque value.

All terminals shall be marked with field wiring numbers printed on back or front mounted marking strips.

Connection of service wires to City Light wires will be by City Light.

All conductors at every termination and all terminal strips shall be permanently tagged with an identifying circuit number conforming to the Signal Wiring Diagram. Wire markers shall be fiberglass tape printed with the circuit numbers. Wire markers shall be applied within 6 inches of the termination.

8-31.3(9)D PEDESTRIAN PUSH BUTTON CABLE

The cable shield shall be grounded to the system ground at the controller end only. The cable shield between cabinet and splice shall be continuous throughout intermediate junction boxes and shall be insulated to prevent grounding in any junction box or in any conduit.

8-31.3(9)E ELECTRICAL SERVICE CONNECTIONS

The Contractor shall furnish and install equipment and wiring for 2 parallel 120 volts, 60 Hz AC electrical services. The electrical service cable shall be installed as indicated on the Drawings.

All electrical conductors within service enclosures shall be copper; except that conductors inside service enclosures shall be aluminum in serving exclusively an aerial distribution system which is totally aluminum. Electrical conductors as used herein are inclusive of bus bars, single conductor cables, conductors terminal lugs, grounding buses, etc. Those services which supply both aluminum aerial distribution feeders and other circuits shall employ copper buses, lugs, terminals, ground bars, etc.

The service neutral shall be connected to the ground in the controller cabinet. The service ground and neutral shall be kept isolated from the logic ground circuits in the controller cabinet.

The Engineer shall be notified when the Contractor is ready for the electrical service connection. The electrical service connection to the overhead secondary or underground vault service wires will be made by City Light.

8-31.3(10) GROUNDING AND BONDING

All metallic appurtenances containing electrical conductors, including cabinets, metallic conduit, metal poles, pedestals, and junction boxes, shall be made mechanically and electrically secure to form a continuous system which shall be effectively grounded.

Where conduit systems are employed, all metallic appurtenances shall be electrically bonded as required by Article 250-95 of the NEC.

The equipment grounding conductor shall in all cases be sized consistent with Table 250-95 of the NEC. All proportional adjustments in grounding conductor capacities shall be considered as accomplished by the installation of a ground rod at the junction box nearest each pole or pedestal in addition to the service ground rod. No "oversizing" of equipment grounding conductors will be required. However, a ground rod at the junction box nearest the pole or pedestal shall not be required if metallic conduit other than that going to the light standard enters the junction box. Where parallel electrical circuits exist in an electrical conduit, the equipment grounding conductor shall be sized as determined by the rating of the largest overcurrent device serving any circuit contained in the conduit. Only one equipment grounding conductor is required in any conduit.

Equipment grounding conductors, if insulated, shall employ insulation rated at 60 degrees centigrade or higher and shall be chemically compatible to other insulations contained within the system.

Identification of the equipment grounding conductor shall conform to all NEC requirements.

Grounding of conduit and neutral at the service point shall be as required under the NEC.

Service ground and neutral shall be kept isolated from the logic ground circuits in the controller cabinet.

A ground rod shall be driven in each new handhole adjacent to metal fixtures. A ground wire shall interconnect all ground rods in each handhole. A ground clamp shall be used to secure the ground wire to the ground rod. The neutral bus on the service switch shall be connected to the closest driven ground rod. Ground rods shall be 5/8-inch diameter by 10 feet long copper clad steel rods made by the molten welded process.

The ground clamp body shall be manufactured of forged cast or high-conductivity drawn copper alloy. Clamps shall provide high pressure contact directly between wire and rod by means of a set screw. The screw shall be of silicon bronze and shall have a square or hexagonal head.

Grounding of steel poles, posts, and pedestals shall be to ground rods in adjacent handholes.

8-31.3(11) POLE LINE HARDWARE INSTALLATION

Span wire shall be insulated above METRO trolley wires with plastic cable guard. The plastic cable guard shall extend a minimum of 4 feet past the nearest trolley wire. Plastic cable guard will be furnished by the City.

Span wire shall be secured to steel strain poles by means of pole bands, and to timber poles by means of single strand guy eye bolts. Span wire sag shall be 6 percent plus or minus 1 percent of the total span. Pole bands and eye bolts shall be installed as detailed on the Drawings.

Span wire shall be secured to eye bolts or strain clamps at poles by the use of self-locking cable clamp type dead-ending devices. Span wire shall be secured to bull rings and anchors by the use of cable guy wrap and guy thimbles. Span wire shall be secured to strain insulators by the use of cable guy wraps.

Strain insulators shall be installed on all spans and down guys at a distance of 9 feet from the face of wood poles and 3 feet to steel poles.

Tether wire shall be mounted a minimum of 18 feet above the roadway.

On steel poles, no lag or through bolts shall be used.

8-31.3(12) RELOCATING EQUIPMENT

When existing equipment is to be relocated, the Contractor shall furnish and install all necessary new materials and equipment (including all hardware) required to install the salvaged equipment in the new installation. Any new hardware required to complete the installation shall be of the same quality and type as hardware required in these Specifications for all other new work.

All traffic signals, flashing beacons, and illuminated signs to be relocated shall be cleaned, relamped and refinished to the same condition as new equipment.

8-31.3(13) REMOVAL AND SALVAGE OF EXISTING EQUIPMENT

Refer to Section 2-02.3(3)G and 2-02.3(7)C.

8-31.3(14) FIELD TESTING

The Contractor shall make the following tests on all new electrical circuits. If requested by the Engineer, test equipment shall be certified before and after the tests:

(a) Test for continuity of each circuit.

(b) Test for grounds in each circuit which consists of the physical examination of the installation to ensure that all required ground jumpers, devices and appurtenances do exist and are mechanically firm, meeting the requirements of Article 250 of the National Electrical Code.

(c) A megger test on each circuit between the conductor and ground with all switchboards, panel boards, fuse holders, switches, receptacles and over current devices in place and all readings recorded. The megger test shall be performed with all wiring installed but connections not made to controller, conflict monitor, load switches, or other plug connected accessories. The Contractor shall furnish the Engineer with 3 copies of the test results identifying observed readings with their respective circuits prior to any checkout of the installation to be turned on or cut over. One copy shall be filed in the controller cabinet.

The insulation resistance on all electrical circuits whose nominal voltage is between 115 volts and 600 volts other than direct burial cable shall not be less than 6 megohms between the conductor and ground on those circuits with total single conductor lengths of more than 2,500 feet, nor less than 8 megohms for those circuits with single conductor length 2,500 feet or less.

For those circuits below 115 volts nominal and all direct burial circuits, the insulation resistance shall not be less than 2 megohms to ground, except not less than 10 megohms for loop wire.

Any change in the above stated minimum readings must be approved in writing by the Engineer. Only those factors based on dielectric properties of conductor insulation, splicing insulations, terminal strips, etc., will be cause for consideration of variance.

(d) A functional test (intersection check-out) in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test will be performed after all field connections are made to the controller cabinet.

Any fault in any material or in any part of the installation revealed by these tests shall be replaced or repaired by the Contractor in a manner approved by the Engineer, and the same test shall be repeated until the system is approved by the Engineer.

8-31.3(15) FINAL INSPECTION

As soon as practicable after the completion of the entire work, it will be examined by the Engineer. The Contractor will be notified when the examination is to be made. The Contractor shall submit, at this time, any as-built wiring diagrams for field wiring and/or controller assembly wiring revisions.

If the inspection reveals any defects in the work as specified and as detailed on the Drawings, such defects shall be repaired or unsatisfactory work be replaced as the Engineer may direct before final acceptance. No extension of the contract time will be granted because of the time required to remedy such defects.

8-31.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Signal Wiring, (Location)" will be by lump sum for each intersection. Measurement for "Detector Loop, (Size)" will be by each complete installation.

8-31.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-31 will be at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Traffic Signal Controller, (Description)," per each.
(2) "Signal Head, (Type) (Description)," per each.
(3) "Pedestrian Push Button Assembly," per each.
(4) "Detector Loop, (Size)," per each.
(5) "Sign, Interior Illuminated, (Size)," per each.
(6) "Sign, Crosswalk, Illuminated," per each.
(7) "Interconnect Cable, (Type)," per linear foot.
(8) "Aerial Terminal Compartment," per each.
(9) "Signal Wiring, (Location)," per lump sum.
(10) "Span Wire," per linear foot.
(11) "Span Wire, Catenary," per linear foot.
(12) "Relocate (Item)," per each.
(13) "Relocate (Item)," per linear foot.
(14) "Relocate (Item)," per lump sum.

The unit contract price for "Traffic Signal Controller, (Description)" shall include all costs for the work required to furnish and install the controller, including but not limited to cabinets, all circuiting, equipment and internal wiring, manufacturer's testing and the pedestal for Type I cabinets.

The unit contract price for "Signal Head, (Type) (Description)" shall include all costs for the work required to furnish and install the signal head, including all mounting hardware for the mounting specified, installation, alignment, testing; and when specified, bimodal fiber optic arrow lens, installation of City-furnished interior illuminated traffic sign, louvers, and programming as may be required.

The unit contract price for "Pedestrian Push Button Assembly" shall include all costs for the work required to furnish and install the pedestrian push button assembly, including the button and housing, 1 or 2 directional signs as specified, and required mounting hardware. Payment for pedestrian push button posts and foundations will be made in accordance with Section 8-32.5.

The unit contract price for "Detector Loop, (Size)" shall include all costs for the work required to saw cut the pavement and furnish and install the loop detector wire and conduit, including lead-in cable to the first handhole from the loop, rope, tar, splices, hardware, and restore the pavement surface as specified in Section 8-31.3(5)A herein.

The unit contract price for "Sign, Interior, Illuminated (Size)" shall include all costs for the work required to furnish and install the interior illuminated sign, including all mounting hardware and sign wiring.

The unit contract price for "Sign, Crosswalk, Illuminated" shall include all costs for the work required to furnish and install the illuminated crosswalk signal, including all mounting hardware, photoelectric cell installed on a photoelectric control mounting bracket, service wiring, and sign wiring as indicated on the Drawings and in the Specifications.

The unit contract price for "Interconnect Cable, (Type)" shall include all costs for the work required to furnish and install the cable in conduits or on poles; and shall include all hardware taps and splices for a complete, interconnected system as specified.

The unit contract price for "Aerial Terminal Compartment" shall include all costs for the work required to furnish and install the compartment, and shall include mounting hardware and sealing for a complete compartment as specified.

The lump sum contract price for "Signal Wiring (Location)" shall include all costs for the work required to furnish and install all signal wiring at the intersection indicated, including signal lead wiring, push-button wiring, sign (attached to signal) wiring, service wiring, and loop lead-in wiring to the last handhole before the loop. Interconnect cable wiring will be included in payment for "Interconnect Cable." Internal controller wiring will be included in payment for "Traffic Signal Controller."

The unit contract price for "Span Wire" and "Span Wire, Catenary", shall include all costs for the work required to furnish and install the spanwire, including wire, clamps, insulators and all hardware for the span wire installation complete.

The unit contract price for "Relocate (Item)," shall include all costs for the work required to remove and reinstall the item, including hardware and rehabilitating signals and signs if required.

Existing materials required to be relocated and found to be unsatisfactory by the Engineer shall be replaced by new material and the cost thereof will be paid for as extra work per Section 1-09.4.

All costs for providing Police control at an intersection, due to one or more vehicular or pedestrian signals going dark or fail to function properly as a result of the Contractor's work, shall be at the Contractor's expense.

All final connections or energizing of electrical signal systems to overhead secondary or to secondary in vaults or handholes will be made by City Light at no cost to the Contractor.

All costs for the return and replacement of material or equipment found to be defective within the guarantee period shall be at the Contractor's expense.

All costs for furnishing and installing hardware not specifically called out, but required to complete the work shall be included in the unit contract prices for the bid items comprising the improvement.

The Contractor will be charged with the actual cost to the City due to any retesting made as required by the provisions in Section 8-31.3(2) and 8-31.3(14).

There will be no charge for the first safety watch on any contract, as specified in Section 8-31.3(9)A. All costs for additional safety watches shall be at the Contractor's expense.

If an intersection is found to be incomplete or inadequate, in accordance with Section 8-31.3(1)B, the Contractor will be charged the actual costs to the City for the unsuccessful review of the intersection. The Contractor will not be billed for the inspection which indicates the signal system is ready for flashing or cut-over.

SECTION 8-32 POLES, PEDESTALS AND FOUNDATIONS

8-32.1 DESCRIPTION

8-32.1(1) GENERAL

This work shall consist of furnishing and installing poles, luminaire extensions, pedestals, posts, mastarms, concrete foundations and back guy assemblies as indicated on the Drawings and in accordance with these Specifications and Standard Plan No's. 524, 540, 541, 543 and 560 through 565.

8-32.1(2) APPLICABLE CODES

See Section 8-30.1(2) for applicable codes.

8-32.1(3) SHOP DRAWINGS

The Contractor shall submit shop drawings in accordance with Section 1-05.3 for the following material:

(a) All metal poles
(b) Nut covers
(c) Mast arms
(d) Luminaire extensions
(e) Anchor bolts, nuts, washers
(f) Bolt extenders
(g) Pedestals

All strain poles or street light only poles which deviate from the Drawings shall include certification by a licensed Professional Engineer that the metal poles meet all structural requirements of Section 9-33.

8-32.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Concrete for foundation	5-05
Poles, Mast Arms Pedestals, and Foundations	9-33
Back Guy Assemblies	9-33

All poles will be subject to inspection at the point of manufacture and at the point of delivery. Inspection and acceptance at the point of manufacture shall not relieve the Contractor from obligation to furnish material in accordance with the Specifications.

All materials, and equipment supplied under this Specification shall be guaranteed against defective workmanship and material for a period as indicated in Section 1-05.10. The Contractor shall be responsible for the return and replacement of any material or equipment found to be defective within the guarantee period, including labor, freight, shipping and delivery. All material returned to the supplier under the guarantee shall be repaired or replaced and returned to the City of Seattle within 30 days of receipt.

8-32.3 CONSTRUCTION REQUIREMENTS

8-32.3(1) POLES

8-32.3(1)A GENERAL

The Contractor shall lay out pole locations and grades as indicated on the Drawings. Poles shall be located to provide a minimum of 3 feet clearance from the face of the curb.

Poles shall be handled in loading, unloading and erecting in such a manner that they will not be damaged.

Field repair of galvanized surfaces shall be accomplished by coating with a heated zinc alloy solder to a minimum thickness of 2 mils per ASTM A 780.

The Contractor shall repair or replace all rejected poles.

8-32.3(1)B METAL POLES AND PEDESTALS

Poles shall not be erected before concrete foundations have set 7 days. Poles shall not be loaded before concrete foundations have set 28 days.

Signal related poles shall not be grouted until after turn-on or cut-over.

Leveling nuts shall be used on all metal poles. Leveling nuts and washers shall be placed on anchor bolts to allow approximately 1 inch of dry pack mortar under the leveling nut. Poles shall be placed on the bolts and the leveling nuts and washers. The leveling and locking nuts and washers shall then be adjusted to plumb the pole.

The pole shall be raked before loading such that it will be plumb after all loads have been applied. Plumb shall be defined as the condition existing when an imaginary vertical line from the center line of the pole top passes through the center line of the pole base at ground level. A tolerance of plus or minus 0.17 inches per foot of pole height above the ground will be permitted with the exception that in no case shall the pole lean toward the street. Locking nuts shall be torqued to the manufacturer's recommendations.

After pole anchor bolts and rake have been inspected and approved by the Engineer with loads applied, tape shall be placed around the periphery of the anchor bolts and leveling nuts, then dry pack mortar shall be placed under the pole to completely fill the void under the base outside the anchor bolts by packing from the bolts and finishing towards the outside. Dry pack mortar shall be sloped at approximately 60 degrees away from the base plate. Mortar shall consist of a 1:3 mixture of cement and fine sand with just enough water so that the mixture will stick together on being molded into a ball by the hand and will not exude free moisture when so pressed. There shall be a 3/4 inch drain tube in the mortar on the lowest side of the base to provide drainage from within the pole or pedestal.

Installation of pedestals shall meet the same requirements for installing pole, except raking will not be required.

All metal poles shall be identified (numbered) by the use of City Light provided or approved pole number plates. An alternative when the plates are not available is identification in accordance with numbering set forth on the Drawings by utilizing 3-inch Series "C" numbers. The light pole number shall be 3 feet above the concrete base oriented 45 degrees from the place of the bracket arm in the direction of approaching traffic. All numbers shall be clearly visible to approaching motorists. Paint for the numbering shall be black alkyd gloss enamel meeting Federal Specification TT-E-489. Numbers shall be applied over a compatible primer. An alternative application of a nonreflective lettering film with a pressure sensitive, self-adhering adhesive back may be used when approved by the Engineer.

8-32.3(1)C WOOD POLES

Wood poles shall be set at the depth indicated in the following table:

RECOMMENDED POLE SETTING DEPTH

Length of Pole (Feet)	Minimum Set Depth in Earth (Feet)	Set Depth in Rock (Feet)
20	5.0	3.0
25	5.0	3.0
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0

After each wood pole is set in the ground to the specified depth, the space around the pole shall be backfilled with selected earth or sand, free of rocks and other deleterious material, placed in layers approximately 4 inches thick. Each layer shall be moistened and thoroughly compacted. The poles shall be raked as necessary to be plumb as defined in Section 8-32.3(1)B after loading.

8-32.3(2) FOUNDATIONS

8-32.3(2)A GENERAL

Foundations shall be Class 5 (1-1/2) concrete and be of the size and configuration indicated on the Drawings. Foundations shall be constructed in undisturbed ground by placing concrete in auger-bored holes or rectangular holes. Concrete shall be placed against undisturbed earth. In unstable ground, metal forms may be used for the top 18 inches of foundation. Each foundation shall be poured in one continuous pouring operation. For purposes of this requirement, delays of more than 20 minutes are not acceptable as one continuous pour. When new excavations are near an existing foundation the Contractor shall provide temporary support for the existing structure until the new concrete has cured.

Anchor bolts shall be set securely in place and held in a vertical position with the specified bolt projection and at the specified bolt circle to match the exact hole pattern of the item to be installed. The top of the bolts shall all be at the same elevation. A steel template shall be used at the lower end and a wood or steel template shall be used at the upper end of the anchor bolt to maintain the correct bolt pattern and spacing. The lower template shall be bolted or welded to the anchor bolt and left in the foundation. Anchor bolts shall not be bent or cut after fabrication.

Prior to placing concrete, all projecting anchor bolts shall be taped with a corrosion protection tape from a point 6 inches below the top of the foundation to the top of the bolt. Tape shall be in accordance with Material Standard 7367.3 and shall remain permanently in place. Nuts and washers shall be installed over the tape. Immediately after concrete is placed, the location of the anchor bolts shall be checked with a template conforming to the bolt pattern of the bases of the poles. Concrete shall be cleaned from anchor bolts and conduit after the concrete is placed.

Concrete shall be float-finished, edged and brushed where necessary. Bending anchor bolts after concrete has set will not be allowed.

Bending of anchor bolts shall be cause for rejection and removal of entire foundation.

8-32.3(2)B CONTROLLER FOUNDATIONS

Anchor bolts shall be the size specified by the controller manufacturer. A bead of waterproof sealant shall be installed under the lip of the controller cabinet prior to installing the cabinet to prevent moisture penetration.

Tops of the controller foundations shall be level with 6-inch minimum height above the adjacent surface.

A 3/4-inch diameter tubular drain hole shall be installed in all concrete foundations for signal controllers Type II and III.

8-32.3(2)C POLE, PEDESTAL AND PEDESTRIAN PUSH-BUTTON POST FOUNDATIONS

Reinforcing steel shall be kept 2 inches clear on all sides of the foundation, and shall be set securely in place.

Where the foundation is in a paved area such as a sidewalk, the foundation shall be held 3-1/2 inches below and parallel to finish grade. Top of the foundation shall be given a float finish. The paving material shall then be placed over the top of the foundation to match the contour and finish of the adjacent surface.

Where foundations are adjacent to a sidewalk the top of the foundation shall be at sidewalk grade and shall be poured up to the sidewalk with a construction joint at the sidewalk edge.

Where the foundation is in an unpaved area, the top 6 inches of concrete shall be formed in a square form. The top of the square shall be 1 inch above the surrounding surface.

Each foundation shall be constructed with 2 conduit entries. If only 1 conduit entry is indicated on the Drawings, a second shall be installed in the foundation and stubbed out 18 inches from the foundation directed the opposite direction of the first, unless directed otherwise by the Engineer.

Conduits shall extend a minimum of 3 inches above final grade. The ground rod (where required) shall extend a maximum of 6 inches above final grade. Anchor bolts shall be installed with sufficient projection above the foundation to allow for a minimum of 3 threads above the upper nut. Where inadequate projection is provided, bolt extenders shall be utilized or complete removal and replacement of the foundation shall be required.

A 13-1/2 inch bolt circle shall be maintained on all Pedestal anchor bolts.

8-32.3(3) BACK GUY ASSEMBLIES

Back guy assemblies for wood poles shall be constructed in accordance with details on Standard Plan No. 560.

All thru bolts shall be properly trimmed and treated.

8-32.3(4) RELOCATING EQUIPMENT

When equipment is to be relocated, the Contractor shall furnish and install all necessary materials and equipment (including all hardware) required to complete the new installation. Any new hardware required to complete the installation shall be of the same quality and type as hardware required in these specifications for other new work.

8-32.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for davit poles and the attached davit arm will be per each as a combined unit.

8-32.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-32 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Pole, Steel Strain, (Type)", per each.
(2) "Pole, Steel Strain Davit, (Type) w/(Length) Arm", per each.
(3) "Pole, Steel Lighting (Length)", per each.
(4) "Pole, (Material) Lighting Davit (Length) w/(Length) Arm," per each.
(5) "Pole, Steel Mast Arm", per each.
(6) "Pole, Aluminum, (Length)," per each.
(7) "Pole, Wood, (Length)," per each.
(8) "Luminaire Extension," per each.
(9) "Mast Arm (Length)," per each.
(10) "Pedestal, Steel, (Length)," per each.
(11) "Pedestrian Push-Button Post," per each.
(12) "Foundation, (Use)," per each.
(13) "Back Guy Assembly," per each.
(14) "Relocate (Item)," per each.

The unit contract price for "Pole, Steel Strain, (Type)," "Pole, Steel Mast Arm," and "Pole, Aluminum (Length)" shall include all costs for the work required to furnish and install the pole, including handhole, bracket arm flange and bolts, base plate, all necessary hardware, raking, plumbing, and grouting.

The unit contract price for "Pole, Steel Strain Davit (Type) with (Length) Arm" and "Pole, (Material) Lighting Davit (Length) with (Length) Arm" shall include all costs for the work required to furnish and install the pole, the extension arm, including handhole, steel pole extension tenon, steel pole luminaire tenon, welding, base plate, all necessary hardware, raking, plumbing, and grouting.

The unit contract price for "Pole, Wood (Length)," shall include all costs for the work required to furnish and install the wood pole, including excavation, backfill material, and compaction.

The unit contract price for "Mast Arm, (Length)" shall include all costs for the work required to furnish and install the mast arm with all necessary hardware, fittings and end cap.

The unit contract price for "Pedestal, Steel, (Length)," shall include all costs for the work required to furnish and install the Pedestal, and shall include installation, plumbing, raking and all hardware as detailed on the Drawings.

The unit contract price for "Pedestrian Push-Button Post," shall include all costs for the work required to furnish and install the post, including all drilling and tapping, plumbing, steel pipe, pipe cap, "meter collar", grout, pipe flange, and all required hardware.

The unit contract price for "Foundation, Traffic Signal Controller (Type)," and "Foundation, (Use)," shall include all costs for the work required to construct the foundation in place as specified and detailed on the Standard Plans, including excavation, backfill, forming, concrete, reinforcing steel, anchor bolts, ground rods, washers, nuts, nut covers, grout and drainage hardware as specified.

All costs for the work required to provide temporary support for existing foundations or other structures near the construction of new foundations as specified in Section 8-32.3(2)A shall be included in the unit contract price bid for "Foundation, (Use)."

The unit contract price for "Back Guy Assembly," shall include all costs for the work required to furnish and install the Back Guy Assembly, and shall include installation of all guy cable, hardware, insulators, pipe, fittings, and anchor as detailed on Standard Plan No. 560.

The unit contract price for "Relocate (Item)" shall include all costs for the work required to remove and reinstall the item, including hardware and rehabilitation as required.

When installation of a new pole, pedestal, or post disturbs existing surface improvements that will remain, the cost of surface restoration will be included in the unit contract price of the pole, pedestal, or post as appropriate.

All costs for the return and replacement of material or equipment found to be defective within the guarantee period shall be at the Contractor's expense.

The City reserves the right to return any signal head or heads, within 1 year from the date of receipt, which fail to comply with these Specifications. The Contractor shall fully reimburse the City for all such heads.

SECTION 8-33 CONDUIT AND TRENCHING

8-33.1 DESCRIPTION

8-33.1(1) GENERAL

This work shall consist of conduit trenching, and furnishing and installing conduit, condulet, condulet junction boxes, and handholes for street lighting, traffic, and irrigating systems as indicated on the Drawings and as specified in these Specifications and Standard Plan No's. 550, 580 and 581.

8-33.1(2) APPLICABLE CODES

See Section 8-30.1(2) for applicable codes.

8-33.1(3) SHOP DRAWINGS

The Contractor shall submit Shop Drawings for the following in accordance with Section 1-05.3:

(a) Conduit and Fittings
(b) Condulets Junction Box
(c) Stand-off Brackets
(d) Brackets used in the CSO structure
(e) Expansion Fittings
(f) Weatherhead
(g) Seals and Sealing Compounds
(h) Galvanizing Repair Material
(i) PVC Coatings to be field installed
(j) Handholes
(k) Flexible Conduit

8-33.2 MATERIAL

Materials shall meet the requirements of the following Sections:

Conduits	9-34
Handholes	9-34
Paint	9-08

8-33.3 CONSTRUCTION REQUIREMENTS

8-33.3(1) TRENCHING

Excavation required for the installation of conduit, foundations, and other materials shall be performed in such a manner as to cause the least possible injury to the streets, sidewalks, and other improvements. Trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. The material from the excavation shall be placed where the least interference to vehicular and pedestrian traffic and to surface drainage will occur.

Excavating shall not be performed until immediately before installation of conduit and other materials. Excavation after backfilling shall be kept well filled and maintained in a smooth andwell drained condition until permanent repairs are made. Work shall be scheduled to permit placing of conduit prior to paving or landscaping operations.

The Contractor shall take any necessary steps to keep excavated native material from becoming saturated beyond the critical moisture limits. Native excavated material shall be protected from weather and contamination by waterproof sheeting or other means approved by the Engineer. When otherwise suitable native backfill material from the trench excavation becomes unsuitable due to failure by the Contractor to protect the material from moisture or contamination, the Contractor shall backfill the trench with Mineral Aggregate Type 17. In general, backfill material from excavation shall be free from large or frozen lumps, wood or other extraneous material and of a quality acceptable to the Engineer.

If the trench is not backfilled the same day conduit is placed, one end of the conduit shall be left free until backfilling is started, or a rigid non-metallic conduit expansion joint shall be installed in the conduit run.

At the end of each day's work and all other times when construction operations are suspended, all equipment and other obstructions shall be removed from that portion of the roadway which may be required to be open for use by public traffic.

Special care shall be taken in backfilling tunnel sections used for conduit installations under existing pavement so that all voids are completely filled. Water saturated sand-pea gravel mixture Mineral Aggregate Type No. 5 may be used provided the space can be completely filled using vibrators.

Conduit shall be laid to provide a minimum of 24 inches of cover at street crossings, 36 inches cover under asphalt roadways, 48 inches of cover under the bottom of railroad ties (conduit under railroad tracks shall be rigid steel), and 18 inches of cover at all other locations, unless otherwise noted on the Drawings.

Bottom of trenches for all conduit shall be free of sharp irregularities which would cause damage to the PVC conduit coating and excessive bending of the conduit. The first 6 inches of backfill shall be free of rocks. The Engineer shall approve all conduit installations prior to backfilling the trench.

Trench backfilling shall be compacted to 95 percent of maximum density in accordance with Section 7-10.3(11) (COMPACTION OF BACKFILL). Optimum moisture content and maximum density will be determined in accordance with Section 2-03.3(14)E (COMPACTION CONTROL TESTS).

8-33.3(2) CONDUIT INSTALLATION

8-33.3(2)A GENERAL

Conduit shall be installed as noted on the Drawings. When installing conduit under existing pavement or sidewalks, removal shall meet the requirements of Sections 2-02.3(3)A, 2-02.3(3)C, and Section 2-02.3(3)F respectively. Pavement and restoration shall conform with the requirements of Sections 5-07 and 8-14 respectively. Conduit and fittings within CSO structures and sewer pump station wet wells shall be considered to be in Class I environment. All construction shall be in compliance with Article 501 of N.E.C.

Conduit shall be installed in the number, type, size and location indicated on the Drawings. Deviations from the locations indicated or relocations that may be required by field conditions shall be approved in writing by the Engineer prior to installation.

For conduit runs that deviate from the planned location and are to be buried in concrete structures such as floor slabs, retaining walls, abutments, or bridge superstructures, the Contractor shall be required to submit an as-built drawing showing the new location of all the rough-in conduit to the Engineer prior to pouring the concrete. The as-built drawing shall show the conduit run in red and be dimensioned to the nearest 1 inch.

Conduit runs parallel to curbs shall be placed adjacent to back of curb, or according to the details on the Drawings or the appendix of the Project Manual, except where in conflict with existing facilities.

Changes of conduit direction shall be made with manufactured or fabricated elbows of radius not less than that noted in the NEC.

All conduit shall be thoroughly cleaned and a proper size mandrel pulled through it prior to installing wires or pull cord. Mandreling shall be done in the presence of the Engineer.

Existing conduit to be incorporated into a new system shall be cleaned with a mandrel and a cylindrical wire brush and blown out with compressed air.

Suitable marker stakes or tacks shall be set flush with the ground to locate the ends of conduits which may be buried so that they may be located in the future.

Conduit entrances into metal junction boxes (Except NEMA 1) shall be drilled and tapped a minimum of 3 full threads for the size conduit used. Bosses shall be provided where the wall thickness is not sufficient for the minimum number of threads.

Entry to electrical vaults or other structures shall be made such that the physical integrity of the vault or structure is not impaired. Any hole for entry to vaults or structures shall be of a diameter no greater than 1-1/2 times the diameter of the conduit entering the vault.

Annular spaces around conduit, ground wire, ducts, at wall penetrations of vault or other structural walls shall be filled with 1:3 cement to fine sand dry pack mortar using just enough epoxy grout mixed with an equal quantity of water so that the mortar mixture will stick together on being molded into a ball by hand and will not exute free moisture. Prior to placing the dry pack mortar, the annular surfaces of the spaces to be filled shall be given a thin continuous film of undiluted epoxy. Threaded inserts shall be coated with an approved rust preventative compound which is soluble in petroleum solvent.

Conduit entering through the bottom of a handhole shall be located near the end walls to leave the major portion of the box clear. Conduit shall enter from the direction of the run, terminating 6 to 8 inches below the handhole lid and near the box wall.

At locations designated by the Engineer, fittings shall be installed to provide a conduit channel that will permit freedom for installing the electrical control wires. When conduit fittings are indicated on the Drawings, or where their installation is required by the Engineer, the Contractor shall also furnish all necessary covers and gaskets. Expansion/deflection fittings shall be installed at all structure expansion joints.

Conduits shall be attached to walls and other surfaces (except poles) using one hole mallable iron pipe clamps and clamp backs.

Rigid steel conduit may be jacked or bored when approved by the Engineer in writing.

New conduit that does not have wire installed shall have a pull cord installed.

For hazardous areas as defined by the NEC, conduit entrances into metal junction boxes shall be drilled and tapped a minimum of 5 full threads for the size conduit used. Bosses shall be provided where the wall thickness is not sufficient for the minimum number of threads.

8-33.3(2)B RIGID STEEL CONDUIT AND PVC-COATED RIGID STEEL CONDUIT

When rigid steel conduit (RSC) is cut, the ends shall be made square and true with conventional pipe cutting equipment. Conduit shall be threaded with a standard conduit cutting die. Burrs and sharp corners at the end of each conduit shall be removed with a tapered reamer. Threads shall be cleaned of all metal, lubricants and red lead. Conduit shall be joined by the use of rigid steel conduit couplings. Slip joints or field cut running threads will not be permitted for coupling conduit. When a standard coupling cannot be used, a threaded union coupling shall be used upon approval of the Engineer. Conduit threads shall be coated with a conduit thread compound designed to ease assembly and disassembly, and to improve electrical conductivity. The compound shall be Appleton Company Type TLC-3 or approved equal. Conduit shall be tightened securely to prevent the entrance of moisture, concrete or other foreign material, and to provide a good electrical connection throughout the entire length of the conduit run. The method of tightening shall not damage the conduit or coupling. Where the coating on the conduit or the coupling has been damaged, it shall be thoroughly painted with galvanizing repair paint Federal Spec. MIL-P-21035 per the manufacturer's recommendations.

All bushings shall be of the insulated throat type. The entire conduit system shall be properly bonded and grounded in accordance with N.E.C.

Installation of the PVC-coated system shall be made in conformance with the following:

(a) **Coupling and Joining:** All connections shall be made with strap wrenches. The conduit shall be pulled up until it is tight enough to be rigid and provide good electrical continuity. Over-tightening that results in gouging of the PVC coating will not be permitted. After each connection is completed, any gouges, cuts or abrasions shall be coated with approved touch-up compound. Solvent weld the sleeves to the conduit at each connection by applying touch-up compound to the PVC coating before screwing on the sleeve. Cutting off plastic sleeves shall be cause for rejection of that length of conduit.

(b) **Cutting:** The conduit shall be tightened securely in a vise or chuck. The cut shall be made with a roll cutter or hack saw. When using either a jaw vise or a chain vise, the use of vise adaptors will be required. If vise adaptors are unavailable, a jaw vise shall be used and the portion of the coated conduit to be gripped in the vise shall be wrapped with emery cloth with the coarse side toward the conduit. The use of a chain vise without adaptors will not be permitted.

(c) **Threading:** When using a hand threader, a tool with an adjustable guide shall be used. If the threader to be used does not have an adjustable guide, ream the stationary guide 0.10 inch to accomodate the plastic coating. Whittling of the PVC coating will not be permitted. After threading, apply touch-up compound to indentations made by the vise. Raw field cut threads shall be protected by the methods set forth above. For machine threading, the use of a threader designed for coated conduit shall be used.

(d) **Bending:** PVC-coated conduit may be bent with conventional bending equipment, however, the internal walls of the shoes shall be machined out approximately 0.050 inch. Bending shall be accomplished by segmented bending rather than a one-shot bend. For sharp bends, saddles, or offsets, a PVC-coated hickey shall be required. Any cuts, gouges, or abrasions shall be coated with touch-up compound. Coating the exterior of the conduit, prior to bending, with a slippery substance such as wire-pulling compound will be permitted.

(e) **Touch-up:** During the installation of the coated conduit, the Contractor shall assure that no metal is left exposed. Metal exposed as the result of field cuts shall be coated with touch-up compound. If in an emergency an uncoated accessory must be used, it should also be coated with touch-up compound. Nonspray type touch-up compound shall be used.

(f) One hole malleable iron pipe strap, pipe spacers (clamp backs), and mounting brackets shall be PVC coated.

8-33.3(2)C PVC CONDUIT

PVC conduit shall be assembled with solvent welded joints in accordance with the manufacturer's written instructions. Bends and fittings shall be factory-produced when available.

8-33.3(3) CONDUIT RISERS

Conduit to be mounted on the outside face of metal poles shall be mounted by use of 3/4 inch stainless or galvanized steel band straps. After steel bands have been drawn tight, the

ends shall be cut and folded under to eliminate protruding edges. Bands shall be placed a maximum of 3 feet apart.

Conduit less than 2 inches in diameter mounted on wood poles shall be mounted by use of 2-hole malleable conduit clamps spaced per N.E.C. A minimum of 2 clamps shall be used per length of conduit.

Conduit sized 2 inches and larger, or more than 1 conduit installed on wood poles, shall be installed using stand-off type brackets. Stand-off brackets shall be installed per N.E.C. with a 10 foot maximum spacing. Attachment shall be near the top of each 10 feet length of conduit.

All conduit risers shall be grounded with a ground clamp installed 8 feet above finished grade. Where conduit risers are connected to a ground rod, a ground rod handhole shall be provided as part of the conduit riser bid item.

The conduit shall be wrapped with corrosion protection tape conforming to Material Standard 7367.3, 8 inches above and below finished grade.

Conduit risers shall be the size indicated on the Drawings. The 90 degree bend, and conduit up the pole to 10 feet above the surface shall be rigid steel. The riser above the 10-foot level shall be PVC, Schedule 80. The riser shall be equipped with a PVC weatherhead and shall be grounded as indicated on Standard Plan No's. 580 and 581.

8-33.3(4) HANDHOLES

When required by the Drawings, handhole extensions shall be provided and installed.

Handholes shown on the Drawings, unless dimensioned, are located schematically, and shall always be located outside the pedestrian travel way unless directed otherwise by the Engineer.

8-33.3(5) JACKING OR BORING

Rigid steel conduit may be jacked or bored when approved by the Engineer. Rigid non-metallic type conduit may be installed under existing pavement if a hole larger than the conduit is predrilled and the conduit installed by hand.

8-33.4 MEASUREMENT

Bid items of work completed pursuant to Contract Documents will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Conduit, (Type), (Size)," will be by the linear foot measured on the ground along the alignment of the conduit between center line of poles or to the 90 degree bend of a conduit riser, or equipment or to the inside face of handholes or vaults.

Measurement for "Conduit Riser, (Size)" will be by each from and including the weatherhead to and including the 90 degree rigid steel bend underground.

No separate measurement will be made for jacked or augered conduit. No measurement will be made for removal or restoration of surface improvements where the conduit is jacked or augered, but such measurement will be made at jacking pits and access holes in accordance with Section 2-02 and 5-07.

8-33.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-33 will be made at the unit contract prices bid only for the pay items listed or referenced below:

(1) "Conduit, (Material), (Size)," per linear foot.
(2) "Trenching, Conduit," per linear foot.
(3) "Conduit Riser, (Size)," per each.
(4) "Handhole (Type)," per each.
(5) "Relocate Handhole," per each.

The unit contract price for "Conduit, (Material), (Size)" shall include all costs for the work required to furnish and install the conduit in the trench, and shall include all bends, fittings, condulets and hardware required.

Where conduit is jacked or augered, payment will be made for conduit trenching that would have been required had the conduit been placed in open cut.

The unit contract price for "Trenching, Conduit" shall include all costs for the work required to excavate, backfill with native material, and compact the trench section for the installation of conduit, including trenching for conduit riser. Backfill from sources other than the trench excavation required due to the unsuitability of native material will be paid for separately in accordance with Section 4-01.5, unless the native material is determined by the Engineer to be unsuitable due to the Contractor's not meeting the requirements for protection from weather and contamination.

The unit contract price for "Conduit Riser, (Size)" shall include all costs for the work required to furnish and install the complete riser, including all conduit, fittings, clamps and hardware from and including the weatherhead to and including the 90x rigid steel bend underground.

The unit contract price for "Handhole (Type)" shall include all costs for the work required to furnish and install the handhole, including excavation, backfill and compaction, and handhole extensions when required.

The unit contract price for "Relocate Handhole" shall include all costs for the work required to remove and reinstall the handhole, including hardware and rehabilitation as required.

DIVISION 9
MATERIALS

SECTION 9-00 DEFINITIONS AND TESTS

9-00.1 FRACTURE

Fractured aggregate is defined as aggregate particles which have one or more fractured faces. A face will be counted as fractured whenever one-half or more of the projected area of the particle is comprised of a fractured face when viewed normal to the fractured face.

9-00.2 WOOD WASTE

Wood waste is defined as all material which, after drying to constant weight, has a specific gravity of less than 1.0.

9-00.3 TEST FOR WEIGHT OF GALVANIZING

At the option of the Engineer, the weight of zinc in ounce per square foot required by the various galvanizing specifications may be determined by an approved magnetic thickness gage suitably checked and demonstrated for accuracy, in lieu of the other methods specified.

9-00.4 SIEVE ANALYSIS OF AGGREGATES

Sieve analysis for acceptance of aggregate gradation shall be performed by procedures described in WSDOT Test Method 104 as follows:

(a) Procedure A (full-washed testing) shall be the sole basis of acceptance for portland cement concrete aggregate, aggregate for BST, and for aggregate for ACP that is being stockpiled for use on a future contract. All other aggregates may be accepted based on Procedure A or as provided below.

(b) Procedure B (partial washed testing, with correlation) may be used as the basis of acceptance for all aggregate other than those described in item (a) above.

(c) Procedure C (dry sieving with correlation) may be used for informational testing or acceptance testing for all aggregates except as restricted in item (a) above. In case of disputed results obtained by Procedure C, Procedure A shall be the reference test method.

9-00.5 DUST RATIO

The dust ratio is defined as the percent of material passing the U.S. No. 200 sieve divided by the percent of material passing the U.S. No. 40 sieve.

9-00.6 SAND/SILT RATIO

The sand/silt ratio is defined as the percent of material passing the U.S. No. 10 sieve divided by the percent of material passing the U.S. No. 200 sieve.

9-00.7 GALVANIZED HARDWARE, AASHTO M 232

An acceptable alternate to hot-dip galvanizing in accordance with AASHTO M 232 will be zinc coatings mechanically deposited in accordance with AASHTO M 298, providing the minimum thickness of zinc coating is not less than that specified in AASHTO M 232, and the process will not produce hydrogen embrittlement in the base metal. Sampling and testing will be made by the Engineer in accordance with commonly recognized national standards and methods used in the laboratory of the Seattle Engineering Department.

SECTION 9-01 PORTLAND CEMENT

9-01.1 TYPES OF CEMENT

Cement shall be classified as Type II cement or Type III cement.

9-01.2 SPECIFICATIONS

9-01.2(1) TYPE II PORTLAND CEMENT

Type II cement shall conform to the requirements for Type II cement of the Standard Specifications for Portland Cement, AASHTO M 85, except that the content of alkalies shall not exceed 0.75 percent by weight calculated as Na_20 plus 0.658 K_20.

Type II cement shall meet the requirements of the above specifications for compressive strength and for time of setting by the Vicat method, AASHTO T 131.

9-01.2(2) TYPE III PORTLAND CEMENT

Type III cement in cloth bags shall not be used. Type III cement shall conform to the requirements for Type III cement of the Standard Specifications for portland cement, AASHTO M 85, except that the content of alkalies shall not exceed 0.75 percent by weight calculated as Na_20 plus 0.658 K_20. It shall meet the requirements of the above specifications for compressive strength and for time of setting by the Vicat method, AASHTO T 131.

9-01.2(3) LOW ALKALI CEMENT

The percentage of alkalies in low-alkali cement shall not exceed 0.60 percent by weight calculated as Na_20 plus 0.658 K_20. This limitation shall apply to all types of portland cement. Percentage of alkalies shall be determined in accordance with ASTM Designation C114.

9-01.3 TESTS AND ACCEPTANCE

Cement may be accepted by the Engineer based on the manufacturer's Certification of Cement Shipment indicating full conformance to the Specifications. All shipments of the cement to the Contractor or concrete supplier shall be accompanied by a Certification of Cement Shipment. The concrete supplier or Contractor shall countersign three copies of this certificate and submit all three copies to the Engineer.

Each mixing facility or plant utilizing portland cement shall be equipped with a suitable means or device for obtaining a representative sample of the cement. The device shall enable the sample to be readily taken in proximity to the cement weigh hopper and from a container or conveyor holding only cement.

Cement will be tested using samples taken at the job site by the Engineer for submission to the Materials Laboratory for testing.

9-01.4 STORAGE ON THE WORK SITE

The cement shall be stored on the site in a manner as to permit easy access for inspection and identification.

Cement shall be adequately protected at all times from rain and dampness. Cement which, in the opinion of the Engineer, contains lumps that will not be pulverized in the mixer shall be rejected.

Type III portland cement stored by the Contractor for a period longer than 30 days, or Type II portland cement stored by the Contractor for a period longer than 60 days, shall be held for retest. If the cement has lost strength during the period of storage, as shown by tests of the Seattle Engineering Department, sufficient additional cement shall be added to the mix to overcome such loss, or the cement may be rejected. The amount of cement to be added to the mix shall be determined by the Engineer.

SECTION 9-02 BITUMINOUS MATERIALS

9-02.1 ASPHALT MATERIAL

9-02.1(1) GENERAL

Asphalt furnished under these Specifications shall not have been distilled at a temperature high enough to injure by burning or to produce flecks of carbonaceous matter, and upon arrival at the work, shall show no signs of separation into lighter and heavier components.

9-02.1(2) MEDIUM-CURING (MC) LIQUID ASPHALT

CHARACTERISTICS		WSDOT Test Method	MC-70	MC-250	MC-800	MC-3000
Kinematic Viscosity at 140° F cSt		202	70-140	250-500	800-1600	3000-6000
Flash Point (Tag Open Cup)	Min.° F	207	100	150	150	150
Water Content	Max. %	217	0.2	0.2	0.2	0.2
Distillation: volume % of total distillate to 680° F		211				
to 437° F			0-20	0-10	—	—
to 500° F			20-60	15-55	0-35	0-15
to 600° F			65-90	60-87	45-80	75-75
Residue of 680 °F distillation % volume by difference	Min. %		55	67	75	80
Properties of residue from distillation to 680° F						
Absolute viscosity at 140° F, poise		203	300-1200	300-1200	300-1200	300-1200
Ductility, 5cm/min. at 77° F, cm	Min.	213	100	100	100	100
Solubility in trichloroethylene	Min. %	214	99.0	99.0	99.0	99.0

If the ductility at 77° F is less than 100, the material will be acceptable if its ductility at 60° F is more than 100.

The material shall not foam when heated to the application temperature recommended in Section 5-02.3(3).

9-02.1(3) RAPID-CURING (RC) LIQUID ASPHALT

CHARACTERISTICS		WSDOT Test Method	RC-70	RC-250	RC-800	RC-3000
Kinematic Viscosity at 140° F, cSt		202	70-140	250-500	800-1600	3000-6000
Flash Point (Tag Open Cup)	Min.°F	207	—	80	80	80
Water Content	Max. %	217	0.2	0.2	0.2	0.2
Distillation: volume % of total distillate to 680° F		211	—	—	—	—
to 374° F	Min.		10	—	—	—
to 437° F	Min.		50	35	15	—
to 500° F	Min.		70	60	45	25
to 600° F	Min.		85	80	75	70
Residue of 680° F distillation % volume by difference	Min. %		55	65	75	80
Properties of residue from distillation to 680° F						
Absolute viscosity at 140° F, poise		203	600-2400	600-2400	600-2400	600-2400
Ductility, 5 cm/min. at 77° F cm	Min.	213	100	100	100	100
Solubility in trichloroethylene	Min. %	214	99.0	99.0	99.0	99.0

The material shall not foam when heated to application temperature recommended in Section 5-02.3(3).

9-02.1(4) PAVING ASPHALT

CHARACTERISTICS	WSDOT Test Method	Viscosity Grade AR-4000W	AR-2000W
TESTS ON RESIDUE FROM RTFC PROCEDURE(1)	208		
Absolute Viscosity at 140° F, poise	203	2500-5000	1500-2500
Kinematic Viscosity at 275° F cSt, min.	202	275	200
Penetration at 77° F 100g/5 sec, min.	201	40	50
Percent of original penetration at 77° F min	(2)	45	40
Ductility at 45° F (1 cm/min.) cm. min.	213	10	20
TEST ON ORIGINAL ASPHALT			
Flashpoint (Cleveland Open Cup) °F min.	206	440	425
Solubility in Trichloroethylene, % min.	214	99.0	99.0

(1) TFO may be used but RTFC shall be the referee method.

(2) Original penetration as well as penetration after RTFC loss will be determined by WSDOT Test Method 201.

9-02.1(5) REJUVENATING (RECYCLING) AGENTS

The rejuvenating agent shall be a liquid emulsion of selected resin petroleum oil approved for use by the Materials Laboratory. Rejuvenating agents shall meet the following specifications for the grade designated:

HOT MIX RECYCLING AGENTS[1]

Test	ASTM Test Method	RA 5 Min.	RA 5 Max.	RA 25 Min.	RA 25 Max.	RA 75 Min.	RA 75 Max.	RA 250 Min.	RA 250 Max.	RA 500 Min.	RA 500 Max.
Viscosity @ 140°F cs	D2170 or D2171	200	800	1000	4000	5000	10,000	15,000	35,000	40,000	60,000
Flashpoint, COC, °F	D92	400	—	425	—	450	—	450	—	450	—
Saturates, Wt. %	D2007	—	30	—	30	—	30	—	30	—	30
Residue from RTFC Oven test at 325°F	D2872[2]										
Viscosity Ratio[3]	—	—	3	—	3	—	3	—	3	—	3
RTFC Oven Weight Change + %	D2872[2]	—	4	—	3	—	2	—	2	—	2
Specific Gravity	D70 or D1298		Report		Report		Report		Report		Report

[1]The final acceptance of recycling agents meeting this specification is subject to the compliance of the reconstituted asphalt blends with the requirements in Section 9-02 for the class of asphalt mix required.

[2]The use of ASTM D1754 has not been studied in the context of this specification; however, it may be applicable. In cases of dispute, the reference method shall be ASTM D2872.

[3]Viscosity Ratio = $\frac{\text{RTFC Viscosity at 140° F. cs.}}{\text{Original Viscosity at 140° F, cs.}}$

SECTION 9-02.1(6) CATIONIC EMULSIFIED ASPHALT

CATIONIC EMULSIFIED ASPHALT

GRADE	TYPE WSDOT Test Method	RAPID SETTING CRS-1 Min.	CRS-1 Max.	CRS-2 Min.	CRS-2 Max.	MEDIUM SETTING CMS-25 Min.	CMS-25 Max.	CMS-2 Min.	CMS-2 Max.	CMS-2h Min.	CMS-2h Max.	SLOW SETTING CSS-1 Min.	CSS-1 Max.	CSS-1h Min.	CSS-1h Max.	SPECIAL TACK STE-1 Min.	STE-1 Max.
Tests on Emulsions:																	
Viscosity SSF @ 77° F. (25°C.) sec.	212	—	—	—	—	—	—	—	—	—	—	20	100	20	100	—	30
Viscosity SSF & 122° F. (50°C.) sec.	212	20	100	100	400	50	450	50	450	50	450	—	—	—	—	—	—
Storage stability test 1 day %	212	—	1	—	1	—	1	1	—	1	—	—	1	—	1	—	1
Demulsibility 35 m.l. 0.8% sodium dioctyl sulfosuccinate, %[4]	212	40	—	40	—	—	—	—	—	—	—	—	—	—	—	25	—
Coating ability & water resistance:																	
Coating, dry aggregate	212	—	—	—	—	Good	—	Good	—	Good	—	Good	—	Good	—	—	—
Coating, after spraying	212	—	—	—	—	Fair	—	Fair	—	Fair	—	Fair	—	Fair	—	—	—
Coating, wet aggregate	212	—	—	—	—	Fair	—	Fair	—	Fair	—	Fair	—	Fair	—	—	—
Coating, after spraying	212	—	—	—	—	Fair	—	Fair	—	Fair	—	Fair	—	Fair	—	—	—
Particle charge test[b]	212	Positive		Positive		Positive		Positive		Positive		Positive		Positive		Positive	
Sieve Test, %	212	—	0.10	—	0.10	—	0.10	—	0.10	—	0.10	—	0.10	—	0.10	—	0.10
Cement mixing test, %	212	—	—	—	—	—	—	—	—	—	—	—	2.0	—	2.0	—	—
Distillation:																	
Oil distillate by vol. of emulsions %	212	—	3	—	3	20	—	12	—	12	—	—	—	—	—	—	5
Residue, %	212	60	—	65	—	60	—	65	—	65	—	57	—	57	—	45	—
Tests on residue from distillation test:																	
Penetration, 77°F (25°C.)	201	100	250	100	250	100	250	40	250	40	90	100	250	40	90	100	200
Ductility, 77°F (25°C.) 5 cm/min., cm	213	40	—	40	—	40	—	40	—	40	—	40	—	40	—	40	—
Solubility in trichloroethylene, %	214	97.5	—	97.5	—	97.5	—	97.5	—	97.5	—	97.5	—	97.5	—	97.5	—

[4]The demulsibility test shall be made within 30 days from date of shipment.
[b]If the particle charge test is inconclusive, material having a maximum pH value of 6.7 will be acceptable.

9-02.1(7) ASPHALT FOR SUB-SEALING

Asphalt for sub-sealing shall conform to the requirements of AASHTO M 238 except that the minimum softening point shall be 170°F.

9-02.1(8) VACANT

9-02.1(9) COAL TAR PITCH EMULSION

Coal tar pitch emulsion shall conform to all requirements of Federal Specification R-P-355. The emulsion shall be prepared from straight run, high temperature, coke oven tar meeting the requirements of Federal Specification RC 1424. The emulsion shall be homogeneous and shall show no separation or coagulation of components that cannot be overcome by moderate stirring. It shall be capable of being applied completely by squeegee, brush, or other approved mechanical methods to the surface of bituminous pavements when spread at the specified rates.

9-02.2 SAMPLING AND ACCEPTANCE

9-02.2(1) NOTICE OF SHIPMENT

Bituminous materials may be accepted by the Engineer based on the manufacturer's certification in the form of a Notice of Asphalt Shipment. This certification (Form 350-053 supplied by the Department of Transportation) shall be supplied in triplicate at the time of shipment of each truck load, truck and trailer, or other lot of asphalt. All information required on the form shall be completed. The original copy shall be mailed on the day of shipment to the Materials Laboratory, the duplicate to the Consignee; and the triplicate with the shipment.

9-02.2(2) SAMPLES

The producer shall ship by prepaid express or U.S. Mail a sample of asphalt taken from each load or other lot that is shipped for use on work. The sample shall consist of one quart (two or more quarts for emulsified asphalt), taken directly from the material during or after loading, properly labeled, and sent promptly to the Materials Laboratory.

Metal quart sample cans shall be cylindrical or rectangular in shape with a 1-3/4 inch hole and a screw cap. Cans with smaller holes, friction top paint cans, and glass jars will not be accepted. Clean polyethylene or similar plastic nonreactive containers will be required for emulsified asphalt.

Identification labels (Form 350-028) for the asphalt cans will be supplied by the Department of Transportation.

9-02.3 TEMPERATURE OF ASPHALT

The temperature of paving asphalts in storage tanks when loaded for transporting to destination shall not be greater than 400°F.

9-02.4 ANTI-STRIPPING ADDITIVE

When directed by the Engineer, asphalt material shall be treated with an approved heat-stable anti-stripping additive. The anti-stripping additive shall be added to the asphalt at the point of shipment and shall be at the percentage designated by the Engineer, not to exceed 1 percent by weight of the asphalt. The anti-stripping additive shall be approved by the Materials Laboratory prior to use. Once designated for use on a specific project, the brand, grade, or percentage of anti-stripping additive shall not be changed without approval of the Engineer.

9-02.5 ASPHALT EMULSION

9-02.5(1) GENERAL

The asphalt emulsion shall be cationic quick setting type (CQS-h) or latex modified cationic quick setting type (CQS-h-latex).

The emulsion shall be in accordance with the following requirements:

Test on emulsions:	CQS-h	CQS-h-latex
Furol Viscosity at 77° F. (Sec)	20-50	20-100
Residue by distillation	57% min.	58% min.
Sieve Test, retained on No. 20	0.10% max.	0.10% max.
pH	6.5 max.	6.5 max.
Settlement at 5 days	1% max.	3% max.
Particle Charge	Positive	Positive
Test on residue:		
Penetration at 77° F. 100g., 5 sec.	40-110	40-90
Solubility in Trichloroethylene	97% min.	99% min.
Ductility at 77° F.	40 cm min.	44 cm min.

Emulsion shall pass all ASTM Specifications for Cationic Emulsified Mixing Grade Asphalts D 2397, and the ISSA TB 102 and 116 specifications for "Stripping" and "Quick Set Emulsified Asphalt Slurry Seal Systems." ISSA TB 114 "Wet Stripping Test for Cured Slurry Seal Mixes" shall also be applied to determine coating and compatibility with a given aggregate.

9-02.5(2) LATEX MODIFIED EMULSION

In addition to the properties for CQS-h-latex above, the latex modified emulsion shall have added to it a bituminous binder. The binder shall be vinyl-acrylic copolymer latex meeting the following requirements:

Non-Volatile, 96	54-56
Viscosity, cps Brookfield, 60 RPM	300-1300
pH	4-6
Particle size, microns	0.4 average
Free vinyl acetate, 96	Less than 0.6
Odor	Very Slight
Specific gravity	1.8
Lbs/Gal.	9.0

Proportion to Asphalt Emulsion: 0-10% by weight - depending on aggregate and job demands.

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SECTION 9-03 AGGREGATES

9-03.0 GENERAL

Mineral aggregates most commonly used for backfill purposes have been given an aggregate type number to identify each particular aggregate. Requirements for mineral aggregates identified by a type number are contained in the Sections beginning with 9-03.9 through the Mineral Aggregate Chart listed in Section 9-03.16.

Mineral aggregates shall be uniform in quality, essentially free from various types of wood waste or other objectionable or extraneous material, and obtained only from sources approved by the Engineer. Written requests for source approval shall be submitted to the Engineer not less than 10 days prior to the intended use of the mineral aggregate. Should the proposed source be one that the Engineer is unfamiliar with, the Engineer reserves the right to take preliminary samples and make preliminary tests at the proposed source prior to

approval. Continued approval of a source is contingent upon the mineral aggregates from that source continuing to meet contract requirements.

Unless otherwise specified, mineral aggregates shall meet the requirements for grading and quality when delivered to the project site. The exact point of acceptance will be determined in the field by the Engineer.

9-03.1 AGGREGATES FOR PORTLAND CEMENT CONCRETE

9-03.1(1) GENERAL REQUIREMENTS

Portland cement concrete aggregates shall be manufactured from ledge rock, talus, or sand and gravel in accordance with the provisions of Section 3-01. They shall possess the characteristics of shape and size such that the concrete, resulting from a mixture of fine and coarse aggregates in the specified proportions, will have the workability which is satisfactory to the Engineer. Regardless of compliance with all other provisions of these Specifications, if the concrete is not of a workable character, or does not exhibit a proper surface when finished, either the fine or the coarse aggregate, or both, will be rejected, and shall be altered as required by the Engineer.

If, in the judgment of the Engineer, based on previous experience or on laboratory tests, concrete aggregates from a given source are detrimentally reactive with alkalies in portland cement, corrective measures, including use of only low-alkali cement may be required as a condition of approval.

9-03.1(2) FINE AGGREGATE FOR PORTLAND CEMENT CONCRETE

9-03.1(2)A GENERAL

Fine aggregate shall consist of sand or other inert materials, or combinations thereof, approved by the Engineer, having hard, strong, durable particles free from adherent coating. Fine aggregate shall be washed throughly to remove clay, loam, alkali, organic matter, or other deleterious matter.

9-03.1(2)B DELETERIOUS SUBSTANCES

The amount of deleterious substances in the washed aggregate shall not exceed the following values:

(a) Particles of specific gravity less than 1.95 shall be no greater than 1.0 percent by weight.

(b) Organic matter, by colorimetric test, shall not be darker than the reference standard color (organic plate No. 3) AASHTO T 21 unless other tests prove a darker color to be harmless.

9-03.1(2)C GRADING

Fine aggregate shall be regularly graded from coarse to fine in two sizes and when separated by means of the U.S. Standard sieves shall meet the following grading requirements expressed as percentages by weight. Class 1 shall be used unless otherwise specified.

Acceptance of the grading and quality of the aggregates will be based on samples taken from the final mix. The exact point of acceptance will be determined in the field by the Engineer.

	Class 1		Class 2	
	Max.	Min.	Max.	Min.
% Passing No. 4	100	95	...	100
% Passing No. 6	98	82	100	93
% Passing No. 8	86	68	95	85
% Passing No. 16	65	47	80	63
% Passing No. 30	42	27	60	40
% Passing No. 50	20	9	30	15
% Passing No. 100	7	0	8	2
% Passing No. 200 (wet sieving)	2.5	0	2.5	0

In individual tests, variations under the minimum or over the maximum will be permitted as follows provided the average of 3 consecutive tests is within the above limits:

Sieve Number	Permissible Variation in Individual Tests
No. 30 and coarser	2.0 percent
No. 50 and finer	0.5 percent

9-03.1(2)D USE OF SUBSTANDARD GRADINGS

Fine aggregate with more than the maximum percentage passing any sieve may be accepted provided the cement content of the finished concrete is increased at the Contractor's cost, 1/3 percent for each 1 percent the fine aggregate passing each sieve is in excess of the maximum.

Under no circumstances shall fine aggregate Class 1 be used which has a grading finer than the following:

Sieve Size	Percent Passing
U.S. No. 8	95
U.S. No. 16	80
U.S. No. 30	60
U.S. No. 50	25
U.S. No. 200	2.5

All percentages are by weight.

9-03.1(3) COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE

9-03.1(3)A GENERAL

Coarse aggregate for portland cement concrete shall consist of gravel, crushed stone, or other inert material or combinations thereof approved by the Engineer, having hard, strong, durable pieces free from adherent coatings. Coarse aggregate shall be washed thoroughly to remove clay, silt, bark, sticks, alkali, organic matter, or other deleterious material. When required by the Engineer, coarse aggregate shall be handpicked to remove harmful material.

9-03.1(3)B DELETERIOUS SUBSTANCES

The amount of deleterious substances shall not exceed the following values:

Amount finer than U.S. No. 200	0.5 percent by weight
Pieces of specific gravity less than 1.95	2.0 percent by weight
Clay lumps	0.5 percent by weight
Shale	2.0 percent by weight
Wood waste	0.05 percent by weight

9-03.1(3)C WEAR IN LOS ANGELES MACHINE

Coarse aggregate shall not have a percentage of wear in the Los Angeles machine in excess of 35 after 500 revolutions.

9-03.1(3)D GRADING

Coarse aggregate for portland cement concrete when separated by means of laboratory sieves shall conform to one or more of the following gradings as called for elsewhere in the Specifications, Project Manual or in the Drawings:

Passing	Grading No. 2		Grading No. 4		Grading No. 5		Grading No. 6	
Sieve Size	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1-1/2" square	100	100	100	–	–	–	–	–
1-1/4" square	95	100	90	100	–	–	–	–
1" square	–	–	–	–	100	–	–	–
3/4" square	40	70	0	20	80	100	100	–
1/2" square	–	–	–	–	–	–	97	100
3/8" square	5	20	0	2	10	40	40	90
U.S. No. 4	0	2	–	–	0	4	5	30

All percentages are by weight.

In individual tests, a variation of 4 under the minimum percentages or over the maximum percentages will be allowed. The average of three successive tests shall be within the percentages stated above. Coarse aggregate shall contain no piece of greater size than two times the maximum sieve size for the specified grading measured along the line of greatest dimension.

Acceptance of grading and quality of the aggregate will be based on samples taken from stockpiles at the concrete plant. The exact point of acceptance will be determined in the field by the Engineer.

9-03.1(3)E USE OF SUBSTANDARD GRADINGS

Coarse aggregate containing more than the maximum percentage passing any sieve may be accepted provided the cement content of the finished concrete is increased at the Contractor's cost, 1/4 percent for each 1 percent the amount passing each of the 3/4 inch, 3/8 inch, and No. 4 sieves is in excess of the maximum. Coarse aggregate No. 2 shall not be used under any circumstances when the combined amount passing any sieve exceeds the following:

3/4" square	70%
3/8" square	30%
U.S. No. 4	5%

Coarse aggregate No. 5 shall not be used under any circumstances when the combined amount passing any sieve exceeds the following:

3/8" square	50%
U.S. No. 4	8%

9-03.1(3)F CONCRETE STRENGTH

Concrete made from coarse aggregate, graded to comply with the requirements of these Specifications, when combined with the specified proportions of cement and the fine aggregate proposed for use with the coarse aggregate, shall develop compressive and flexural strengths at age of 14 days of not less than 90 percent of that developed by concrete made from the same cement and washed sand and gravel from Steilacoom, Washington, of the same grading and mixed in the same proportions and to the same consistency.

The increase of cement content or the use of admixture will not be permitted for the purpose of qualifying aggregates.

9-03.2 VACANT

9-03.3 VACANT

9-03.4 AGGREGATE FOR BITUMINOUS SURFACE TREATMENT

9-03.4(1) GENERAL REQUIREMENTS

Aggregate for bituminous surface treatment shall be manufactured from ledge rock, talus, or gravel, in accordance with Section 3-01, which meets the following test requirements:

Los Angeles Wear, 500 Rev.	35% max.
Degradation Factor	30% min.

9-03.4(2) GRADING AND QUALITY

Aggregate for bituminous surface treatment shall conform to the requirements in the table below for grading and quality. The particular type or grading to be used shall be as shown in the Drawings. All percentages are by weight.

The material shall meet the requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

PASSING SIEVE	Crushed Cover Stone Percent Passing	Crushed Screening Percent Passing 3/4"-1/2"	5/8"-1/4"	1/2"-1/4"	3/8"-#10	1/4"-0"
1" square		100				
3/4" square	100	95-100	100	–	–	–
5/8" square	95-100	–	95-100	100	–	–
1/2" square	–	0-20	–	95-100	100	–
3/8" square	–	0-5	–	–	90-100	100
1/4" square	30-50	–	0-10	0-15	50-75	90-100
U.S. No. 10	–	–	0-3	0-3	0-10	30-60
U.S. No. 200	0-7.5	0-1.0	0-1.0	0-1.0	0-1.0	0-10.0
% fracture, by weight, min.	75	75	75	75	75	75
Sand equivalent min.	40	–	–	–	–	–
Static Stripping Test	Pass	Pass	Pass	Pass	Pass	Pass

The fracture requirement shall be at least one fractured face and will apply to material retained on each sieve size No. 10 and above if that sieve retains more than 5 percent of the total sample.

The finished product shall be clean, uniform in quality, and free from wood, bark, roots, and other deleterious materials.

Crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves.

The portion of aggregate for bituminous surface treatment retained on a 1/4-inch sieve shall not contain more than 0.1 percent deleterious materials by weight.

9-03.5 VACANT

9-03.6 AGGREGATES FOR ASPHALT TREATED BASE (ATB)

9-03.6(1) GENERAL REQUIREMENTS

Aggregates for asphalt treated base shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01 that meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor	15% min.

9-03.6(2) GRADING

Aggregates for asphalt treated base shall meet the following requirements for grading:

Sieve Size	Percent Passing
2" square	100
1/2" square	56-100
1/4" square	40-78
U.S. No. 10	22-57
U.S. No. 40	8-32
U.S. No. 200	2.0-9.0
Asphalt Cement, Percent of Total Mixture	2.5-4.5

(Exact percentage of asphalt to be determined by the Engineer.) All percentages are by weight.

Acceptance of the grading and quality of the aggregates will be based on samples taken from the final mix.

9-03.6(3) TEST REQUIREMENTS

When the aggregates are combined within the limits set forth in Section 9-03.6(2) and mixed in the laboratory with the designated grade of asphalt, the mixture shall be capable of meeting the following test values:

Stabilometer Value	30 min.
Cohesiometer Value	50 min.
Modified Lottman Stripping Test	Pass

The sand equivalent value of the mineral aggregate for asphalt treated base shall not be less than 35.

9-03.7 AGGREGATE FOR COAL TAR PITCH SEAL

Aggregate for coal tar pitch seal shall be either a natural sand or manufactured product composed of clean, hard, durable, uncoated particles free from dirt, organic matter, and other objectionable substances. The aggregate shall meet the following grading requirements:

Sieve Size	Percent Passing
U.S. No. 16	100
U.S. No. 30	15-85
U.S. No. 50	2-10
U.S. No. 100	0-2.0
Sand Equivalent	30 min.

All percentages are by weight.

9-03.8 AGGREGATES FOR ASPHALT CONCRETE

9-03.8(1) GENERAL REQUIREMENTS

Aggregates for asphalt concrete shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01. The material from which they are produced shall meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor, Wearing Course	30% min.
Degradation Factor, Other Courses	20% min.

It shall be uniform in quality, substantially free from wood, roots, bark, extraneous materials, and adherent coatings. The presence of a thin, firmly adhering film of weathered rock will not be considered as coating unless it exists on more than 50 percent of the surface area of any size between consecutive laboratory sieves.

Aggregate removed from deposits contaminated with various types of wood waste shall be washed, processed, selected, or otherwise treated to remove sufficient wood waste so that the oven-dried material retained on a 1/4 inch square sieve shall not contain more than 0.1 percent by weight of material with a specific gravity less than 1.0.

9-03.8(2) TEST REQUIREMENTS

Aggregate for asphalt concrete shall meet the following test requirements:

		Class of Asphalt Concrete B	D	E	F	G
Fracture, by weight	(See Note)	(1)	(2)	(3)	(3)	(1)
Sand Equivalent	Min.	45	–	45	35	45

(1) The fracture requirements are at least 1 fractured face on 75 percent of the material retained on each sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.

(2) The fracture requirements are at least 2 fractured faces on 75 percent and at least 1 fractured face on 90 percent of the material retained on each sieve, U.S. No. 8 and above, if that sieve retains more than 5 percent of the total sample.

(3) The fracture requirements are at least 1 fractured face on 50 percent of the material retained on each sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.

When material is being produced and stockpiled for use on a specific Contract or for a future Contract, the fracture and sand equivalent requirements shall apply at the time of stockpiling. When material is used from a stockpile that has not been tested as provided above, the requirements for fracture and sand equivalents shall apply at the time of its introduction to the cold feed of the mixing plant.

The properties of the aggregate in a preliminary mix design for asphalt concrete shall be such that when it is combined within the limits set forth in Section 9-03.8(6) and mixed in the laboratory with the designated grade of asphalt, mixtures with the following test values can be produced:

9-03.1(3)D GRADING

Coarse aggregate for portland cement concrete when separated by means of laboratory sieves shall conform to one or more of the following gradings as called for elsewhere in the Specifications, Project Manual or in the Drawings:

Passing	Grading No. 2		Grading No. 4		Grading No. 5		Grading No. 6	
Sieve Size	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1-1/2" square	100	100	100	–	–	–	–	–
1-1/4" square	95	100	90	100	–	–	–	–
1" square	–	–	–	–	100	–	–	–
3/4" square	40	70	0	20	80	100	100	–
1/2" square	–	–	–	–	–	–	97	100
3/8" square	5	20	0	2	10	40	40	90
U.S. No. 4	0	2	–	–	0	4	5	30

All percentages are by weight.

In individual tests, a variation of 4 under the minimum percentages or over the maximum percentages will be allowed. The average of three successive tests shall be within the percentages stated above. Coarse aggregate shall contain no piece of greater size than two times the maximum sieve size for the specified grading measured along the line of greatest dimension.

Acceptance of grading and quality of the aggregate will be based on samples taken from stockpiles at the concrete plant. The exact point of acceptance will be determined in the field by the Engineer.

9-03.1(3)E USE OF SUBSTANDARD GRADINGS

Coarse aggregate containing more than the maximum percentage passing any sieve may be accepted provided the cement content of the finished concrete is increased at the Contractor's cost, 1/4 percent for each 1 percent the amount passing each of the 3/4 inch, 3/8 inch, and No. 4 sieves is in excess of the maximum. Coarse aggregate No. 2 shall not be used under any circumstances when the combined amount passing any sieve exceeds the following:

3/4" square	70%
3/8" square	30%
U.S. No. 4	5%

Coarse aggregate No. 5 shall not be used under any circumstances when the combined amount passing any sieve exceeds the following:

3/8" square	50%
U.S. No. 4	8%

9-03.1(3)F CONCRETE STRENGTH

Concrete made from coarse aggregate, graded to comply with the requirements of these Specifications, when combined with the specified proportions of cement and the fine aggregate proposed for use with the coarse aggregate, shall develop compressive and flexural strengths at age of 14 days of not less than 90 percent of that developed by concrete made from the same cement and washed sand and gravel from Steilacoom, Washington, of the same grading and mixed in the same proportions and to the same consistency.

The increase of cement content or the use of admixture will not be permitted for the purpose of qualifying aggregates.

9-03.2 VACANT

9-03.3 VACANT

9-03.4 AGGREGATE FOR BITUMINOUS SURFACE TREATMENT

9-03.4(1) GENERAL REQUIREMENTS

Aggregate for bituminous surface treatment shall be manufactured from ledge rock, talus, or gravel, in accordance with Section 3-01, which meets the following test requirements:

Los Angeles Wear, 500 Rev.	35% max.
Degradation Factor	30% min.

9-03.4(2) GRADING AND QUALITY

Aggregate for bituminous surface treatment shall conform to the requirements in the table below for grading and quality. The particular type or grading to be used shall be as shown in the Drawings. All percentages are by weight.

The material shall meet the requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

PASSING SIEVE	Crushed Cover Stone Percent Passing	Crushed Screening Percent Passing 3/4"-1/2"	5/8"-1/4"	1/2"-1/4"	3/8"-#10	1/4"-0"
1" square		100				
3/4" square	100	95-100	100	–	–	–
5/8" square	95-100	–	95-100	100	–	–
1/2" square	–	0-20	–	95-100	100	–
3/8" square	–	0-5	–	–	90-100	100
1/4" square	30-50	–	0-10	0-15	50-75	90-100
U.S. No. 10	–	–	0-3	0-3	0-10	30-60
U.S. No. 200	0-7.5	0-1.0	0-1.0	0-1.0	0-1.0	0-10.0
% fracture, by weight, min.	75	75	75	75	75	75
Sand equivalent min.	40	–	–	–	–	–
Static Stripping Test	Pass	Pass	Pass	Pass	Pass	Pass

The fracture requirement shall be at least one fractured face and will apply to material retained on each sieve size No. 10 and above if that sieve retains more than 5 percent of the total sample.

The finished product shall be clean, uniform in quality, and free from wood, bark, roots, and other deleterious materials.

Crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves.

The portion of aggregate for bituminous surface treatment retained on a 1/4-inch sieve shall not contain more than 0.1 percent deleterious materials by weight.

9-03.5 VACANT

9-03.6 AGGREGATES FOR ASPHALT TREATED BASE (ATB)

9-03.6(1) GENERAL REQUIREMENTS

Aggregates for asphalt treated base shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01 that meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor	15% min.

9-03.6(2) GRADING

Aggregates for asphalt treated base shall meet the following requirements for grading:

Sieve Size	Percent Passing
2" square	100
1/2" square	56-100
1/4" square	40-78
U.S. No. 10	22-57
U.S. No. 40	8-32
U.S. No. 200	2.0-9.0
Asphalt Cement, Percent of Total Mixture	2.5-4.5

(Exact percentage of asphalt to be determined by the Engineer.) All percentages are by weight.

Acceptance of the grading and quality of the aggregates will be based on samples taken from the final mix.

9-03.6(3) TEST REQUIREMENTS

When the aggregates are combined within the limits set forth in Section 9-03.6(2) and mixed in the laboratory with the designated grade of asphalt, the mixture shall be capable of meeting the following test values:

Stabilometer Value	30 min.
Cohesiometer Value	50 min.
Modified Lottman Stripping Test	Pass

The sand equivalent value of the mineral aggregate for asphalt treated base shall not be less than 35.

9-03.7 AGGREGATE FOR COAL TAR PITCH SEAL

Aggregate for coal tar pitch seal shall be either a natural sand or manufactured product composed of clean, hard, durable, uncoated particles free from dirt, organic matter, and other objectionable substances. The aggregate shall meet the following grading requirements:

Sieve Size	Percent Passing
U.S. No. 16	100
U.S. No. 30	15-85
U.S. No. 50	2-10
U.S. No. 100	0-2.0
Sand Equivalent	30 min.

All percentages are by weight.

9-03.8 AGGREGATES FOR ASPHALT CONCRETE

9-03.8(1) GENERAL REQUIREMENTS

Aggregates for asphalt concrete shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01. The material from which they are produced shall meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor, Wearing Course	30% min.
Degradation Factor, Other Courses	20% min.

It shall be uniform in quality, substantially free from wood, roots, bark, extraneous materials, and adherent coatings. The presence of a thin, firmly adhering film of weathered rock will not be considered as coating unless it exists on more than 50 percent of the surface area of any size between consecutive laboratory sieves.

Aggregate removed from deposits contaminated with various types of wood waste shall be washed, processed, selected, or otherwise treated to remove sufficient wood waste so that the oven-dried material retained on a 1/4 inch square sieve shall not contain more than 0.1 percent by weight of material with a specific gravity less than 1.0.

9-03.8(2) TEST REQUIREMENTS

Aggregate for asphalt concrete shall meet the following test requirements:

		Class of Asphalt Concrete B	D	E	F	G
Fracture, by weight	(See Note)	(1)	(2)	(3)	(3)	(1)
Sand Equivalent	Min.	45	–	45	35	45

(1) The fracture requirements are at least 1 fractured face on 75 percent of the material retained on each sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.

(2) The fracture requirements are at least 2 fractured faces on 75 percent and at least 1 fractured face on 90 percent of the material retained on each sieve, U.S. No. 8 and above, if that sieve retains more than 5 percent of the total sample.

(3) The fracture requirements are at least 1 fractured face on 50 percent of the material retained on each sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.

When material is being produced and stockpiled for use on a specific Contract or for a future Contract, the fracture and sand equivalent requirements shall apply at the time of stockpiling. When material is used from a stockpile that has not been tested as provided above, the requirements for fracture and sand equivalents shall apply at the time of its introduction to the cold feed of the mixing plant.

The properties of the aggregate in a preliminary mix design for asphalt concrete shall be such that when it is combined within the limits set forth in Section 9-03.8(6) and mixed in the laboratory with the designated grade of asphalt, mixtures with the following test values can be produced:

		Class of Asphalt Concrete				
		B	D	E	F	G
Stabilometer Value	Min.	35	—	35	35	35
Cohesiometer Value	Min.	100	—	100	50	100
Percent Air Voids		2-4.5	—	2-4.5	2-4.5	2-4.5
Modified Lottman Stripping Test		Pass	Pass	Pass	Pass	Pass

The stabilometer value for asphalt concrete containing 50 percent or greater of recycled asphalt concrete shall be 30 minimum.

Mineral aggregates utilized in MC 250 and MC 800 asphalt concrete mixes shall meet the same requirements as the aggregates used in Asphalt Concrete Cl B.

9-03.8(3) GRADING

9-03.8(3)A GRADATION—FUTURE USE

When produced for future work on other Contracts, aggregate for Classes B, E, or F asphalt concrete, shall be furnished and stockpiled separately in the following applicable sizes: 1-1/4 inches to 1/4 inch, 3/4 inch to 1/4 inch, 5/8 inch to 1/4 inch, and 1/4 inch to 0. The aggregates produced shall meet the grading requirements set forth in the table below. Acceptance of the aggregate shall be based on gradation tests at the time of stockpiling.

COARSE AGGREGATE

	Class of Asphalt Concrete		
	B	E	F
Sieve Size	5/8"-1/4"	1-1/4"-1/4"	3/4"-1/4"
	Percent Passing		
1-1/4" square	—	100	—
1" square	—	85-100	—
3/4" square	—	—	100
5/8" square	100	45-70	—
1/2" square	72-100	—	40-100
3/8" square	28-72	—	—
1/4" square	0-28	0-15	0-30
U.S. No. 10	0-2	—	—

All percentage are by weight.

FINE AGGREGATE

	Class of Asphalt Concrete				
	B	D	E	F	G
Sieve Size	1/4"-0	3/8"-0	1/4"-0	1/4"-0	3/8"-0
	Percent Passing				
1/2" square	—	100	100	100	100
3/8" square	100	97-100	—	—	97-100
1/4" square	85-100	—	75-100	70-100	60-88
U.S. No. 4	—	30-50	—	—	—
U.S. No. 8	—	5-15	—	—	—
U.S. No. 10	50-70	—	50-75	45-80	32-53
U.S. No. 40	18-36	—	—	—	11-24
U.S. No. 80	10-22	—	12-28	—	6-15
U.S. No. 200	5.0-9.0	2.0-5.0	3.0-12.0	3.0-12.0	3.0-7.0

All percentages are by weight.

Coarse and fine aggregate shall be proportioned in the following approximate ratios for each of the classes of asphalt concrete:

	Class of Asphalt Concrete				
	B	D	E	F	G
% Coarse Aggregate	35	—	50	35	—
% Fine Aggregate	65	100	50	65	100

All percentages are by weight.

9-03.8(3)B GRADATION—IMMEDIATE USE

The Contractor may furnish aggregates for use on the same Contract from a single stockpile or from multiple stockpiles. The gradation of the aggregates may differ from the sizes specified in Section 9-03.8(3)A provided that the completed mixture complies in all respects with the pertinent requirements of Section 9-03.8(6).

Acceptance of the aggregate gradation shall be based on samples taken from the final mix.

9-03.8(3)C GRADATION—RECYCLED ASPHALT PAVEMENT AND MINERAL AGGREGATE

Asphalt concrete planings or old asphalt concrete utilized in the production of asphalt concrete shall be sized prior to entering the mixer so that a uniform and thoroughly mixed asphalt concrete is produced in the mixer. If there is evidence of the old asphalt concrete not breaking down during the heating and mixing of the asphalt concrete, the Engineer may elect to modify the maximum size entering the mixer. No contamination by deleterious materials will be allowed in the old asphalt concrete used.

The gradation for the new mineral aggregate used in the production of the asphalt concrete shall be the responsibility of the Contractor, and when combined with recycled material the combined material shall meet the gradation specification requirements for the specified Class ACP as listed in Section 9-03.8(6) or as shown in the Project Manual. The new aggregate shall meet the general requirements listed in Section 9-03.8(1) d shall meet the appropriate fracture and sand equivalent requirements as listed in Section 9-03.8(2).

9-03.8(4) BLENDING SAND

In the production of aggregate for asphalt concrete there is often a deficiency of material passing the U.S. No. 40. When this occurs, blending sand in an amount specified by the Engineer may be used to make up this deficiency, provided that a satisfactory final mix is produced, including fracture requirements.

Blending sand shall be clean, hard, sound material, either naturally occurring sand or crusher fines, and must be material which will readily accept an asphalt coating. The exact grading requirements for the blending sand shall be such that, when it is mixed with an aggregate, the combined product shall meet the requirements of Section 9-03.8(6) for the class of material involved. Blending sand shall meet the following quality requirement:

Sand Equivalent	30 min.

Blending sand shall be tested by the Materials Laboratory before it will be approved for use.

9-03.8(5) MINERAL FILLER

Mineral filler shall conform to the requirements of AASHTO M 17.

9-03.8(6) PROPORTIONS OF MATERIALS

The materials of which asphalt concrete is composed shall be of such sizes, gradings, and quantities that, when proportioned and mixed together, they will produce a well graded mixture within the requirements listed in the table which follows.

For the determination of a Project Mix Design, the Contractor shall submit to the Engineer representative samples of the various aggregates to be used along with gradation data showing the stockpile averages and variation of the aggregates as produced together with proposed combining ratios and average gradation of the completed mix. The initial asphalt content shall be determined by the Engineer from the aggregates and data provided.

The percentages of aggregate include mineral filler, when used, refer to the completed dry mix. The percentage of asphalt refers to the complete asphalt concrete mixture.

GRADING AND ASPHALT REQUIREMENTS

Sieve Size	Class B	Class D	Class E	Class F	Class G
			Percent Passing		
1-1/4" square	—	—	100	—	—
1" square	—	—	90-100	—	—
3/4" square	—	—	—	100	—
5/8" square	100	—	67-86	—	—
1/2" square	90-100	100	60-80	80-100	100
3/8" square	75-90	97-100	—	—	97-100
1/4" square	55-75	—	40-62	45-78	60-88
U.S. No. 4	—	30-50	—	—	—
U.S. No. 8	—	5-15	—	—	—
U.S. No. 10	32-48	—	25-40	30-50	32-53
U.S. No. 40	11-24	—	10-23	—	11-24
U.S. No. 80	6-15	—	6-14	—	6-15
U.S. No. 200	3-7	2-5	2-9	2-8	3-7
Mineral Filler	3.0-7.0	2.0-5.0	2.0-9.0	2.0-8.0	3.0-7.0
Asphalt % of total mixture	4.0-7.5	5.5-8.5	3.5-7	4-7	4-7.5
Sand-Silt Ratio	5.5-10.5	—	—	—	5.5-10.5

All percentages are by weight.

Aggregate gradings within the above ranges shall be such that there will be a minimum of 2 percent of the total aggregate retained between any successive pair of sieves finer than the U.S. No. 10. The gradings shall be of such uniformity that the fractions of aggregate passing the 1/4 inch and U.S. No. 10 during the day's run shall conform to the following limitations:

Maximum variation in percentage of material passing 1/4" square	10
Maximum variation in percentage of material passing U.S. No. 10	8

For asphalt concrete Class B produced using recycled asphalt materials, the sand silt requirements and the gradation for the U.S. #200 sieve for the asphalt concrete for placement in areas other than the wearing course of travelled lanes, are revised as follows:

	Passing U.S. #200	Sand/Silt
50%-60% Recycled Material	3.0-8.0%	Waived
61%-70% Recycled Material	3.0-9.0%	Waived
71%-100% Recycled Material	3.0-10.0%	Waived

9-03.9 AGGREGATES FOR BALLAST AND CRUSHED SURFACING

9-03.9(1) BALLAST

Roadway ballast shall be manufactured from ledge rock or talus obtained from sources approved by the Engineer. Roadway ballast shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 14.

That portion of roadway ballast retained on a 1/4 inch square sieve shall not contain more than 0.2 percent wood waste.

When approved by the Engineer, Mineral Aggregate, Type 1 or 2 may be utilized for roadway ballast in lieu of Mineral Aggregate, Type 14.

Ballast shall be a totally crushed material with no naturally occuring surfaces and shall apply to material retained on each sieve size 1/4 inch and above if that sieve retains more than 5 percent of the total sample.

9-03.9(2) SHOULDER BALLAST

Shoulder ballast shall meet the requirements of Section 9-03.9(1) for ballast except the gradation shall meet the requirements of Section 9-03.16 for Mineral Aggregate, Type 13 or such other mineral aggregate manufactured from ledge rock or talus as may be specified by the Engineer or Contract Documents. The sand equivalent value and dust ratio requirements of Section 9-03.9(1) shall not apply.

9-03.9(3) CRUSHED SURFACING

Except as otherwise specified below, crushed surfacing shall be manufactured from ledge rock or talus and shall meet the grading requirements of Section 9-03.16 for Mineral Aggregate Type 1, Type 2, and Type 3.

Crushed surfacing shall be a totally crushed material with no naturally occuring faces and shall apply to material retained on each sieve size No. 10 and above if that sieve retains more than 5 percent of the total sample.

The portion of crushed surfacing retained on a 1/4 inch square sieve shall not contain more than 0.15 percent wood waste.

Crushed surfacing may be manufactured from gravel if its use will meet the requirements set forth in Section 9-03.11 for Mineral Aggregate Type 1G and 2G.

9-03.9(4) MAINTENANCE ROCK

Maintenance rock shall meet all requirements of Section 9-03.9(3) for crushed surfacing top course except that it sha[ll] meet the following specifications for grading:

Sieve Size	Percent Passing
1/2" square	100
1/4" square	55-70
U.S. No. 40	10-25
U.S. No. 200	7 max.

All percentages are by weight.

9-03.9(5) SAND FILLER

Sand filler shall consist of naturally ocurring sand grain[s,] preferably angular, screened from natural deposits an[d] meeting the requirements of Section 9-03.16 for Miner[al] Aggregate Type 11.

9-03.10 AGGREGATE FOR GRAVEL BASE

Gravel base shall meet the requirements of Sectic[on] 9-03.12(2) for Mineral Aggregate Type 17.

9-03.11 CRUSHED GRAVEL

Crushed gravel shall be manufactured by mechanical[ly] crushed clean, washed gravel, and shall meet the gradir[ng] requirements of Section 9-03.16 for Mineral Aggregate Typ[e] 1G, 2G, and 21 through 24. The number of fractured surfac[es] and the minimum percent of crushed particles required [to] have the fractured surfaces specified are as follows:

Mineral Aggregate Type	Number of Fractured Surfaces	Minimum Percent Required
1G	2 or more	90%
2G	2 or more	90%
21	1 or more	75%
22	1 or more	75%
23	1 or more	75%
24	2 or more	95%

Mineral Aggregate, Type 1G and Type 2G may be used [a]s Top and Base Course in lieu of a Crushed Rock Type 1 and [2] only if specified and meeting one or more of the following:

(a) the Crushed Surfacing Mineral Aggregate Type 1G ar[nd] 2G will be covered and confined completely with aspha[lt] or cement concrete pavement; or

(b) confined within a trench; and

(c) costs shall be adjusted in accordance with Section 4-04.

Crushed gravel shall be substantially free from adhere[nt] coatings. The presence of a thin, firmly adhering film [of] weathered rock shall not be considered as coating unless [it] exists on more than 50 percent of the surface area of any si[ze] between successive laboratory sieves.

The portion of mineral aggregate retained on a 1/4 inc[h] sieve shall not contain more than 0.1 percent wood waste b[y] weight. The portion of material passing a U.S. No. 10 sie[ve] shall not have wood waste that will result in more than 2[5] parts per million of organic matter by colorimetric tests whe[n] tested. The color shall be measured after the sample has bee[n] in the test solution for 1 hour.

9-03.12 GRAVEL BACKFILL

Gravel backfill shall consist of crushed, partially crushed, [or] naturally ocurring granular material depending on the type [of] mineral aggregate specified by the Engineer or the Contract Documents.

9-03.16 for Mineral Aggregate Type 13.

The page numbers 281 & 282 were transposed in the book.

N																								Los Angeles Abrasion (Max.) Per
1																								35
2																								35
2																								35
3.																								35
4.																								35
5.																								35
6.																								35
7.																								
9.	3/8" Washed Gravel	Pipe Bedding	9-03.12(3)	0-3	....	....	....	0-10	....	....	....	95-100	....	....	100	....	....	....	....	....	....	....			
10.	Pit Run Sand	Backfill Embankment	9-03.12(5)	0-10	10-60	....	....	40-100	....	....	90-100	100	....	....	....	....	....	....	....	....	....	....			
11.	Sand Filler		9-03.(9)5A	0-15	....	15-40	40-75	....	....	....	90-100	100	....	....	....	....	....	....	....	....	....	....			
13.	2-1/2" Minus Crushed Rock	Shoulder Ballast	9-03.9(2)	....	....	....	....	....	....	....	0-5	....	....	....	40-80	....	....	....	....	100	....	....			40
14.	2-1/2" Crushed Rock	Ballast Roadway	9-03.9(1)	0-9	....	0-16	....	....	....	....	30-50	....	....	....	....	50-85	....	....	65-100	100	....	....	35	2/3	40
15.	Pit Run Sandy Gravel	Backfill Embankment	9-03.12(5)	0-10	....	....	....	....	....	....	20-40	....	....	....	100	....	....	....	....	....	....	....			30
17.	Bank Run Gravel	Select Backfill	9-03.12(2)	0-5	....	....	....	....	....	....	25-75	....	....	....	....	....	....	....	....	....	95-100	....	60	2/3	
21.	1-1/2" Cr. Gravel		9-03.11	....	....	....	....	....	....	....	0-25	....	45-70	85-100	....	....	....	100	....	....	....	....			30
22.	5/8" Crushed Gravel	PVC and CMP Pipe Bedding	9-03.11	....	....	....	....	....	....	....	0-25	....	75-100	100	....	....	....	....	....	....	....	....			
23.	1/2" Minus Crushed Gravel	Cover Rock	9-03.11	2-12	....	....	40-75	....	....	....	70-100	....	100	....	....	....	....	....	....	....	....	....			30
24.	1/2" Minus Crushed Gravel	Chip Rock	9-03.11	0-3	....	0-5	0-10	....	0-20	25-55	50-90	98-100	100	....	....	....	....	....	....	....	....	....			30
26.		Filter																							

9-03.9(4) MAINTENANCE ROCK

Maintenance rock shall meet all requirements of Section 9-03.9(3) for crushed surfacing top course except that it shall meet the following specifications for grading:

Sieve Size	Percent Passing
1/2" square	100
1/4" square	55-70
U.S. No. 40	10-25
U.S. No. 200	7 max.

All percentages are by weight.

9-03.9(5) SAND FILLER

Sand filler shall consist of naturally ocurring sand grains, preferabiy angular, screened from natural deposits and meeting the requirements of Section 9-03.16 for Mineral Aggregate Type 11.

9-03.10 AGGREGATE FOR GRAVEL BASE

Gravel base shall meet the requirements of Section 9-03.12(2) for Mineral Aggregate Type 17.

9-03.11 CRUSHED GRAVEL

Crushed gravel shall be manufactured by mechanically crushed clean, washed gravel, and shall meet the grading requirements of Section 9-03.16 for Mineral Aggregate Types 1G, 2G, and 21 through 24. The number of fractured surfaces and the minimum percent of crushed particles required to have the fractured surfaces specified are as follows:

Mineral Aggregate Type	Number of Fractured Surfaces	Minimum Percent Required
1G	2 or more	90%
2G	2 or more	90%
21	1 or more	75%
22	1 or more	75%
23	1 or more	75%
24	2 or more	95%

Mineral Aggregate, Type 1G and Type 2G may be used as Top and Base Course in lieu of a Crushed Rock Type 1 and 2 only if specified and meeting one or more of the following:

(a) the Crushed Surfacing Mineral Aggregate Type 1G and 2G will be covered and confined completely with asphalt or cement concrete pavement; or
(b) confined within a trench; and
(c) costs shall be adjusted in accordance with Section 4-04.

Crushed gravel shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves.

The portion of mineral aggregate retained on a 1/4 inch sieve shall not contain more than 0.1 percent wood waste by weight. The portion of material passing a U.S. No. 10 sieve shall not have wood waste that will result in more than 250 parts per million of organic matter by colorimetric tests when tested. The color shall be measured after the sample has been in the test solution for 1 hour.

9-03.12 GRAVEL BACKFILL

Gravel backfill shall consist of crushed, partially crushed, or naturally ocurring granular material depending on the type of mineral aggregate specified by the Engineer or the Contract Documents.

9-03.12(1) GRAVEL BACKFILL FOR FOUNDATIONS

9-03.12(1)A CLASS A

Gravel backfill for foundations, Class A, shall meet the requirements of Section 9-03.9 and 9-03.16 for Mineral Aggregate, Type 2 or Mineral Aggregate Type 14, whichever is specified.

9-03.12(1)B CLASS B

Gravel backfill for foundations, Class B shall conform to the requirements of Section 9-03.12(2) for Mineral Aggregate Type 17.

9-03.12(2) GRAVEL BACKFILL FOR WALLS

Gravel backfill for walls shall consist of free draining sand and gravel from naturally occurring or screened sources; have such chracteristics of size and shape that it will compact readily; and meet the requirements of Section 9-03.16 for Mineral Aggregate Type 17.

That portion of the material retained on a 1/4 inch square opening shall contain not more than 0.20 percent by weight of wood waste.

9-03.12(3) GRAVEL BACKFILL FOR PIPE BEDDING

Pipe bedding material shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 9 and Mineral Aggregate Type 22 as specified on the Drawings and Standard Plan No. 285.

Pea gravel bedding, Mineral Aggregate Type 9 shall consist of screened sand, gravel, or other inert materials, or combinations thereof, from sources approved by the Engineer. The aggregate shall have hard, strong, durable particles free from adherent coatings. The material shall be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious substances. The amount of deleterious substances in the washed pea gravel shall not exceed values specified in Section 9-03.1(2)B.

Crushed gravel bedding, Mineral Aggregate Type 22 shall be manufactured from screened crushed gravel. The finished product shall be clean, uniform in quality, and free from wood, bark, roots, and other deleterious materials. The crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves. The portion of Mineral Aggregate Type 22 retained on a 1/4 inch sieve shall not contain more than 0.1 percent deleterious materials by weight.

9-03.12(4) GRAVEL BACKFILL FOR DRAINS

Gravel backfill for drains shall meet the requirements of Section 9-03.1(3)B, 9-03.12(6), and 9-03.16 for Mineral Aggregate Type 26 except the percent by weight passing the U.S. No. 200 sieve specified in Section 9-03.1(3)B shall not be greater than 2.0 percent.

9-03.12(5) PIT RUN SAND AND GRAVELS

Pit run sand and gravels shall consist of free draining granular materials obtained from naturally ocurring deposits or manufactured from screened gravel.

Pit run sand shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 10.

Pit run sandy gravel shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 15.

Section 9-03.16 MINERAL AGGREGATE CHART

No.	Aggregate Type	Use	Section	Sieve Analysis-Percent Passing by Weight (Wet Sieving) 200	50	40	10	8	6	4	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	8	Sand Equivalent (Min.)	Dust Ratio (Min.)	Los Angeles Abrasion (Max.) Per
1.	5/8" Minus Crushed Rock	Top Course & Keystone	9-03.9(3)	0-10	....	8-24	....	....	....	....	55-75	....	....	100	....	....	....	....	....	....	....	....	40		35
1G.	5/8" Minus Crushed Gravel	Top Course & Keystone	9-03.9(11)	0-10	....	8-24	....	....	....	....	55-75	....	....	100	....	....	....	....	....	....	....	....	40		35
2.	1-1/4" Minus Crushed Rock	Base Course	9-03.9(3)	0-7.5	....	3-18	....	....	....	....	30-50	....	....	50-80	....	....	100	....	....	....	....	....	40		35
2G.	1-1/4" Minus Crushed Gravel	Base Course	9-03.9(11)	0-7.5	....	3-18	....	....	....	....	30-50	....	....	50-80	....	....	100	....	....	....	....	....	40		35
3.	1/2" Minus Crushed Rock		9-03.9(11)	0-7	....	10-25	....	....	....	....	55-70	....	100	....	....	....	....	....	....	....	....	....			35
4.	1-1/2" Wash. Gravel		9-03.1(3)	....	....	....	....	....	....	....	....	0-2	....	....	0-20	....	90-100	100	....	....	....	....			35
5.	1" Washed Gravel		9-03.1(3)	....	....	....	....	....	....	....	....	10-40	....	....	10-100	100	....	....	....	....	....	....			35
6.	Washed Sand		9-03.1(2)B	0-2.5	9-20	....	68-86	82-98	95-100	....	....	....	....	....	....	....	....	....	....	....	....	....			
7.	Building Sand		9-03.1(2)B	0-2	15-30	....	85-95	95-100	100	....	....	....	....	....	....	....	....	....	....	....	....	....			
9.	3/8" Washed Gravel	Pipe Bedding	9-03.12(3)	0-3	....	....	0-10	....	....	....	....	....	....	....	100	....	....	....	....	....	....	....			
10.	Pit Run Sand	Backfill Embankment	9-03.12(5)	0-10	10-60	....	40-100	....	....	....	90-100	100	....	....	....	....	....	....	....	....	....	....			
11.	Sand Filler		9-03.(9)5A	0-15	....	15-40	40-75	....	....	....	90-100	100	....	....	....	....	....	....	....	....	....	....			
13.	2-1/2" Minus Crushed Rock	Shoulder Ballast	9-03.9(2)	....	....	....	....	....	....	....	0-5	....	....	....	40-80	....	....	....	....	100	....	....			40
14.	2-1/2" Crushed Rock	Ballast Roadway	9-03.9(1)	0-9	....	0-16	....	....	....	....	30-50	....	....	....	....	50-85	....	65-100	100	....	....	35	2/3	40
15.	Pit Run Sandy Gravel	Backfill Embankment	9-03.12(5)	0-10	....	....	....	....	....	....	20-40	....	....	....	100	....	....	....	....	....	....	....			30
17.	Bank Run Gravel	Select Backfill	9-03.12(2)	0-5	....	....	....	....	....	....	25-75	....	....	....	....	....	....	....	....	....	95-100	....	60	2/3	
21.	1-1/2" Cr. Gravel		9-03.11	....	....	....	....	....	....	....	0-25	....	45-70	85-100	....	....	....	100	....	....	....	....			30
22.	5/8" Crushed Gravel	PVC and CMP Pipe Bedding	9-03.11	....	....	....	....	....	....	....	0-25	....	75-100	100	....	....	....	....	....	....	....	....			
23.	1/2" Minus Crushed Gravel	Cover Rock	9-03.11	2-12	....	....	40-75	....	....	....	70-100	....	100	....	....	....	....	....	....	....	....	....			30
24.	1/2" Minus Crushed Gravel	Chip Rock	9-03.11	0-3	....	0-5	0-10	....	0-20	25-55	50-90	98-100	100	....	....	....	....	....	....	....	....	....			30

9-03.12(6) WASHED SAND AND GRAVELS

Washed sand and gravels shall meet the gradation requirements of Section 9-03.16 for Mineral Aggregate Types 4, 5, 6, 7, and 26, whichever is specified.

Washed sand and gravels shall consist of screened sand, gravel or other inert materials, or combinations thereof, from sources approved by the Engineer, having hard, durable particles free from adherent coatings. The materials shall be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious substances. The amount of deleterious substances in the washed sand or gravel shall not exceed the values specified in Section 9-03.1(2)B for Mineral Aggregate Types 6, 7, and 26 and Section 9-03.1(3)B for Mineral Aggregate Types 4 and 5.

9-03.13 BACKFILL FOR SAND DRAINS

9-03.13(1) SAND DRAIN BACKFILL

Backfill for sand drains shall conform to the following grading:

Sieve Size	Percent Passing
1/2" square	90-100
1/4" square	65-100
U.S. No. 10	40-100
U.S. No. 50	3-30
U.S. No. 100	0-4
U.S. No. 200	0-3.0

All percentages are by weight.

9-03.13(2) SAND DRAINAGE BLANKET

Aggregate for the sand drainage blanket shall consist of granular material, free from wood, bark, or other extraneous material and shall meet the following requirements for grading:

Sieve Size	Percent Passing
2-1/2" square	90-100
1/4" square	30-100
The portion passing 1/4" shall meet the following requirements for grading:	
U.S. No. 10	50-100
U.S. No. 50	0-30
U.S. No. 100	0-7.0
U.S. No. 200	0-3.0

All percentages are by weight.

That portion of backfill for sand drains and sand drainage blanket retained on a 1/4 inch square sieve shall contain not more than 0.05 percent by weight of wood waste.

9-03.14 GRAVEL BORROW

Unless otherwise specified on the Drawings or in the Project Manual, gravel borrow shall meet the requirements of Section 9-03.12(2) and the grading requirements in Section 9-03.16 for Mineral Aggregate Type 17.

If requested by the Contractor, the screen size may be increased if it is determined by the Engineer that larger size aggregate will be satisfactory for the specified backfilling or embankment construction.

9-03.15 TEST METHODS FOR AGGREGATES

The properties enumerated in these Specifications shall be determined in accordance with the following methods of test:

Title	Test Method
Sampling	AASHTO T 2
Clay Lumps in Aggregates	AASHTO T 112
Abrasion of Coarse Aggregates by Use of the Los Angeles Machine	WSDOT No. 101
Material Finer than U.S. No. 200 Sieve in Aggregates	WSDOT No. 102
Sieve Analysis of Fine and Coarse Aggregates	WSDOT No. 104
Organic Impurities	WSDOT No. 111
Determination of Degradation Value	WSDOT No. 113
Determination of Fineness Modulus	WSDOT No. 119
Lightweight Pieces in Aggregates	WSDOT No. 122
Mortar Strength	WSDOT No. 311
Percentage of Particles Smaller than 0.025 mm and 0.005 mm	WSDOT No. 603
Stabilometer R Value, Untreated Materials	WSDOT No. 611
Swell Pressure and Permeability	WSDOT No. 611
Stabilometer S Value, Treated Materials	WSDOT No. 703
Cohesiometer	WSDOT No. 719
Compressive Strength of Concrete	WSDOT No. 801
Flexural Strength of Concrete	WSDOT No. 802

9-03.17 ROCK

Rock for constructing new rock facings shall be large, broken pieces of igneous rock. Rock material shall be rectangular, selected pieces of rock sound and resistant to weathering. Rock shall be free of soft, weathered material and seams of soft rock susceptible to deterioration. When broken into pieces weighing 50 to 100 grams and tested for soundness with sodium sulfate in accordance with AASHTO T104, the loss through a 1 inch sieve after 6 cycles shall not exceed 35 percent by weight.

The density of rock material shall be a minimum of 160 pounds per cubic foot. The size categories for rock shall be as follows:

SIZE	APPROX. WEIGHT	MINIMUM DIMENSIONS	APPROX. VOLUME
One-man rock	160 to 400 lb	12 inches	1.75 cf
Two-man rock	500 to 800 lb	13 inches	4 cf
Three-man rock	900 to 1,200 lb	16 inches	6.6 cf
Four-man rock	1,300 to 1,600 lb	18 inches	9 cf

Rocks less than 1 cubic foot in volume or weighing less than 160 pounds shall not be used.

SECTION 9-04 JOINT AND CRACK SEALING MATERIALS

9-04.1 PREMOLDED JOINT FILLERS

9-04.1(1) ASPHALT FILLER FOR CONTRACTION AND LONGITUDINAL JOINTS IN CONCRETE PAVEMENTS

Premolded joint filler for use in contraction and longitudinal joints shall be 3/8 inch in thickness and shall consist of a suitable asphalt mastic encased in asphalt-saturated paper or asphalt-saturated felt. It shall be sufficiently rigid for easy installation in summer months and not too brittle for handling in cool weather.

Premolded joint filler shall meet the requirements of ASTM Standard D994 or AASHTO Designation M33.

9-04.1(2) PREMOLDED JOINT FILLER FOR EXPANSION JOINTS

Premolded joint filler for through joints shall be 3/4 inch thick and as wide as the depth of the pavement.

Premolded joint filler shall meet the requirements of ASTM Standard D1751 or AASHTO Designation M213.

9-04.1(3) VACANT

9-04.1(4) ELASTOMERIC EXPANSION JOINT SEALS

Premolded elastomeric expansion joint seals shall conform to the requirements of AASHTO M 220 and shall be formed by an extrusion process with uniform dimensions and smooth exterior surfaces. The cross-section of the seal shall be shaped to allow adequate compressed width of the seal, as approved by the Engineer.

9-04.2 JOINT SEALANTS

9-04.2(1) JOINT SEALANTS FOR SAWED CONTRACTION JOINTS

Joint sealants for sawed contraction joints shall meet the requirements of one of the following: (1) AASHTO M 173, Concrete Joint Sealer, Hot Poured Elastic Type, (2) ASTM D 1850, Concrete Joint Sealer, Cold Application Type; except that the test for evaluation of the bond requirements in the above specifications shall be in accordance with the bond test methods referred to in Section 9-04.2(2). Unless otherwise stated in the Project Manual, the Contractor will have the option of using either of the above two types.

9-04.2(2) POURED JOINT SEALER FOR PAVEMENT AREAS

The physical properties of the joint sealer, when mixed in accordance with the manufacturer's recommendations, shall be as follows:

(a) **Color:** Gray or black.
* (b) **Viscosity:** Must be pourable and self-leveling at 50 xF.
* (c) **Application Life:** Not less than 3 hours at 72 xF and 50 percent Relative Humidity.
(d) **Set to Touch:** Not more than 24 hours at 72 xF and 50 percent Relative Humidity.
(e) **Curing Time:** Not more than 96 hours at 72 xF and 50 percent Relative Humidity.
(f) **Non-Volatile Content:** Not less than 92 percent.
(g) **Hardness Rating (Durometer "Shore A"):** 5-35.
(h) **Resiliency:** Not less than 80 percent.
(i) Bond test methods shall be in accordance with WSDOT Test Method No. 412A.

* Viscosity and application life may be waived providing the material is mixed and placed by a pump and mixer approved by the Engineer.

Suitable primer, if required by the manufacturer, shall be furnished with each joint sealer. The primer shall be suitable for brush or spray application at 50x F or higher and shall cure sufficiently at 50xF to pour the joint within 24 hours. It shall be considered as an integral part of the sealer system. Any failure of the sealer in the test described herein, attributable to the primer, shall be grounds for rejection or retesting of the sealer.

Acceptance of joint sealing compound for use on a project shall be on the basis of laboratory tests of samples representative of each batch of material to be used on the job. A period of at least two weeks shall be allowed for completion of tests. Each container of the compound shall be clearly identified as to batch number.

9-04.2(3) POURED JOINT SEALER FOR WALKWAYS

Poured joint sealer used to seal sawed joints in sidewalks, stairs, plazas, and other walkways shall be a polyurethane sealer conforming to the requirements of Federal Specification TT-S-00227E Type I (Self-leveling) Class A or Type II (Non-sag) Class A.

9-04.3 JOINT MORTAR

Mortar for hand-mortared joints in pipes when specified shall be made in the proportions as given in Section 7-02.3(1)B3 in the Project Manual.

Cement shall conform to the requirements of AASHTO M 85, Type I or Type II.

Sand shall conform to the requirements of AASHTO M 45.

Water shall conform to the requirements of Section 9-25.1.

9-04.4 RUBBER GASKETS

9-04.4(1) RUBBER GASKETS FOR CONCRETE PIPES AND PRECAST MANHOLES

Rubber gaskets for use in joints of concrete culvert or storm sewer pipe and precast manhole sections shall conform to the applicable requirements of ASTM C443.

9-04.4(2) VACANT

9-04.4(3) RUBBER GASKETS FOR ALUMINUM OR STEEL CULVERT OR STORM SEWER PIPE

Gaskets for use with metal culvert or storm sewer pipe shall be continuous closed cell, synthetic expanded rubber gaskets conforming to the requirements of ASTM D 1056, Grade 2B3.

9-04.4(4) RUBBER GASKETS FOR ALUMINUM OR STEEL DRAIN PIPE

Gaskets for metal drain pipe shall be self-adhering, butyl-based scrim-supported type. When specified, the gaskets shall be as described in the Standard Plans.

9-04.4(5) PROTECTION AND STORAGE

Rubber gasket material shall be stored in a clean, cool place, protected from sunlight and contaminants. They shall be protected from direct sunlight at all times except during actual installation. Pipes with gaskets affixed shall be installed in the line within 28 days.

9-04.5 FLEXIBLE PLASTIC GASKETS

The gasket material shall be produced from blends of refined hydro-carbon resins and plasticizing materials reinforced with inert mineral filler and shall contain no solvents. It shall not depend on oxidizing, evaporating, or chemical action for adhesive or cohesive strength. It shall be supplied in extruded rope-form of such cross-section and size as to adequately fill spaces between the precast sections.

The gasket material shall be protected by a suitable removable two piece wrapper so designed as to permit removing one half, longitudinally, without disturbing the other. Its composition and properties shall conform to those set forth below.

	Test Method	Min.	Max.
Bitumen (Petroleum plastic content)	ASTM D 4	50	70
Ash-inert Mineral Matter	AASHTO T 111	30	50
Penetration	ASTM D 217		
32 °F (300gm) 60 sec		75	—
77 °F (150gm) 5 sec		50	120
115 °F (150gm)5 sec		—	150
Softening Point,°F	ASTM D 36	320	—
Specific Gravity at 77 °F	ASTM D 71	1.20	1.35
Weight per gallon, lb.		10.4	11.25
Ductility at 77 °F (cm)	ASTM D 113	5.0	—
Flash Point C.O.C., °F	ASTM D 93	600	—
Fire Point C.O.C., °F	ASTM D 92	625	—
Volatile Matter	ASTM D 6	—	2.0

9-04.6 EXPANDED POLYSTYRENE

Expanded polystyrene shall be of a cellular molded type with a density of 1.5 plus or minus 0.25 pounds per cubic foot.

9-04.7 EXPANDED RUBBER

Closed cell expanded rubber joint filler shall conform to ASTM D 1056, Grade No. 2B3.

9-04.8 FLEXIBLE ELASTOMERIC SEALS

Flexible elastomeric seals for PVC drain pipe and underdrain pipe shall conform to the requirements of ASTM D 3212.

9-04.9 SOLVENT CEMENTS

Solvent Cements for PVC underdrain pipe shall conform to the requirements of ASTM D 2564.

9-04.10 CRACK SEALING—RUBBERIZED ASPHALT

Rubberized asphalt for crack sealing asphalt concrete pavement shall conform to AASHTO M 173 (ASTM D 1190) and have a COC flash point (AASHTO T 48) of 400 F minimum. AASHTO M 173 (ASTM D 1190) is modified to delete the Bond Test requirement. AASHTO T 48 is modified to require careful agitation of the rubberized asphalt sample during testing to prevent local overheating.

SECTION 9-05 SANITARY SEWER AND STORM DRAIN STRUCTURES, CULVERTS, AND CONDUITS

9-05.0 ACCEPTANCE BY MANUFACTURER'S CERTIFICATION

Certain drainage materials may be accepted by the Engineer based on a manufacturer's certificate of compliance. These materials are as follows:

Metal drain and underdrain pipe,
PVC and corrugated polyethyiene drain pipe and underdrain pipe,
Metal culvert and sanitary sewer pipe and pipe arch less than 30 inches diameter,
Metal culvert end sections,
Corrugated metal structural plate pipe, pipe arch, and under passes, and
Ductile iron pipe.

9-05.1 DRAIN PIPE

9-05.1(1) CONCRETE DRAIN PIPE

Concrete drain pipe shall meet requirements of ASTM Designation C14 Class 3 for pipe less than 12 inches in diameter; ASTM C76 Class IV for 12 and 15 inches diameter pipe; and ASTM C76 Class III for pipe 18 inches in diameter and larger, uniess noted otherwise on the Drawings.

9-05.1(2) ZINC COATED (GALVANIZED) OR ALUMINUM COATED (ALUMINIZED) CORRUGATED IRON OR STEEL DRAIN PIPE

9-05.1(2)A GENERAL

Zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel drain pipe shall meet the requirements of AASHTO M 36. The galvanized or aluminized sheet thickness shall be 0.052 inch for 6-inch diameter drain pipe and 0.064 inch for 8-inch diameter and larger drain pipe. Welded seam aluminum coated (aluminized) corrugated iron or steel drain pipe with metallized coating applied inside and out following welding is acceptable.

9-05.1(2)B COUPLING BANDS

Coupling bands for zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel drain pipe shall meet the requirements of coupling bands for Type I pipe of AASHTO M 36, except that bands using projections (dimples) shall not be permitted. The bands shall be fabricated of the same material as the pipe, and with the same metallic protective treatment as the pipe.

Acceptable coupling bands for corrugated metal pipe shall be made using a 2 piece, 24 inches wide corrugated coupling band, held together with angles and bolts, a neoprene gasket between the pipe and the band, and be of the same material and corrugations as the pipe, and meet the requirements of Section 9-05.4(7).

9-05.1(3) CORRUGATED ALUMINUM ALLOY DRAIN PIPE

9-05.1(3)A GENERAL

Corrugated aluminum alloy drain pipe shall meet the requirements of AASHTO M 196, without perforations.

9-05.1(3)B COUPLING BANDS

Coupling bands for corrugated aluminum alloy drain pipe shall meet the requirements of coupling bands for Type I pipe of AASHTO M 196, except that bands using projections (dimples) shall not be permitted. The bands shall be fabricated of the same material as the pipe.

Acceptable coupling bands for aluminum corrugated pipe shall be made using a 2 piece, 24 inches wide corrugated coupling band, held together with angles and bolts, a neoprene gasket between the pipe and the band, and be of the same material and corrugations as the pipe, and meet the requirements of Section 9-05.5(5).

9-05.1(4) VACANT

9-05.1(5) POLYVINYL CHLORIDE (PVC) DRAIN PIPE

Polyvinyl Chloride (PVC) drain pipe and fittings shall meet the requirements of ASTM D3034 SDR35 with restrained gasket joints.

9-05.1(6) CORRUGATED POLYETHYLENE DRAINAGE TUBING DRAIN PIPE

Corrugated polyethylene drainage tubing drain pipe shall meet the requirements of AASHTO M 252. The maximum size pipe shall be 8 inches in diameter.

9-05.2 SUBSURFACE DRAIN PIPE

9-05.2(1) VACANT

9-05.2(2) PERFORATED CONCRETE SUBSURFACE DRAIN PIPE

Perforated concrete subsurface drain pipe shall meet the requirements of AASHTO M 175, Type I, except the perforations shall be approximately 1/2 inch in diameter. Strength requirements shall be as shown in Table I of AASHTO M 86.

9-05.2(3) VACANT

9-05.2(4) ZINC COATED (GALVANIZED) OR ALUMINUM COATED (ALUMINIZED) CORRUGATED IRON OR STEEL SUBSURFACE DRAIN PIPE

9-05.2(4)A GENERAL

Zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe shall meet the requirements of AASHTO M 36, except that perforations required in Class I, II, and III pipe may be located anywhere on the tangent of the corrugations provided the other perforation spacing requirements remain as specified. Welded seam aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe with metallized coating applied inside and out following welding is acceptable.

The pipe may conform to any one of the Type III pipes specified in AASHTO M 36, and perforations in Class I, II, and III pipe may be drilled or punched. The galvanized or aluminized sheet thickness shall be 0.052 inch for 6-inch diameter subsurface drain pipe and 0.064 inch for 8-inch and larger diameter subsurface drain pipe.

9-05.2(4)B COUPLING BANDS

Coupling bands for zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe shall meet the requirements of coupling bands for Type III pipe of AASHTO M 36. The bands shall be fabricated of the same material as the pipe and with the same metallic protective treatment as the pipe, if metallic bands are used.

Acceptable coupling bands are the two-piece helically corrugated band with nonreformed ends and integrally formed flanges, universal bands (dimple bands), a smooth sleeve type coupler, and those bands meeting the requirements of Section 9-05.4(7). Smooth sleeve type couplers may be either plastic or steel suitable for holding the pipe firmly in alignment without the use of sealing compound or gaskets.

9-05.2(5) PERFORATED CORRUGATED ALUMINUM ALLOY SUBSURFACE DRAIN PIPE

9-05.2(5)A GENERAL

Perforated corrugated aluminum alloy subsurface drain pipe shall meet the requirements of AASHTO M 196, except that the perforations may be located anywhere on the tangent of the corrugations providing the other perforation spacing requirements remain as specified.

9-05.2(5)B COUPLING BANDS

Coupling bands for corrugated aluminum alloy subsurface drain pipe shall meet the requirements of coupling bands for Type III pipe of AASHTO M 196. The bands shall be fabricated of the same material of the pipe, if metallic bands are used.

Acceptable coupling bands are the two-piece helically corrugated band with nonreformed ends and intergally formed flanges, universal bands (dimple bands), a smooth sleeve type coupler, and those bands meeting the requirements of Section 9-05.5(5). Smooth sleeve type couplers may be either plastic or aluminum alloy suitable for holding the pipe firmly in alignment without the use of sealing compound or gaskets.

9-05.2(6) PERFORATED PVC SUBSURFACE DRAIN PIPE

Perforated PVC subsurface drain pipe shall meet the requirements of AASHTO M 278. The maximum size pipe shall be 8 inches in diameter.

9-05.2(7) PERFORATED CORRUGATED POLYETHYLENE DRAINAGE TUBING SUBSURFACE DRAIN PIPE

Perforated corrugated polyethylene drainage tubing subsurface drain pipe shall meet the requirements of AASHTO M 252. The maximum size pipe shall be 8 inches in diameter.

9-05.3 CONCRETE CULVERT PIPE

9-05.3(1) PLAIN CONCRETE CULVERT PIPE

9-05.3(1)A GENERAL

Plain concrete pipe shall meet the requirements of ASTM C14 Class 2.

9-05.3(1)B END DESIGN

The end designs for plain concrete culvert pipe shall conform to the applicable requirements of AASHTO M 198 when rubber gasketed joints are required. Unless specified otherwise in the Contract, the Contractor shall have the option of providing rubber gasket or cement mortar joints. The planes of the ends of the pipes shall be perpendicular to their longitudinal axes.

9-05.3(1)C BASIS FOR ACCEPTANCE

The basis for acceptance of plain concrete culvert or drain pipe shall be on the results of three edge bearing tests performed at the manufacturer's plant within the 90-day period immediately preceding shipment of the pipe.

9-05.3(1)D AGE AT SHIPMENT

Plain concrete culvert pipe may be shipped when it meets all test requirements. Unless it is tested and accepted at an earlier age, it shall not be considered ready for shipment sooner than 28 days after manufacture when made with type II portland cement, nor sooner than 7 days when made with type III portland cement.

9-05.3(2) REINFORCED CONCRETE CULVERT PIPE

9-05.3(2)A GENERAL

Reinforcing concrete culvert pipe shall conform to the requirements of ASTM C76 Class III.

9-05.3(2)B END DESIGN

Section 9-05.3(1)B will apply to reinforced concrete culvert pipe.

9-05.3(2)C BASIS FOR ACCEPTANCE

The basis for acceptance of reinforced concrete pipe 60 inches in diameter and smaller shall be determined by the results of the three edge bearing test for the load to produce a 0.01 inch crack, and testing to the ultimate load will ordinarily not be required, except as necessary to obtain samples for making the absorption test. In lieu of broken pieces of pipe obtained as above provided, 4-inch diameter cores from pipe sections selected by the Engineer may be furnished for performing the absorption test. Sections of pipe which have been tested to the actual 0.01-inch crack will ordinarily not be further load tested; and such sections which meet or exceed the required strength and workmanship standards may be accepted for use on the project.

Acceptance of reinforced concrete pipe larger than 60 inches diameter shall be based on inspection of the size and placement of the reinforcing steel, and, at the option of the Engineer, on compressive strength tests of 4-inch diameter cores cut from the pipe, or on compressive strength of representative test cylinders cast with and cured with the pipe.

9-05.3(2)D AGE AT SHIPMENT

Reinforced concrete culvert pipe may be shipped when it meets the requirements of Section 9-05.3(1)D.

9-05.3(3) BEVELED CONCRETE END SECTIONS

Beveled concrete end sections shall be plain concrete conforming to AASHTO M 86 or reinforced concrete conforming to the applicable sections of AASHTO M 170 with the design requirements as listed in Table 2, Wall B, Circular Reinforcement in circular pipe, and WSDOT Standard Plan No. B-7a.

9-05.4 STEEL CULVERT PIPE AND PIPE ARCH

9-05.4(1) GENERAL

Steel culvert pipe and pipe arch shall meet the requirements of AASHTO M 36, Type I and Type II. Welded seam aluminum coated (aluminized) corrugated steel pipe and pipe arch with metallized coating applied inside and out following welding is acceptable.

9-05.4(2) ELLIPTICAL FABRICATION

When elongated pipes are specified, circular pipes shall be fabricated 5 percent out of round to form an elliptical section. The vertical or longer axis of the elliptical section shall be clearly marked before shipping.

9-05.4(3) VACANT

9-05.4(4) ASPHALT COATINGS AND PAVED INVERTS

Asphalt for asphalt coatings and paved inverts shall meet the requirements of AASHTO M 190, Section 4. The coatings for Treatments 1, 2, and 5 as specified in Section 7-02.3(1)C3A shall be uniform, inside and out, and applied in accordance with the following requirements:

The metal shall be free from grease, dirt, dust, moisture, or other deleterious contaminants. Either process described below may be used for application.

(a) Pipe Not Preheated:

The temperature of the asphalt at the time of pipe immersion shall be 400°F (plus or minus 5 degrees), and the duration of the immersion shall conform to the following schedule:

Thickness in Inches		Minimum Immersion
Steel	Aluminum	Time-Minutes
.064	.060	2.5
.079	.075	3.0
.109	.105	5.0
.138	.135	6.5
.168	.164	8.0

(b) Pipe Preheated:

The asphalt shall have a temperature of 380 degrees F (plus or minus 5 degrees), and the pipe shall be brought to a temperature of 300 degrees F to 350 degrees F before immersion.

Paved inverts for Treatments 2 and 4 as specified in Section 7-02.3(1)C3A shall consist of bituminous material applied in such a manner that one or more smooth pavements will be formed in the invert filling the corrugations for at least 40 percent of the circumference. The pavement shall have a minimum thickness of 1/8-inch above the crest of the corrugations except where the upper edges intercept the corrugation. The pavements shall be applied following the coating with asphalt or fiber bonding.

Treatment 5 may be substituted for Treatment 2, and Treatment 6 for Treatment 4 at the option of the Contractor.

9-05.4(5) VACANT

9-05.4(6) SPUN ASPHALT LINING

Asphalt for spun linings over 100 percent periphery shall conform to AASHTO M 190, Section 4. Asphalt spun linings shall provide a smooth surface for the full interior of the pipe by completely filling the corrugations to a minimum thickness of 1/8 inch above the crests. The interior lining shall be applied by centrifugal or other approved methods. The interior shall be free from sags or runs, but slight residual corrugations due to cooling shrinkage of the lining will not be cause for rejection. At the three-sheet laps, an interior nonuniformity equal to the thickness of the sheet is allowable. The thickness of the lining shall be maintained to the ends of the pipe.

The thickness of the lining over the crest of the corrugation shall not vary by an amount in excess of 1/2 inch over the entire area of the spun lining.

In the case of helical corrugated pipe manufactured with a continuous lock seam, an interior nonuniformity over the lock seam equal to the thickness of two culvert sheets is allowable.

9-05.4(7) COUPLING BANDS

Coupling bands shall be flange bands or corrugated bands as shown in the Drawings or WSDOT Standard Plan No's. B-13a through B-14 and shall be fabricated of the same material as the pipe and with the same metallic protective treatment as the pipe. The corrugated bands shall conform to the pipe and shall meet all applicable requirements of AASHTO M 36 except that coupling bands for all sizes of steel pipe arch with 3-inch x 1-inch corrugations shall be 24 inches wide. Bands having projections in lieu of corrugations will not be allowed.

Steel bolts and nuts for coupling bands shall meet the requirements of ASTM A 307 and shall be galvanized in accordance with ASTM A 153.

Steel angles, when required for coupling bands, shall meet the requirements of AASHTO M 36.

Asphalt coating shall not be used on coupling bands.

Coupling bands meeting the requirements of Section 9-05.10(2) shall also be acceptable.

Coupling bands shall be made by the same manufacturer as the steel pipe selected for installation.

9-05.4(8) STEEL PIPE ARCH

Steel pipe arch shall meet the requirements for steel pipe and pipe arch of these Specifications except in the method of fabrication. Circular pipe shall be fabricated in two semi-circles, and the pipe arch shall be fabricated in two separate sections, the upper portion or arch, and the bottom section including the connecting arcs.

Both longitudinal edges of the lower section of the pipe arch shall be notched to provide interlocking seams which will form the two segments into the full section when it is erected in the field. Hook and eye bolts, or other approved means, shall be provided to hold the segments firmly together.

Individual plates shall be a minimum of 2 feet in length except for short or half sections required to complete the end section of the culvert.

When protective treatment is specified in the Drawings, pipe arch shall be coated with one of the treatments as provided in Section 7-02.3(1)C3A.

9-05.4(9) STEEL END SECTIONS

9-05.4(9)A GENERAL

The applicable provisions of AASHTO M 36 shall apply to the construction of steel end sections, except that the end sections shall be fabricated of the same material with the same metallic protective treatment as the pipe.

Asphalt coating shall not be used on steel end sections.

9-05.4(9)B FABRICATION

The shape, thickness, dimensions, and number of pieces shall conform to WSDOT Standard Plan No. B-9 for the size and shape of pipe shown in the Drawings. They shall be manufactured as integral units or so formed that they can be readily assembled and erected in place. When bolts are used for assembly, they shall be 3/8 inch diameter or larger and shall be galvanized. No field welding or riveting will be permitted.

9-05.4(9)C GALVANIZED HARDWARE

Bolts, nuts, and miscellaneous hardware shall be galvanized in accordance with the provisions of AASHTO M 232.

9-05.4(9)D TOE PLATE EXTENSIONS

Toe plate extensions shall be furnished only when so designated in the Drawings. When required, the toe plate extensions shall be punched with holes to match those in the lip of the skirt and fastened with 3/8 inch or larger galvanized nuts and bolts. Toe plate extensions shall be the same material and thickness as the end section and shall be fabricated of the same material with the same metallic protective treatment as the end section.

9-05.5 ALUMINUM CULVERT PIPE

Aluminum culvert pipe shall conform to the applicable requirements of AASHTO M 196.

9-05.5(1) ELLIPTICAL FABRICATION

Section 9-05.4(2) shall apply to aluminum pipes.

9-05.5(2) MITERED ENDS

Section 7-02.3(1)C2C shall apply to aluminum pipes.

9-05.5(3) PROTECTIVE TREATMENT

When protective treatment is specified for aluminum pipe, it shall be Treatment 5 as shown in Section 7-02.3(1)C3A.

9-05.5(4) ASPHALT COATINGS

Asphalt coatings for aluminum culvert pipe shall meet the requirements of Section 9-05.4(4).

9-05.5(5) COUPLING BANDS

Coupling bands shall meet applicable requirements of AASHTO M 196. Bands having projections in lieu of corrugations will not be allowed.

Steel bolts and nuts for coupling bands shall meet the requirements of ASTM A 307 and shall be galvanized in accordance with AASHTO M 232 or AASHTO B 633.

Aluminum angles shall be of the same material of the coupling bands.

Asphalt coating shall not be used on coupling bands.

Coupling bands shall be made by the same manufacturer as the aluminum pipe selected for installation.

9-05.5(6) ALUMINUM END SECTIONS

The applicable provisions of AASHTO M 196 shall apply to the construction of end sections and toe plate extensions for aluminum pipes. In addition, they shall conform to the requirements of Section 9-05.4(9).

Asphalt coating shall not be used on aluminum end sections.

9-05.6 STRUCTURAL PLATE PIPE, PIPE ARCH, ARCH AND UNDERPASS

9-05.6(1) GENERAL

Structural plate pipes shall be full circle of the type, gage or thickness, and diameter specified.

Structural plate pipe arches shall be a multi-centered shape, made up of four circular arcs tangent to each other at their junctions and symmetrical about the vertical axis, and of the type, gage or thickness, and span specified.

Structural plate arches shall be a single-centered circular arc shape placed on a reinforced concrete foundation, and of the design, type, gage or thickness, and span as provided for in the Drawings.

Structural plate underpasses shall be a multi-centered shape, made up of a variable number of circular arcs tangent to each other at their junctions and symmetical about the vertical axis, and of the design, type, gage or thickness, and span specified.

9-05.6(2) FABRICATION

The plates at longitudinal and circumferential seams shall be connected by bolts; the bolt holes shall be staggered in rows 2 inches apart, one hole being punched in the valley and one in the crest of each corrugation along both edges of each plate. Bolt holes on circumferential seams shall be spaced at approximate 12 inches intervals. No hole shall be closer to the edge of the plate than twice the diameter of the bolt.

9-05.6(3) ELLIPTICAL FABRICATION

Section 9-05.4(2) shall apply to structural plate pipes.

9-05.6(4) STRUCTURAL PLATE PIPE ARCH

Plates for structural plate pipe arches shall be formed so that the top shall be an arc of not more than 180 degrees nor less than 155 degrees; the bottom shall be an arc of not more than 50 degrees nor less than 10 degrees; and the top shall be joined at each end to the bottom by an arc having a radius between 18 and 31 inches and of not more than 87-1/2 degrees nor less than 75 degrees.

9-05.6(5) STRUCTURAL PLATE ARCH

Structural plate arches and their foundations shall be as shown in the Drawings.

9-05.6(6) STRUCTURAL PLATE UNDERPASS

Structural plate underpasses shall be as provided for in WSDOT Standard Plan No's. B-8 and B-8a, or, in the case of a special design, as provided for in the Drawings.

9-05.6(7) VACANT

9-05.6(8) PLATES

9-05.6(8)A CORRUGATED STEEL PLATES

Galvanized corrugated steel plates for constructing structural plate pipe, pipe arches, arches, and underpasses, and nuts and bolts used in their assembly shall conform to the requirements of AASHTO M 167 except that the minimum weight of spelter coating on the plates shall be 3 ounces of zinc per square foot of double exposed surface. If the average spelter coating as determined from the required samples is less than 3.0 ounces, or if any one specimen shows less than 2.7 ounces, the lot samples shall be rejected. Nuts, bolts, and miscellaneous hardware shall be galvanized in accordance with AASHTO M 232.

9-05.6(8)B CORRUGATED ALUMINUM PLATES

Aluminum alloy plates and fasteners intended for use in the construction of structural plate pipe, pipe arches, arches, and underpasses shall conform to the requirements of AASHTO M 219. Nuts, bolts, and miscellaneous hardware shall be galvanized in accordance with AASHTO M 232.

9-05.7 CONCRETE SEWER PIPE

9-05.7(1) PLAIN CONCRETE SEWER PIPE

Plain concrete sanitary sewer pipe shall meet the requirements of ASTM C14 Class 3, unless otherwise called for on the Drawings. Permeability test shall be conducted as follows:

The pipe selected for test shall be placed either end down on a soft rubber pad, at the option of the Engineer, and filled with water. The pipe shall be kept full of water for a period of 2 minutes. At the end of that period the outer surface of the pipe shall be examined for leaks.

A leak is herein defined as a moist spot on which, when wiped dry with a cloth, moisture will quickly reappear.

The Engineer may select a maximum of 2 percent but in no case shall less than 5 pipes of each size be tested.

9-05.7(2) REINFORCED CONCRETE SEWER PIPE

Reinforced concrete pipe shall conform to ASTM Designation C76, and shall be of the class noted on the Drawings or in the Project Manual.

Pipe ends of reinforced concrete pipe may be bell and spigot, modified bell and spigot, or tongue and groove unless otherwise specified in the Project Manual.

Acceptance shall be based on load bearing tests, material tests and inspection of the product at all stages of construction. Acceptance by cylinders or cores instead of load bearing tests is permissible when agreed upon by the manufacturer and the Engineer prior to manufacture.

Both bells and spigots shall be reinforced in pipe 30 inches or more in diameter.

The identification of the minor axis of elliptical reinforcement shall be in accordance to Section 7-02.3(1)B4.

9-05.7(3) CONCRETE SEWER PIPE JOINTS

All concrete pipe shall be joined with rubber gaskets. The joints and gasket material shall meet the requirements of ASTM C443. Gasket material shall be handled and stored in accordance to Section 9-04.4(5).

9-05.7(4) TESTING CONCRETE SEWER PIPE JOINTS

9-05.7(4)A GENERAL

When a particular type of pipe joint design, material or joining method has not previously been tested and approved, the following test shall be made on one test length of the assembled sewer pipe to qualify the design, material or method of joining the pipe. At the option of the Engineer, additional testing may be requested if subsequent field testing of installed pipe indicates difficulty in obtaining property joined pipe. The tests will be conducted at the manufacturer's yard, and the manufacturer will be required to make such space and facilities available as required to conduct the tests in an efficient and workmanlike manner.

9-05.7(4)B HYDROSTATIC PRESSURE ON PIPES IN STRAIGHT ALIGNMENT

Hydrostatic pressure tests on pipes in straight alignment shall be made in accordance with the procedure outlined in paragraph 8(a) of AASHTO M 198, except that they shall be performed on an assembly consisting of not less than three nor more than five pipe sections selected from stock by the Engineer and assembled in accordance with standard installation instructions issued by the manufacturer. The end sections shall be bulkheaded and restrained against internal pressure.

9-05.7(4)C HYDROSTATIC PRESSURE TESTS ON PIPES IN MAXIMUM DEFLECTED POSITION

Upon completion of the test for pipe in straight alignment, the test section shall be deflected until at least two of the joints have been deflected to the maximum amount shown in the manufacturer's standard installation instructions. When thus deflected, there shall be no leakage at the joints from an applied internal hydrostatic pressure of 5 psi.

9-05.7(4)D HYDROSTATIC PRESSURE TEST ON 15 INCH DIAMETER AND LARGER PIPE UNDER DIFFERENTIAL LOAD

The test sections shall be suitably supported so that one of the pipes of the test assembly is suspended freely between adjacent pipes, bearing only on the joints. The suspended pipe shall then be loaded, at its midpoint, in addition to the weight of the pipe, in accordance with the following schedule:

Diameter	Load
15 inches	7,400 lbs.
18 inches	8,800 lbs.
21 inches	10,000 lbs.
24 inches and over	11,000 lbs.

While under this load, the stressed joints shall show no leakage when subjected to an internal hydrostatic pressure of 5 psi. At the option of the manufacturer, 1/2 of the load may be applied on the bell end of the suspended pipe in lieu of the full load on the center of the suspended pipe.

9-05.8 VITRIFIED CLAY SEWER PIPE

This material shall not be used in the City of Seattle projects unless specified in the Project Manual. Vitrified clay sewer pipe shall conform to ASTM C 700, and all joints shall be factory manufactured in accordance with ASTM C 425.

9-05.9 STEEL SPIRAL RIB SEWER PIPE

9-05.9(1) GENERAL

Steel spiral rib sewer pipe shall be manufactured of metallic coated (aluminized or galvanized) corrugated steel and inspected in conformance with Section 9-05.4. The size, coating, and metal shall be as shown in the Drawings or in the Specifications.

The manufacturer of spiral rib sewer pipe shall furnish to the Engineer a certificate of compliance stating that the materials furnished comply in all respects with these Specifications. The Engineer may require additional information or tests to be performed by the Contractor, at no expense to the Owner.

Unless otherwise specified, spiral rib sewer pipe shall be furnished with pipe ends cut perpendicular to the longitudinal axis of the pipe. Pipe ends shall be cut evenly. Spiral rib pipe shall be fabricated either by using a continuous helical lock seam with a seam gasket or a continuous helical welded seam paralleling the rib.

Helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of material. The ribs shall be essentially rectangular and shall be 3/4 inch plus 2 times the wall thickness (2t) plus or minus 1/8 inch (measured outside to outside) and a minimum of 0.95 inch high (measured as the minimum vertical distance from the outside of pipe wall immediately adjacent to the lockseam or stiffener to top surface of rib). The maximum spacing of ribs shall be 11.75 inches center to center (measured normal to the direction of the ribs). The radius of bend of the metal at the corners of the ribs shall be a minimum of 0.10 inch and a maximum of 0.17 inch. If the sheet between adjacent ribs does not contain a lockseam, a stiffener shall be included midway between ribs, having a nominal radius of 0.25 inch and a minimum height of 0.20 inch toward the outside of the pipe. Pipe shall be fabricated with ends that can be effectively jointed with coupling bands.

When required spiral rib pipe shall be bituminous treated or paved. The bituminous treatment for spiral rib pipe shall conform to the requirements of Sections 7-02.3(1)C3A and 9-05.4(4).

Requirements for steel spiral rib sewer pipe shall also be applied to steel narrow pitch spiral rib sewer pipe specified herein in this Section 9-05.9 except as modified as follows:

(a) Narrow pitch spiral rib pipe shall be fabricated by using a continuous helical lock seam paralleling the rib.

(b) Helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of material. The ribs shall be .375 inch plus or minus 1/8 inch wide (measured outside to outside) and a minimum of .4375 inch high (measured as the minimum vertical distance from the outside of pipe wall to top surface of the rib). The maximum spacing of ribs shall be 4.80 inches center to center (measured normal to the direction of the ribs). The radius of bend of the metal at the corners of the ribs shall be a minimum of 0.0625 inch with an allowable tolerance of plus or minus 10 percent.

9-05.9(2) CONTINUOUS LOCK SEAM PIPE

9-05.9(2)A GENERAL

Pipes fabricated with continuous helical seam parallel to the rib may be used for full circle pipe. The lock seam shall be formed in the flat between ribs and shall conform to Sections 7.5.1 through 7.5.3 of AASHTO M 36.

For narrow pitch spiral rib storm sewer pipe, the lap width specified in Section 7.5.1 shall be 1/4 inch.

For use in applications without bituminous treatment, the continuous lockseam must be qualified by tests conducted by the Materials Laboratory.

9-05.9(2)B BASIS FOR ACCEPTANCE

The basis for acceptance will be a qualification test, conducted by the Materials Laboratory, for each manufacturer of helically corrugated, gasketed spiral rib, or narrow pitch spiral rib lock seam steel pipe. Only those specific pipe sizes and gasket materials approved under the qualification test will be accepted.

Continuous lock seam, pipe shall be sampled and tested in accordance with AASHTO T-249.

9-05.9(3) CONTINUOUS WELDED SEAM PIPE

Pipes fabricated with a continuous helical welded seam parallel to the ribs may be used for full circle pipe. The welding process for galvanized steel pipe shall be so controlled that the combined width of the weld and adjacent spelter coating burned by the welding does not exceed three times the thickness of the metal. If spelter is burned outside these limits,

the weld and burned spelter shall be treated as required below. Testing for welded seam quality control shall conform to AASHTO T-421. Welded pipe fabricated from aluminized steel pipe shall have the coating of the welded area repaired by flame-sprayed metallizing inside and out after welding.

When the galvanized (zinc coated) surface has been burned by gas or arc welding, all surfaces of the welded connections shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked galvanizing removed, after which the areas shall be repaired by flame spray metallizing both inside and out.

9-05.9(4) COUPLING BANDS

Coupling bands shall be of the same material as the pipe. Coupling bands and gaskets shall conform to Section 9-05.10(2).

9-05.10 STEEL SEWER PIPE

9-05.10(1) GENERAL

Steel sewer pipe shall conform to the requirements of Section 9-05.4 for steel culvert pipe, except that protective coating shall be Treatment 5 as specified in Section 7-02.3(1)C3A, and be constructed of either helically corrugated lock seam or helically corrugated continuous welded steel pipe. When gasketed helically corrugated lock seam steel pipe is called for, Treatment 5 is not required. Welded seam aluminum coated (aluminized) steel pipe shall require metallized aluminum coating inside and out following welding and shall not require Treatment 5.

9-05.10(2) COUPLING BANDS

Coupling bands for sewer pipe shall conform to the details shown in the WSDOT Standard Plan No's. B-13a through B-14 and to these Specifications:

Bands shall be made of the same base metal as the pipe and may be two nominal thicknesses lighter than used for the pipe but not thicker than 0.109 inch or lighter than 0.064 inch. Corrugations on the bands shall be the same size and shape as those on the pipe to be connected. Steel bolts and nuts shall meet the requirements of ASTM A 307, and galvanized in accordance with AASHTO M 232. Welds shall develop the full strength of the parent metal.

Type F bands may be used as an alternate to all other types shown for steel sewer pipe sizes 12 inches in diameter to 84 inches in diameter inclusive, provided that two annular corrugations are formed on each pipe end to be joined. The end corrugation shall be 2 inches x 1/2 inch and the inside adjacent corrugation shall be 2-2/3 inches x 1/2 inch.

When annular corrugated bands are used to connect lock-seam helically corrugated pipes, the seam shall be welded at the pipe ends prior to recorrugating to prevent unraveling of the seam.

Coupling bands shall be made by the same manufacturer as the steel sewer pipe selected for installation.

9-05.10(3) BASIS FOR ACCEPTANCE

The basis for acceptance of steel sewer pipe will be the same as specified in Section 9-05, except when gasketed helically corrugated lock seam steel pipe is called for. A qualification test conducted by the Headquarters Materials Laboratory will be required for each manufacturer of gasketed helically corrugated lock seam steel pipe. Only those specific pipe sizes and gasket materials approved under the qualification test will be accepted.

9-05.11 ALUMINUM SEWER PIPE

9-05.11(1) GENERAL

Aluminum sewer pipe shall conform to the requirements of Section 9-05.5 for aluminum culvert pipe, except that the protective coating shall be Treatment 5 as specified in Section 7-02.3(1)C3A, and the pipe shall be constructed of helically corrugated lock seam aluminum pipe.

When gasketed helically corrugated lock seam aluminum pipe is called for, Treatment 5 is not required.

9-05.11(2) COUPLING BANDS

Section 9-05.10(2) shall apply to aluminum pipes, except the band shall not be more than 0.105 inches or less than 0.060 inches in thickness.

Coupling bands shall be made by the same manufacturer as the aluminum sewer pipe selected for installation.

9-05.11(3) BASIS FOR ACCEPTANCE

The basis for acceptance of aluminum sewer pipe will be the same as specified in Section 9-05, except when gasketed helically corrugated lock seam aluminum pipe is called for. A qualification test, conducted by the Materials Laboratory, will be required for each manufacturer of gasketed helically corrugated lock seam aluminum pipe. Only those specific pipe sizes and gasket materials approved under the qualification test will be accepted.

9-05.12 PVC SEWER PIPE

Polyvinyl chloride pipe shall conform to the requirements of ASTM D 3034 SDR 35 or ASTM F 789.

Joints for PVC pipe shall conform to ASTM D 3212 using restrained gasket conforming to ASTM F 477.

Fittings for PVC pipe shall be injection molded tees or factory solvent cemented saddle tees. Normally, all fittings shall be the same material as the pipe being connected except that fittings using other materials or constructed with more than one material may be used subject to the approval of the Engineer. Fittings shall have sufficient strength to withstand handling and load stresses normally encountered.

9-05.13 DUCTILE IRON SEWER PIPE

Ductile iron pipe shall conform to ANSI A 21.51 or AWWA C 151 and shall be cement mortar lined, push-on joint, or mechanical joint. The ductile iron pipe shall be Class 50 or the class indicated on the Drawings or in the Project Manual.

Joints for ductile iron pipe shall be rubber gasketed conforming to the requirements of ANSI A 21.11 or AWWA C-111.

Cast iron fittings may be used with ductile iron pipe. Saddles fastened to pipe with external bands shall not be acceptable on any new system. Normally, all fittings shall be the same material as the pipe being connected, except that fittings using other materials or constructed with more than one material may be used subject to the approval of the Engineer. Fittings shall have sufficient strength to withstand handling and load stresses normally encountered.

9-05.14 VACANT

9-05.15 VACANT

9-05.16 VACANT

9-05.17 ALUMINUM SPIRAL RIB SEWER PIPE

9-05.17(1) GENERAL

Aluminum spiral rib sewer pipe shall be manufactured of corrugated aluminum and inspected in conformance with Section 9-05.5. The size, coating, and metal shall be as shown in the Drawings or in the Specifications.

The manufacturer of spiral rib sewer pipe shall furnish to the Engineer a certificate of compliance stating that the materials furnished comply in all respects with these Specifications. The Engineer may require additional information or tests to be performed by the Contractor, at no expense to the Owner.

Unless otherwise specified, spiral rib sewer pipe shall be furnished with pipe ends cut perpendicular to the longitudinal axis of the pipe. Pipe ends shall be cut evenly. Spiral rib pipe shall be fabricated by using a continuous helical lock seam with a seam gasket.

For spiral rib sewer pipe - helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of material. The ribs shall be 3/4 inch wide by 3/4 inch deep with a nominal spacing of 7-1/2 inches center to center. Pipe shall be fabricated with ends that can be effectively jointed with coupling bands.

For narrow pitch spiral rib sewer pipe, helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of material. The ribs shall be .375 inch plus or minus 1/8 inch wide (measured outside to outside) and a minimum of .4375 inch high (measured as the minimum vertical distance from the outside of pipe wall to top surface of the rib). The maximum spacing of ribs shall be 4.80 inches center to center (measured normal to the direction of the ribs). The radius of bend of the metal at the corners of the ribs shall be a minimum of 0.0625 inch with an allowable tolerance of plus or minus 10 percent.

For wide pitch spiral rib storm sewer pipe, helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of material. The ribs shall be 3/4 inch + 1/8 inch wide (measured outside to outside) and a minimum of 0.95 inch high (measured as the minimum vertical distance from the outside of pipe wall to top surface of the rib). The maximum spacing of ribs shall be 11.75 inches center to center (measured normal to the direction of the ribs). The radius of bend of the metal at the corners of the ribs shall be 0.0625 inch with an allowable tolerance of + 10 percent.

9-05.17(2) CONTINUOUS LOCK SEAM PIPE

Pipes fabricated with continuous helical seam parallel to the rib may be used for full circle pipe. The lock seam shall be formed in the flat between ribs and shall conform to Section 13.2.1 through 13.2.5 of AASHTO M 196.

For narrow pitch spiral rib storm sewer pipe, the seam lap width specified in Section 13.2.1 shall be 1/4 inch. The continuous lock seam must be qualified by tests conducted by the Materials Laboratory.

9-05.17(3) BASIS FOR ACCEPTANCE

The basis for acceptance will be a qualification test, conducted by the Materials Laboratory, for each manufacturer of helically corrugated, spiral rib, narrow pitch spiral rib or wide pitch spiral rib lock seam pipe. Only those specific pipe sizes and gasket materials approved under the qualification test will be accepted.

Continuous lock seam pipe shall be sampled and tested in accordance with AASHTO T 249.

9-05.17(4) COUPLING BANDS

Coupling bands shall be of the same material as the pipe. Coupling bands and gaskets shall conform to Section 9-05.10(2).

9-05.18 FILTER FABRIC

The geotextile shall be of woven or nonwoven construction and consist of long chain polymeric fibers composed of polypropylene, polyethylene, polyester, polyvinylidene chloride, or polyamide. The fibers shall be oriented into a multi-directional stable network whereby they retain their positions relative with each other and allow the passage of water as specified. The fabric shall be free or any chemical treatment or coating which reduces the permeability and shall be inert to chemicals commonly found in soil. The geotextile shall conform to the physical property requirements listed below.

Physical Property	Test Method	Acceptable Typical Test Results
Tensile Strength, wet, lbs.	ASTM D-1682	90 (*minimum)
Elongation, wet, %	ASTM D-1682	20 (*minimum)
Coefficient of Water Permeability, cm/sec	Falling Head 20 cm to 10 cm	.02 (minimum)
Puncture Strength, lbs.	ASTM D751[1]	40 (minimum)
Pore Size-EOS, U.S. Standard Sieve	Corps of Engrs CW-02215	70 - 100

*Minimum is the minimum value in any principal direction for the typical fabric weight.

[1]Tension testing machine with ring clamp; steel ball replaced with a 5/16 inch diameter solid steel cylinder with hemispherical tip centered within the ring clamp.

The geotextile shall be furnished in a protective wrapping which shall protect the fabric from ultraviolet radiation and from abrasion due to shipping and handling.

9-05.19 FLOW CONTROL STRUCTURE

The Flow Control Structure shall be made from a standard manhole section, diameter as indicated on the Drawings and Standard Plan No. 270a for flow control structures.

Where surface water is to enter directly through the cover of the flow control structure, the cast iron frame and grate shall be per Standard Plan No. 264 and the precast slab shall be per Standard Plans No's. 243a and 243b to fit the diameter of the chamber. In all other cases, Standard Plans ring and cover shall be used with a precast slab conforming to Standard Plans Series 200 with a 24-inch round opening. Manhole sections, castings and slabs shall meet the requirements of Section 7-05.

The Control device and connection shall consist of PVC pipe cross with an orifice, a pipe connection, and shear gate with a steel chain. The diameters of the control device and connection shall be the same as the diameter of the outlet pipe as indicated on the Drawings. The PVC pipe used for the cross and connection shall meet the specifications of ASTM D1785 Schedule 40. The PVC material used for the orifice plate and the shear gate shall be plate material meeting the specifications of ASTM D1784, PVC Class 12454-B. The orifice plate material shall be 1/4 inch thick; the shear gate material shall be 1/2 inch thick. The shear gate pin shall be of the same PVC material as the shear gate. The shear-gate chain shall be 12 gauge galvanized steel straight link chain.

9-05.20 ALUMINUM DETENTION PIPE

Aluminum detention pipe shall be helical or annular corrugated aluminum pipe, meeting the requirements of AASHTO Designation M196 Type I with the gauge as indicated on the Drawings. The end plate and all end plate reinforcement shall be aluminum alloy 6061-T6 structural plate with the thickness as indicated on the Drawings. The surfaces that are in contact with concrete shall be painted. The paint shall conform to Federal Specification TT-P-645 (Primer, Paint, Zinc Chromate, Alkyd Vehicle).

9-05.21 STEEL DETENTION PIPE

Steel detention pipe shall be galvanized helical or annular corrugated steel pipe, meeting the requirements of AASHTO Designation M36 Type 1, asphalt coated to requirements of AASHTO Designation M190 Type A with the gauge as indicated on the Drawings. The end plate and all end plate reinforcement will be structural steel plate of the type and thickness as designated on the Drawings.

SECTION 9-06 STRUCTURAL STEEL AND RELATED MATERIALS

9-06.1 STRUCTURAL CARBON STEEL

Structural carbon steel shall conform to the requirements of AASHTO M 183, Structural Steel.

9-06.2 STRUCTURAL LOW ALLOY STEEL

Structural low alloy steel shall conform to the requirements of AASHTO M 223 or M 222 as specified in the Drawings.

9-06.3 STRUCTURAL HIGH STRENGTH STEEL

Structural high strength steel shall be high yield strength, quenched and tempered structural steel conforming to the requirements of AASHTO M 244.

9-06.4 VACANT

9-06.5 BOLTS

9-06.5(1) UNFINISHED BOLTS

Unfinished bolts (ordinary machine bolts) shall conform to the specification requirements of ASTM A 307. They shall be Grade A unless otherwise specified in the Drawings or in the Project Manual.

9-06.5(2) TURNED BOLTS

Turned bolts shall be made from structural carbon steel as defined in Section 9-06.1 unless otherwise specified in the Drawings or the Project Manual.

9-06.5(3) HIGH STRENGTH BOLTS

High strength bolts for structural steel joints shall conform to the requirements of AASHTO M 164 or M 253. Bolts conforming to AASHTO M 253 shall not be galvanized. Bolts conforming to AASHTO M 164 that are to be galvanized shall conform to AISI 10XX series and shall have a maximum yield strength of 105,000 psi. Bolts conforming to AASHTO M 164 that are 1 inch in diameter or smaller and have a yield strength greater than 105,000 psi shall not be galvanized; however, they may be used provided they are painted with 2 coats of zinc rich paint, formula A-9-73, consisting of 2 mils minimum dry thickness per coat.

Bolts conforming to AASHTO M 164 that are to be used unpainted and nongalvanized, shall be Type 3. Nuts and washers used with Type 3 bolts shall have comparable atmospheric corrosion resistance and weathering characteristics.

The Contractor shall furnish to the Engineer 4 copies of the manufacturer's inspection test report for each shipping lot of bolts furnished. Tests shall be made in accordance with the applicable ASTM requirements.

When specified, ASTM A 354, Grade BD bolts may be used provided they meet the requirements set forth in Section 9 of AASHTO M 253.

9-06.5(4) ANCHOR BOLTS

Anchor bolts shall meet the requirements of ASTM A 449. The galvanizing and painting requirements shall be the same as listed for bolts conforming to AASHTO M 164 in Section 9-06.5(3). Washers for ASTM A 449 bolts shall meet the requirements of ASTM F 436.

The bolts shall be tested by the manufacturer in accordance with the applicable ASTM requirements and they shall be inspected before shipment to the job site.

9-06.6 VACANT

9-06.7 VACANT

9-06.8 STEEL CASTINGS

Steel castings shall conform to the requirements of AASHTO M 103, Mild to Medium Strength Carbon-Steel Castings for General Application, grade 70-36, unless otherwise designated in the Drawings or in the Project Manual.

9-06.9 GRAY IRON CASTINGS

Gray iron castings shall conform to the requirements of AASHTO M 105. The class of castings to be furnished shall be that designated in the Drawings or in the Project Manual.

9-06.10 MALLEABLE IRON CASTINGS

Malleable iron castings shall conform to the requirements of ASTM A 47.

9-06.11 STEEL FORGINGS AND STEEL SHAFTING

Steel forgings shall conform to the requirements of AASHTO M 102. The classes of forgings to be furnished shall be those specified in the Drawings or in the Project Manual.

Steel shafting shall conform to the requirements of AASHTO M 169, Grade Designation 1016 to 1030 inclusive, unless otherwise specified.

9-06.12 BRONZE CASTINGS

Bronze castings shall conform to the requirements of AASHTO M 107, Bronze Castings for Bridges and Turntables.

9-06.13 COPPER SEALS

Copper sheets for seals shall conform to the requirements of AASHTO M 138. They shall be UNS C12500, light cold rolled, and furnished in flat sheets each not less than 0.018 inch in thickness.

All splices or joints shall be carefully brazed or soldered to produce a continuous watertight seal for the full length of each unit.

9-06.14 DUCTILE IRON CASTINGS

Ductile iron castings shall conform to the requirements of ASTM A 536, Grade 80-55-06, unless otherwise specified in the Drawings or in the Project Manual.

9-06.15 WELDED SHEAR CONNECTORS

Welded shear studs shall be made from cold drawn bar stock conforming to the requirements of AASHTO M 169. Grades 1010 through 1020, inclusive, either semi-killed or killed deoxidation.

The material shall conform to the following mechanical properties:

Tesile Strength	60,000 psi. min.
Yield Strength	50,000 psi. min.
Elongation	20% min.
Reduction of Area	50% min.

Mechanical properties shall be determined in accordance with AASHTO Methods and Definitions T 244.

At the manufacturer's option, mechanical properties of the studs shall be determined by testing either the steel after cold finishing, or the full diameter finished studs.

9-06.16 VACANT

9-06.17 VACANT

9-06.18 METAL BRIDGE RAILING

Metal bridge railing shall conform to the type and material specifications set forth in the Drawings.

Section 8, part (b) of the Aluminum Association Standard Specifications for Aluminum Railing Posts Alloy A 344-T4 is hereby revised to provide that no X-ray inspection will be required after a foundry technique has been established for each mold which will ensure production of castings which are free from harmful defects. Inspection for approval of castings will be made by the Engineer after the finished castings have been anodized as noted in the Drawings.

Welding of aluminum shall be made in accordance with Section 1.5.5 of the "Standard Specifica- tions for Structural supports for Highway Signs, Luminaires and Traffic Signals", AASHTO 1975.

Aluminum materials shall conform to ASTM B 209 grades as follows: the Filler Alloy shall be 4043, 5356, or 5556 for Welding Base Metals 6061 or 6063 to 6061, 6063, 356, or A356. Filler Alloy for Welding Base Metal 5086 shall be 5356 or 5556.

9-06.19 BRIDGE DRAINS

Bridge drains shall be made of cast steel conforming to the requirements of ASTM Designation A 27, Mild to Medium Strength Carbon-Steel Castings for General Application, grade 70-36, unless otherwise designated in the Drawings or in the Project Manual.

9-06.20 DOWNSPOUTS

Downspouts shall be standard weight steel pipe, 4-inch or 6-inch diameter as shown in the Drawings.

All downspouts shall be hot-dipped galvanized in accordance with ASTM Designation A 120 after cutting to length, grooving, threading, bending or any other fabrication. Any areas where the galvanizing has been disrupted shall be repaired with galvanizing repair paint Formula A-9-73.

All fastenings of the downspouts to the structure, couplings, and pipe supports shall be galvanized in accordance with ASTM Designation A 153.

9-06.21 VACANT

9-06.22 BOLTS, WASHERS AND OTHER HARDWARE

Ordinary machine bolts and flat head bolts shall be made from commercial bolt stock meeting the specifications of ASTM A 307, and shall be grade A. Drift bolts and dowels may be either wrought iron or medium steel. Washers may be cast iron or malleable iron or may be cut from medium steel or wrought iron plate.

All bolts and other hardware which are to be galvanized and which require bending or shaping shall be hot forged to the required shape before galvanizing. Cold bending of such material will not be permitted because of the tendency toward embrittlement during the galvanizing process. Galvanizing shall be in accordance with AASHTO M 232.

Split rings for log cribbing of 4-inch inside diameter shall be manufactured from hot rolled, low-carbon steel conforming to ASTM A 711 AISI, Grade 1015. Each ring shall form a true circle with the principle axis of the cross-section of the ring metal parallel to the geometric axis of the ring. The thickness of the metal section shall be 0.195 inch plus or minus 0.010 inch and the section shall be beveled from the central portion toward the edges to a thickness of 0.145 inch plus or minus 0.010 inch. It shall be cut through in one place in its circumference to form a tongue and slot. Split ring connectors shall be galvanized in accordance with AASHTO M 232.

Spike-grid timber connectors shall be manufactured according to ASTM A 47 for malleable iron castings. They shall consist of 4 rows of opposing spikes forming a 4-1/8 inch square grid with 16 teeth which are held in place by fillets which are diamond shaped in cross-section.

Nails shall be round wire of standard form. Spikes shall be wire spikes or boat spikes, as specified in the Drawings. Bolts, dowels, washers, and other hardware, including nails, shall be black or galvanized as specified in the Drawings, but if not so specified shall be galvanized when used in treated timber structures.

SECTION 9-07 REINFORCING STEEL

9-07.1 GENERAL

9-07.1(1) ACCEPTANCE BY MANUFACTURER'S CERTIFICATION

Reinforcing steel may be accepted by the Engineer based on the manufacturer's certificate of compliance.

9-07.1(2) BENDING

Steel reinforcing bars shall be cut and bent by careful and competent workmen. They shall be bent cold to templates, which shall not vary appreciably from the shape and dimension shown in the Drawings.

Hooks and bends of steel reinforcing bars shall be bent to the following inside diameters unless shown otherwise in the Drawings:

Bar Size	Stirrups and Ties	All Other Bars
No. 3	1-1/2"	6 bar diameters
No. 4	2"	6 bar diameters
No. 5	2-1/2"	6 bar diameters
No. 6	4-1/2"	6 bar diameters
No. 7		6 bar diameters
No. 8		6 bar diameters
No. 9 through No. 11		8 bar diameters
No. 14 through No. 18		10 bar diameters

The supplementary requirements of AASHTO M 31 for bend tests shall apply to size No. 14 and No. 18 steel reinforcing bars which have hooks or bends.

9-07.1(3) LENGTHS

Net lengths of bent bars shown in the "LENGTH" column of the bar list in the Drawings are rounded to the nearest inch. Net length is the length of bar after all bend deductions are subtracted from the gross length.

The following bend deductions per 90 degrees bend have been subtracted from the gross length:

Bar Size	Stirrups and Ties	All Other Bars
No. 3	3/4"	1"
No. 4	1"	1-1/2"
No. 5	1-1/4"	1-1/2"
No. 6	2"	2"
No. 7		2"
No. 8		2-1/2"
No. 9		3-1/2"
No. 10		3-1/2"
No. 11		4"
No. 14		6"
No. 18		7-1/2"

For bends other than 90 degrees, a direct proportion of these deductions will be used. The bend deductions listed will apply, except where bending radii are shown in the Drawings.

For standard hooks on the ends of bars, the following hook lengths, in addition to the out to out detailed dimension, have been provided:

	Length Added for One Hook		
	180° Hook	90° Hook	
Bar Size	All Bars	Stirrup and Ties	All Other Bars
No. 3	5"	3"	5"
No. 4	5"	3-1/2"	6-1/2"
No. 5	7"	4-1/2"	8-1/2"
No. 6	8"	5-1/2"	10"
No. 7	10"		1' 0"
No. 8	11"		1' 1-1/2"
No. 9	1' 3"		1' 3-1/2"
No. 10	1' 5"		1' 6-1/2"
No. 11	1' 7"		1' 8"
No. 14	2' 2"		2' 1"
No. 18	2' 11"		2' 9-1/2"

9-07.1(4) INSPECTION

The provisions of Section 6-03.3(1) shall apply to the inspection of rolling and fabricating reinforcing steel.

9-07.2 DEFORMED STEEL BARS

Unless otherwise specified in the Project Manual or on the Drawings, reinforcing bars for the particular use specified shall be deformed steel bars of the size specified in the Contract Documents meeting the requirements of ASTM Designation A615, Grade 60.

Deformed steel bars are referred to in the Drawings and Specifications by numbers: for example, #3, #4, #5, etc.

Reinforcing bars shall be free from loose mill scale, dirt, grease or other defects affecting the strength or bond with concrete. Steel coated with rust may be used if the oxidations are not deep or loose coated. Size numbers shall be taken to represent the diameter of the bar in 1/8 inch units, except where standard wire gauge sizes are indicated on the Drawings.

9-07.3 EPOXY-COATED STEEL REINFORCING BARS

Epoxy-coated rebars shall be coated according to AASHTO M 284 with the additional following modifications:

(a) The list of steel reinforcing bars acceptab;e for epoxy coating shall include ASTM A-706.

(b) The Contractor shall furnish a written certification that properly identifies the material, the number of each batch of coating material used, quantity represented, date of manufacture, name and address of manufacturer, and a statement that the supplied coating material meets the requirements of AASHTO M 284.

(c) The Contractor shall supply to the Engineer a representative sample of eight ounces of the coating material from each batch. The sample shall be packaged in an airtight container and identified by batch number.

(d) Prior to coating the bars, the Contractor shall submit to the Engineer for review, the coating material manufacturer's recommendation on the proper use and application requirements of the coating material.

(e) A certification stating that all bars have been coated in accordance with the coating material manufacturer's recommendations and these Specifications shall be furnished with each shipment. This certification shall include for each bar size the preheat temperatures, cure times, thickness checks, holidays detected, and test results. Two copies of these certifications shall be furnished to the Engineer.

(f) The Contractor shall give advance notice to the Engineer of the coating schedule in the coating plant so that City inspection may be provided. The Engineer may inspect the coated bars at the coating plant for approval.

(g) The patching material, compatible with the coating material and inert in concrete, shall be supplied to the purchaser.

(h) For projects where epoxy-coated steel reinforcing bars are used in the top mat of bridge decks only, the maximum amount of damage to the coating shall not exceed 0.25 percent of the surface area of each bar.

(i) All samples shall be shipped to the Materials Laboratory.

9-07.4 PLAIN STEEL BARS

Where plain steel bars are specified, they shall conform to the chemical and physical properties of ASTM A615, Grade 60, unless specifically noted otherwise. Plain steel bars are indicated in the Drawings and Specifications by fractions of an inch: for example, 3/8" diameter, 1/2" diameter, 5/8" diameter, etc.

9-07.5 DOWEL BARS (FOR CEMENT CONCRETE PAVEMENT)

Dowel bars shall be plain steel bars of the dimensions shown in the Standard Plans. They shall conform to AASHTO M 183. Dowel bars shall be epoxy encapsulated.

9-07.6 TIE BARS (FOR CEMENT CONCRETE PAVEMENT)

Tie bars shall conform to the requirements of the Standard Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement, ASTM Designation A 615, Grade 60 for straight bars and Grade 40 for bent bars.

The form of the deformed bar shall be subject to approval by the Engineer.

Tie bars shall be free from rust, loose mill scale, dirt, grease, or other defects affecting the strength or bond with the concrete.

Tie bars shall be epoxy encapsulated.

9-07.7 WIRE MESH

Wire mesh for concrete reinforcement shall conform to the requirements of the Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement, ASTM Designation A 185 or the Standard Specifications for Welded Deformed Steel Wire Fabric for Concrete Reinforcement, ASTM Designation A 497. All wire mesh shall be of an approved kind and quality of manufacturer.

9-07.8 DEFORMED WIRE

Deformed wire shall conform to the requirements of ASTM Designation A 496, Deformed Steel Wire for Concrete Reinforcement.

Deformed wire is noted in the Drawings and Specifications by the letter D, followed by a number indicating the cross-sectional area of the wire in hundredths of a square inch: for Example, D20, D31, etc.

9-07.9 COLD DRAWN WIRE

Cold drawn wire shall conform to the requirements of AASHTO M 32, Cold Drawn Steel Wire for Concrete Reinforcement.

Cold drawn wire is noted in the plans and specifications by the letter W followed by a number indicating the cross-sectional area of the wire in hundredths of a square inch; for example, W2, W5, W20, etc.

9-07.10 PRESTRESSING REINFORCEMENT

Prestressing reinforcement shall be 1/2 inch diameter for prestressed concrete girders or precast-prestressed concrete piles and 1/2 inch or 0.6 inch diameter for cast-in-place prestressed concrete.

Prestressing reinforcement shall be mill bright high-tensile-strength seven wire strand conforming to the requirements of AASHTO M 203, Grade 270.

All wires shall be stress-relieved as a unit after the wires have been formed into a strand.

All prestressing reinforcement furnished for a given structural member shall have a maximum elongation differential of 3 percent at stress of 0.8 of the ultimate strength of the prestressing steel. Each reel of prestressing reinforcement shall be accompanied by a manufacturer's certificate of compliance, a mill certificate, and a test report. The mill certificate and test report shall include the chemical composition, the yield and ultimate strengths, elongation at rupture, modulus of elasticity, and the stress strain curve for the actual prestress reinforcing intended for use. All values certified shall be based on test values and actual sectional areas of the material being certified.

For each reel furnished, a sample, not less than 5 feet long, shall be sent to the Materials Laboratory.

SECTION 9-08 PAINTS

9-08.1 RAW MATERIALS

The acceptance of particular lots of raw materials shall in no way obligate the Engineer to accept lots of finished paint that do not conform to the requirements of these Specifications. When not specifically detailed, the raw materials shall meet the requirements of the applicable Federal Specification in effect at the time of manufacture. Products not covered by State or Federal Specifications shall be of top quality, meeting prevailing commercial standards. Raw materials for paints shall conform to the requirements of the Specifications listed below.

Alkyd resin solution, Federal TT-R-266, Type I or Type II.

Aluminum paste, ASTM D 962, Type 2, Class B. Paints made with the paste shall be smooth and highly lustrous.

Anti-skinning agent shall have no deleterious effect on the drying time of the finished paint. It shall effectively prevent skinning when added in the amounts specified in each formula and tested in accordance with Federal Test Std. No. 141a, Method 3021.

Aromatic petroleum thinner–water white low aniline petroleum solvent Kauri-Butanol value ..... 70 (min.)

Barium sulfate pigment, ASTM D 602.

Basic lead silico-chromate, ASTM D 1648.

Chrome oxide green, ASTM D 263. The tinting properties shall be such that the standard color of the formulas using chrome oxide green can be produced without departing from the limits of composition given in those formulas.

Chrome yellow pigment and paste, ASTM D 211, Type III.

Fibrous magnesium silicate (talc), ASTM D 605.

Lampblack pigment and paste, ASTM D 209.

Liquid drier, ASTM D 600.

Mineral spirits, ASTM D 235.

Raw linseed oil, ASTM D 234.

Red iron oxide pigment, ASTM D3721, D3722 & D3724.

Red lead pigment and paste, ASTM D 83, 97 percent grade.

Silica shall be finely ground amorphous or crystalline material. It shall have a maximum oil absorption of 50 when tested in accordance with ASTM D 281.

Soya lecithin shall be pure.

Spar varnish, Federal TT-V-119.

Titanium pigments, ASTM D 476. Titanium dioxide for use in exterior white paints shall conform to Type II. Titanium pigments used in tinted paints and enamels shall be exterior chalk resistant, Type III.

Turpentine shall be gum spirits of turpentine, ASTM D 13.

Yellow iron oxide, hydrated, ASTM D 768.

Zinc oxide pigment and paste, ASTM D 79.

Zinc yellow (zinc chromate), ASTM D 478.

Raw materials not specifically covered shall meet current Federal specifications for said material.

9-08.2 PAINT FORMULAS--GENERAL

All paints shall be made from materials meeting the requirements specified in Section 9-08.1. The paint shall be made in accordance with the following formulas and shall meet the requirements set forth above as well as the special requirements set forth for each formula. The formulas are stated in terms of dry pigment. Each formula shall contain the specified raw materials which shall be proportioned to give the compositions in percentages by weight or parts by weight, as shown in the formulas that follow.

(a) **Formula A-3-71—Red Lead Sealing Paste:**

Red Lead (dry pigment)	88.5%
Raw Linseed Oil	8.5%
Nonleafing Aluminum Paste	2.9%
Liquid Driers	0.1%
Weight per gallon (minimum)	36.0 lbs.
Drying time–surface dry for recoat	24 hours

This material shall be ground to a smooth, uniform paste of putty-like consistency. Additional linseed oil may be added at the time of use to reduce the paste to workable consistency for spatula or brush. This material hardens in storage and should be used within 15 days of the date of manufacturing.

(b) **Formula A-4-83—Phenolic-Red Lead Primer:**

The primer shall meet the requirements of Federal Specification TT-P-86, Type IV, Paint: Red-Lead Base, Ready Mixed. The viscosity of the finished paint shall be 80-90 K.U. at 70 degrees F and the Sag Index shall be six minimum.

(c) **Formula A-5-61–Vinyl Pretreatment:**

The primer shall meet the requirements of Federal Specification MIL-P-15328B or MIL-P-15328C, Primer Pretreatment (Formula 117B for Metals).

Vinyl Wash Primer shall be mixed by adding 1 volume of acid component (diluent) to 4 volumes of resin component (base solution) slowly and with constant stirring. The material shall be used within 8 hours of mixing. The wash primer coat shall be spray applied to all surfaces at a coverage rate of 250 to 300 square feet per gallon to yield a dry film of 0.5 to 0.9 mils thickness. If necessary to maintain a wet spray, additional thinning with normal Butanol or 99 percent Isopropanol will be allowed. Acid component above the required amount shall not be used for thinning. A drying time of 1 hour is required before recoating.

(1) Butanol shall meet Federal Specification TT-B-846b Butyl Alcohol; Normal.

(2) Isopropanol (99 percent) shall conform to ASTM D 770 Isopropyl Alcohol.

(d) **Formula A-6-86—Zinc Dust Zinc Oxide Primer:**

The primer shall meet the requirements of Federal Specification TT-P-641 Primer–Paint: Zinc Dust-Zinc Oxide Type III.

(e) **Formula A-7-70—Shop Coat for Steel (Basic Lead Silico Chromate):**

This paint shall generally conform to Federal Specification TT-P-615, Type II. The characteristics of the paint shall be as follows:

Viscosity	80-90 K.U.
Weight per gallon (minimum)	13.4 pounds
Grind (N.S.) (minimum)	4
Drying time (for test purposes) (maximum)	18 hours
Sag index (minimum)	6

Test Requirements: Prior to shipment.

For complete characteristics see Federal Specification TT-P-615.

(f) **Formula A-9-73—Galvanizing Repair Paint, High Zinc Dust Content:**

The galvanizing repair paint shall meet the requirements of Federal Specification MIL-P-21035 (Ships) Paint, High Zinc Dust Content, Galvanizing Repair.

(g) **Formula A-10-83 Vinyl—Red Lead Primer:**

The primer shall meet the requirements of Federal Specification MIL-P-23281 PRIMER, VINYL-RED LEAD (for brush or spray).

(h) **Formula B-4-83—Phenolic First Field Coat for Steel:**

The phenolic first field coat for steel shall meet the requirements of Federal Specification TT-P-86, Type IV–Paint: Red-Lead-Base Ready Mixed–except that 0.4 percent of the red lead content shall be replaced with lampblack to give a resultant brown color. The viscosity of the finished paint shall be 80-90 K.U. at 70 degrees F and the Sag Index shall be a 6 minimum.

(i) **Formula B-7-70—First Field Coat for Steel (Basic Lead Silico Chromate):**

This paint shall generally conform to Federal Specification TT-P-615, Type II.

Five pounds per 100 gallons (approximately 0.5 percent of the total formula weight) of the red iron oxide called for in Formula A-7-70 shall be replaced with lampblack to yield a brown color.

Other than color, the characteristics of the B-7-70 shall be the same as listed for A-7-70.

(j) **Formula C-6-86—Green Phenolic Finish Coat for Steel:**

Zinc chromate (dry pigment)	13.8 parts
Chrome green oxide (dry pigment)	16.1 parts
Titanium dioxide (dry pigment)	16.7 parts
Yellow iron oxide (dry pigment)	1.3 parts
Fibrous magnesium silicate (dry pigment)	5.0 parts
Aluminum stearate (dry pigment)	0.2 parts
Spar varnish	22.1 parts
Raw linseed oil	21.4 parts
Driers	1.0 parts
Anti-skinning agent	0.1 parts
Mineral spirits	2.3 parts
Weight per gallon (minimum)	12.5 pound
Viscosity at 70x F	72-78 k.u.
Grind (Minimum)	6
Set to touch	4 hours
Dry hard	18 hours
Sag Index	7 min.

Test Requirements: Prior to shipment.
Viscosity Adjustment: Mineral spirits to be added at the factory to achieve the specified viscosity.

The proportions of tinting pigments may be varied to achieve the desired color. The color of the paint when dry must match the color of a standard C-6-86 color chip. Additional tinting pigments may be required. A fungicide, N-(Trichloromethylthio) phthalimide shall be added at a rate of 3 pounds per 100 gallons.

(k) **Formula C-9-86—Phenolic Finish Coat for Steel:**

Zinc Oxide (dry pigment)	10.0 parts
Titanium Dioxide (dry pigment)	21.0 parts
Fibrous Magnesium Silicate (dry pigment)	3.2 parts
Barium Sulfate (dry pigment)	12.8 parts
Tinting Pigments	5.9 parts
Treated Bentonite Clay (dry pigment)	0.2 parts
Anti-Sag Agent	1.9 parts
Raw Linseed Oil	12.6 parts
Spar Varnish	29.0 parts
Anti-Skin Agent	0.1 parts
Driers	1.0 parts
Mineral Spirits	1.8 parts
Xylene	0.5 parts
Weight per gallon (minimum)	12.6 lbs.
Viscosity	72-78 K.U.
Dry Hard (maximum)	18 hours
Set to Touch (maximum)	4 hours
Grind (N.S.) (minimum)	5

Sag Index (minimum)	7
Total Solids by Weight	80 ± 5%

Test Requirements: Prior to shipment.

Adjustments for tinting pigments and talc, solvents and chemical additives shall be made at the factory to achieve the desired color and physical characteristics. A fungicide, N-(Trichloromethylthio) phthalimide shall be added at the rate of 3 pounds per 100 gallons.

(l) **Formula C-10-83—Vinyl Finish Coat:**

Vinyl Finish Coat shall conform to the following specifications:

(1) Pigment (12 Percent Minimum by Weight) - A combination of titanium dioxide and colored pigments or a combination of colored pigments such that the resultant paint when dry matches the color sample available at the Project Engineer's office.

(2) Vehicle (88 Percent Maximum by Weight) -

Vinyl Resin Type II(3)	9.1 parts
Vinyl Resin Type III(4)	9.1 parts
Tricresyl Phosphate	3.4 parts
Methyl Isobutyl Ketone	39.2 parts
Toluene	39.2 parts
	100.0

(3) Vinyl Resin Type II shall be hydroxyl containing vinyl chloride-acetate copolymer. It shall contain 89.5 to 91.5 percent (by weight) vinyl chloride, 2.0 to 5.5 percent vinyl acetate and 5.3 to 7.0 percent vinyl alcohol. It shall produce results in the specified formulations equal to the Bakelite Corporation Vinylite resin VAGH

(4) Vinyl Resin Type III shall be a vinyl chloride-acetate co-polymer of medium average molecular weight and shall contain 85 to 88 percent vinyl chloride and 12 to 15 percent vinyl acetate by weight. It shall produce in the specified formulations results equal to Bakelite Corporation Vinylite resin VYHH.

Lampblack shall be ground in the Vinyl Finish Coat vehicle to yield a smooth well ground paint, Black Vinyl Tinting Paste, satisfactory for tinting either the Vinyl-Red Lead Primer or Vinyl Finish Coat.

The Vinyl Finish Coat and Vinyl Tinting Paste shall be ground to a fineness of not less than 5 when testing in accordance with Federal Test Method Std. No. 141b, Method 4411.1.

Vinyl Thinner shall be composed of the following materials:

Toluene	90 percent by volume
Methyl Isobutyl Ketone	10 percent by volume

The paints as received will require thinning with from 20 to 35 percent by volume of Vinyl Thinner to maintain a wet spray.

(m) **Formula D-1-57—Aluminum Paint:**

Aluminum paste Type 2 Class B	2.0 pounds
Spar Varnish	1.0 gallon

Aluminum paint shall be mixed on the job site, and only enough for one day shall be mixed at a time. The weighed amount of paste shall be placed in a suitable mixing container and the measured volume of vehicle then poured over it. The paste shall be incorporated by vigorous stirring with a paddle.

Test Requirements: Prior to mixing.

(n) **Formula D-4-57—Black Enamel:**

The enamel shall meet the requirements of Federal TT-E-529 Black Enamel, Synthetic, Semi Gloss.

Test requirements: This enamel will be sampled and tested in the ready-mixed form.

(o) **Formula D-5-83—White Guard Rail Paint (Alkyd Vehicle):**

Titanium dioxide (dry pigment)	28.1 parts
Zinc oxide (dry pigment)	10.9 parts
Fibrous magnesium silicate (dry pigment)	4.3 parts
Aluminum stearate (dry pigment)	0.5 parts
Alkyd vehicle	37.0 parts
24% lead naphthenate drier	0.4 parts
6% Cobalt naphthenate drier	0.2 parts
6% Manganese naphthenate drier	0.2 parts
Anti-skinning agent	0.2 parts
Mineral spirits	18.2 parts
Weight per gallon (minimum)	11.0 pound
Viscosity at 70 F	80-90 K.U.
Nonvolatile content (minimum)	70.2%
Grind (minimum)	4
Hiding power (maximum scale reading)	30
Set to touch	4 hours
Dry hard	18 hours
Sag Index	7 min.

Test Requirements: Prior to shipment.
Viscosity Adjustment: Mineral spirits will be added at the factory to achieve the specified viscosity.

This formula is to be used over primed or previously painted surfaces.

(p) **Formula E-1-57—White for Wood Structures:**

The material shall conform to Federal TT-P-102, Class A.

Test Requirements: This paint will be sampled and tested in the ready-mixed form.

Primer: Turpentine may be added to the above paint in quantities not to exceed 1-1/2 pints per gallon of paint for use as a primer.

(q) **Formula E-2-62—Primer for Wood:**

The primer shall be a ready mixed priming paint for use over unpainted wood surfaces. It shall meet the requirements of Federal Specification TT-P-25 Primer, Paint, Exterior.

Test Requirements: This paint shall be sampled and tested in the ready mixed form.

(r) **Formula F-3-64—Orange Equipment Enamel:**

The enamel shall meet the requirements for Enamel, Alkyd, Gloss, Federal Specification TT-E-489, except that the Sag Index shall be seven minimum. The color, when dry, shall match that of Federal Standard No. 595, color 12246.

Test Requirements: When manufactured on Contract or Purchase Order for maintenance use, the enamel will be sampled and tested in the ready-mix form. No factory inspection will be required; however, a one pint sample representing the batch must be submitted to the Materials Laboratory for approval before use.

For factory application to individual items of new equipment, samples of the enamel will not be required; however, the equipment manufacturer must match the color and certify the quality of enamel used.

(s) **Formula H-1-83—Primer for Concrete:**

Titanium dioxide	5.0 parts
Calcium carbonate	19.7 parts
Fibrous magnesium silicate	6.8 parts
Silica 6.8 parts	
Spar varnish	52.3 parts
Mineral spirits	9.4 parts
Weight per gallon (minimum)	9.8 pounds
Drying time (for testing purposes only)	18 hours

Viscosity at 70degrees F 65-75 K.U.
Consistency: The paint shall not thicken after manufacture to an extent sufficient to impair its brushing qualities.
Test Requirements: Prior to shipment.

(t) Paint for Precast Curbs:

Paint for precast curbs shall be in accordance with Section 9-29.

(u) Formula K-1-83--Exterior Acrylic Latex Paint-White:

This paint shall meet the requirements of Federal Specification TT-P-19, Paint, Acrylic Emulsion, Exterior, except that the viscosity shall be 75-85 K.U.

This paint may be used self-primed in multiple coats over salts treated wood and on interior and exterior masonry surfaces.

Test Requirements: This paint will be sampled and tested in the ready-mixed form.

(v) Formula K-2-83—Traffic Signal Yellow Enamel:

Traffic signal yellow enamel shall meet the provision of Federal Specification TT-E-489-Enamel, Alkyd, Gloss- and shall match the color of "Standard Interstate Yellow."

9-08.3 INSPECTION REQUIREMENTS GENERAL

The manufacturer shall notify the Engineer of the date on which manufacture will be started, and the Engineer shall have the right to inspect all details of the manufacturing process.

Quantities of 20 gallons or less of the above formulas will be accepted without inspection upon the manufacturer's notarized certificate. This certificate shall contain a statement by the manufacturer to the effect that the material meets the formula specification, and shall include a list of materials and quantities used. One copy of the certificate shall accompany the paint when shipped and one copy with a sample of the paint shall be sent to the Materials Laboratory. The paint may be used at once without further release from the Materials Laboratory.

9-08.4 PROCESS OF MANUFACTURE

9-08.4(1) GENERAL

The following process of manufacture shall be used for each paint except aluminum paint. Pigments shall be ground thoroughly in appropriate portions of the specified vehicle to form a paste meeting the requirements set forth in Section 9-08.4(7).

The grinding shall be done in a mill approved by the Engineer. The use of the "colloid" type of mill will not be approved. Weighed quantities of the paste and weighed or measured quantites of the vehicles shall then be mixed thoroughly and strained, if necessary, to form a paint free from skins, lumps, and foreign materials.

9-08.4(2) VISCOSITY ADJUSTMENT

The volatile thinner content of the paint shall be adjusted at the factory to meet the required viscosity, but in no case shall the resultant weight per gallon and nonvolatile content of the paint be below that specified in the formula.

9-08.4(3) WEIGHT VARIATIONS

The weight per gallon of the paint in any lot shall not be less than that stated in the formula. A "lot" as used in this section shall be the quantity of paint ground at one time by any one mill.

9-08.4(4) DRYING TIME AND QUANTITY OF DRIER

The paint shall dry within the length of time stated in each formula but shall not contain sufficient quantities of drier to cause the paint to dry to a nonuniform or nonelastic film. The manufacturer will be permitted to vary the quantity of drier given in the formula sufficiently to accomplish the above results.

9-08.4(5) WORKING PROPERTIES

The paint shall contain no caked material that cannot be broken up readily by stirring. When applied to a clean vertical surface, the paint shall dry without running, streaking, or sagging.

9-08.4(6) STORAGE PROPERTIES

Paints manufactured under these Specifications shall show no skin over the surface after 48 hours in a partially filled container, when tested as outlined in Federal Test Method Standard No. 141. A slight amount of skin or gel formation where the surface of the paint meets the side of the container may be disregarded. Variable percentages of anti-skinning agents are shown in those formulas set forth above that are susceptible to undesirable skin formation. The manufacturer will be allowed to vary the amount of anti-skinning agent given in the formulas provided the above results are accomplished and provided the paint does not dry to a nonuniform or nonelastic film.

9-08.4(7) FINENESS OF GRINDING

The paint shall be ground so that all particles of pigment will be dispersed and be coated with vehicle, and the residue on a 325 sieve will not exceed 1 percent by weight of the pigment.

9-08.4(8) STANDARD COLORS

When the paint is required to match a standard color, the manufacturer may obtain a sample of the required color without cost upon application to the Materials Laboratory.

9-08.4(9) CONTAINERS

Each container shall be filled with paint and sealed airtight. Each container shall be filled with the amount of paint required to yield the specified quantity when measured at 70 degrees F.

All point shall be shipped in new suitable containers having a capacity not greater than 5 gallons. Each container shall be marked with a suitable number to identify the particular batch from which it was filled.

9-08.5 TEST METHODS

As set forth in Section 9-08.2, all paints shall meet the special requirements set forth for each formula. The test methods used to check those special requirements shall be as specified by Federal Specification TT-P-141. When test methods are not covered by the above, applicable ASTM methods shall be followed.

9-08.6 SHIPPING

Except for lots of paint in quantities of 20 gallons or less which are accepted upon the manufacturer's certificate, the manufacturer shall not ship any lot of paint until the paint has been tested and released by the Seattle Engineering Department Materials Laboratory. This release will not constitute final acceptance of the paint. Final acceptance will be based on inspection or testing of jobsite samples as determined by the Engineer.

9-08.7 FIELD SAMPLES

Because of the volatility of the solvents used in the paint, the upper limit on viscosity shall be waved on all paint samples taken in the field.

SECTION 9-09 TIMBER AND LUMBER

9-09.1 GENERAL REQUIREMENTS

All timber and lumber in permanent structures except guard rail posts, mileposts, sign posts, or as otherwise specified, shall be Douglas fir or larch.

9-09.2 GRADE REQUIREMENTS

9-09.2(1) GENERAL

Unless otherwise noted in the Drawings or in the Project Manual, all timber and lumber shall be graded as shown in the Tabulated Working Stress Chart.

9-09.2(2) SURFACING AND SEASONING

All lumber shall be sized as indicated in the Drawings, except that lumber which is to be painted shall in all cases be surfaced on four sides.

Lumber to be painted shall be thoroughly air dried or kiln dried to an equivalent moisture content and shall be stored in such a manner as to remain in a thoroughly dry condition until placed in the work.

9-09.2(3) PROTECTION AGAINST END CHECKING

Immediately upon acceptance by the Inspector at the mills, all ends of sticks 3-inch x 3-inch and larger (except decking), which are to be used without preservative pressure treatment, shall be treated with gloss oil or other effective protective end coating.

9-09.2(4) INSPECTION

All timber and lumber purchased or used under these Specifications shall meet the tabulated working stress requirements specified in Section 9-09.2. Lumber graded and grade stamped under the applicable paragraph numbers of the current grading and dressing rules of the West Coast Lumber Inspection Bureau or the Western Wood Products Association, as defined in Section 9-09.2, will be accepted provided that it is certified to the State of Washington by a certificate of inspection executed by one of the above named associations, by the Pacific Lumber Inspection Bureau, or by a mill recognized by the American Lumber Standards Committee. Certificates of inspection shall identify the destination or job for which the material is intended and, if specified, each piece inspected and certified shall be marked to indicate such inspection. Such certification or grade marking shall not constitute final acceptance of the material, and the Engineer may reject any and all lumber or timber that does not comply with the specifications upon delivery. In the event of a rejection, each of the above inspection services shall acquiesce to reinspection, if required; and the Owner may require or will permit reinspection of such material under the reinspection provisions in the rules of the association under which the material is graded and sold.

9-09.2(5) HEWN AND ROUND TIMBERS

Hewn timbers may be substituted for sawed timber, subject to the approval of the Engineer, and shall be of the same cross-section and conform to the grading rules for structural timber.

9-09.3 PRESERVATIVE TREATMENT

9-09.3(1) GENERAL REQUIREMENTS

9-09.3(1)A SEASONING BEFORE TREATMENT

Timber, lumber, or piling may be air seasoned or kiln dried, before treatment, until the moisture remaining in the wood will not prevent the injection and proper distribution of the specified amount of preservative. For air seasoning, the materials shall be stored as follows:

Lumber shall be segregated according to size and each layer in the stack shall be segregated by at least 1-inch strips with an air space of 1 inch or more between each two pieces of lumber in any layer; for caps, stringer, posts or larger timbers, at least 2-inch strips shall be used to separate the layers. Alleys at least 3 feet wide shall be left between rows of stacks, and the materials shall be at least 12 inches off the ground on concrete or treated timber sills. Piling shall be sorted in like manner, placing as nearly as practicable only one length in a stack, using at least 2-inch strips or saplings of equal size between each layer, and reversing all piling in every other layer in order to keep the stacks level. The space under and between the rows of stacks shall be kept free at all times of rotting wood, weeds, or rubbish. The yard shall be so drained that no water will stand under the stacks or in their immediate vicinity.

9-09.3(1)B PLACING IN TREATING CYLINDERS

Each cylinder charge shall consist of pieces approximately equal in size and moisture and sapwood content into which approximately equal quantities of preservative fluid can be injected. Pieces shall be separated to ensure contact of steam and preservatives with all surfaces.

Timber and lumber shall be framed, bored, incised, or chamfered, where possible, before treatment.

9-09.3(1)C INCISING

In order to secure a more uniform penetration, sawed timber and lumber measuring 2 inches or over in thickness and 4 inches or over in width shall be incised by a machine having power driven rolls designed to incise to a uniform depth and continuity of predetermined pattern. Timber or lumber 3 inches or over in the least dimension shall be incised on all four sides. Timber or lumber less than 3 inches in the least dimension shall be incised on the wide faces only.

The shape of the teeth shall conform to a type so designed that the points are sharp and the edges wedge-shaped so that upon entering and leaving the wood, a spreading of the fibers is accomplished.

9-09.3(1)D PLANT EQUIPMENT

Treating plants shall be equipped with thermometers and gauges necessary to indicate and record accurately the conditions at all stages of treatment, and all equipment shall be maintained in condition satisfactory to the purchaser. The apparatus and chemicals necessary for making the analyses and tests required by the purchaser shall also be provided by the operators and be kept in condition for use at all times.

9-09.3(2) CREOSOTE TREATMENT

9-09.3(2)A CREOSOTE OIL

Creosote for both pressure treatment and surface treatment shall meet the requirements of the Standard Specifications for Creosote, ASTM D 390.

Structural Purpose	F_b	F_v	$F_{c\perp}$	F_c	E	Grade
	Tabulated Working Stresses (psi)					
Timber and Lumber in Permanent Structures						
Douglas Fir (except 4" or deeper laminated decking)	1550	85	455	1100	1,700,000	Stress, Grades, Beams and Stingers, Dense No.1, Structural 130bb WCLB
	1600	85	385	1100	1,600,000	Timbers-Beams and Stringers, Select Structural 70.10 WWPA
Douglas Fir 4" or deeper laminated decking	1800	95	455	1450	1,900,000	Structural Joists and Planks, Douglas Fir, Dense No. 1 123bb WCLB
	1800	95	385	1400	1,800,000	Structural Joists and Planks and Appearance, DFL Select Structural 62.10 WWPA
Guard Rail Posts						
Douglas Fir	1200	85	385	1000	1,600,000	Stress Grades, Post and Timbers, No. 1 Structural 131b WCLB
	1200	85	385	1000	1,600,000	Posts and Timbers, DFL No. 1 80.11 WWPA
Hem Fir	1200	70	245	975	1,400,000	Stress, Grades, Posts and Timbers, Select Structural 131a WCLB
	1200	70	245	950	1,400,000	Posts and Timbers, Hem-Fir, Select Structural 80.10 WWPA
Lodgepole Pine 6" x 8" or 8" x 8"	1100	65	250	850	1,100,000	Select Structural WWPA or WCLB
Lodgepole Pine 8" x 8" only	875	65	250	725	1,100,000	Grade No. 1, WWPA or WCLB
Sign Posts, MilePosts, Sawed Fence Posts, and Mailbox Posts(1)						
Western Cedar 4" x 4"	1450	75	295	1250	1,100,000	Structural Light Framing, Selects Structural 124a WCLB 42.10 WWPA
4" x 6"	1250	75	295	1100	1,100,000	Structural Joists and Planks, Select Structural 123a WCLB 62.10 WWPA
6" x 6", 6" x 8" 8" x 10"	1050	70	295	900	1,000,000	Posts and Timbers, SelectStructural 131a WCLB, 80.10 WWPA
6" x 10", 8" x 12"	1100	70	295	875	1,000,000	Beams and Stringers Select Structural 130a WCLB, 70.10 WWPA
Douglas Fir 4" x 4"	1450	95	385	1000	1,700,000	Structural Light Framing, No. 2 Grade 124c WCLB, 42.12 WWPA
4" x 6"	1250	95	385	1050	1,700,000	Structural Joists and Planks, No. 2 Grade 123c WCLB, 62.12 WWPA
6" x 6", 6" x 8" 8" x 10"	1200	85	385	1000	1,600,000	Posts and Timbers, No. 1 Grade 131b WCLB, 80.11 WWPA
6"x10",8"x12"	1350	85	385	935	1,600,000	Beams and Stringers No. 1 Grade 130b WCLB, 70.11 WWPA
Hem-Fir 4"x4"	1650	75	245	1300	1,500,000	Structural Light Framing, Select Structural 124a WCLB, 42.10 WWPA
4"x6"	1400	75	245	1150	1,500,000	Structural Joists and Planks, Select Structural 123a WCLB, 62.10 WWPA
6" x 6", 6" x 8" 8" x 10"	1200	70	245	950	1,400,000	Posts and Timbers, Select Structural 131a WCLB, 80.10 WWPA
6"x10", 8"x12"	1250	70	245	900	1,400,000	Beams and Stringers Select Structural 130a WCLB, 70.10 WWPA

Note: (1) For single post applications, the grade for Western Cedar 4"x4" is expanded to allow No. 2 or better, 124c WCLB, 42.12 WWPA.
For single post applications, the grade for Western Cedar 4"x6" is expanded to allow No. 2 or better, 123c WCLB, 62.12 WWPA.

9-09.3(2)B OIL SEASONING FOR DOUGLAS FIR

Green Douglas fir timber or piling shall be seasoned by boiling in oil under a vacuum until the moisture remaining in the wood will not prevent the injection and proper distribution of the specified amount of preservative.

The material shall be boiled in creosote under a vacuum at temperatures not less than 180 degrees F and not more than 200 degrees F for lumber, nor 220 degrees F for piling.

A minimum vacuum of 20 inches shall be maintained during boiling. The seasoning period shall be maintained until condensation passing off from the timber is at the rate of approximately 1/10 of a pound per cubic foot of timber per hour.

9-09.3(2)C PENETRATION AND RETENTION

The range of temperature, pressure, and time duration shall be controlled to result in a maximum penetration by the quantity of preservative injected. The vacuum requirements stipulated are in inches of mercury at sea level, and necessary corrections shall be made for altitude.

After treatment by the specified process, the material shall meet the minimum requirements, for both penetration and retention, set forth in the following table:

Material	Retention per Cu. Ft. of Wood	Process Type	Penetration in Inches
Struct. Timber for Gen. Bridge Const., 5 inches or less in Thickness	10 lb. min.	Empty Cell	3/8 min.
Struct. Timber for Gen. Bridge Const., More than 5 inches in Thickness	10 lb. min.	Empty Cell	1/2 min.
Struct. Timber in Salt or Fresh Water, 5 inches or less in Thickness	14 lb. min.	Full Cell	3/8 min.
Struct. Timber in Salt or Fresh Water, More than 5 inches in Thickness	14 lb. min.	Full Cell	1/2 min.
Timber Piling, General	10 lb. min.	Empty Cell	1 min.
Timber Piling in Fresh Water	10 lb. min.	Empty Cell	1 min.
Timber Piling in Salt Water	14 lb. min.	Full Cell	1 min.

The penetration of the preservative shall be based on black or dark oil, and in no case will light discoloration of the wood due to treatment be taken into consideration in measuring the depth of penetration.

Tests for penetration shall be made by taking borings with an increment borer or a 5/8 inch auger. All holes so bored shall be plugged by the Contractor with tight-fitting creosoted plugs.

As many penetration tests of lumber and piling shall be made as may be considered necessary by the Engineer. In case of piling, the holes shall be bored midway between the ends; in case of timber and lumber, every fourth stick of the charge may be bored.

9-09.3(2)D HEATING IN OIL

Air seasoned or kiln dried Douglas fir shall be heated in oil prior to the pressure treatment. The preservative shall be introduced to the timber at a temperature of 160 degrees F to 180 degrees F, and the temperature shall be gradually raised to 200 degrees F and held at that temperature for a period of from 3 to 5 hours or a sufficient length of time to obtain an even temperature throughout the material.

9-09.3(2)E FULL-CELL PROCESS

Following the heating period, in the case of air seasoned or kiln dried material, and the seasoning under vacuum period in the case of material that is oil seasoned, the cylinder shall be filled with creosote and the pressure applied as required to a maximum limit of 175 psi and maintained, taking into consideration the quantity of creosote absorbed during the heating with oil until the specified absorption of creosote has been obtained.

Temperature of the creosote during the pressure period shall be between 160 degrees F and 200 degrees F. After pressure is completed, the cylinder shall be emptied of creosote and a vacuum of at least 20 inches promptly created and maintained for a sufficient period of time to free the material from dripping creosote.

9-09.3(2)F EMPTY-CELL PROCESS

Following the heating period, in the case of air seasoned or kiln dried material, and the seasoning under vacuum period in the case of material that is oil seasoned, the material shall be subjected to an air pressure of sufficient intensity and duration which, in the judgment of the operator, is sufficient to accomplish the final retention of creosote specified. The preservative shall then be introduced, the air pressure being maintained constant until the cylinder is completely filled.

Creosote shall then be pressed from the measuring tanks into the wood in a quantity sufficient, in the opinion of the operator, to leave the required retention at the completion of the process herein described. Maximum pressure shall in no case exceed 200 psi. The temperature of the creosote during the pressure period shall be between 160 degrees F and 200 degrees F.

After pressure is completed, the cylinder shall be quickly emptied of creosote, and a vacuum of at least 20 inches created and maintained for such period of time as may be required to remove dripping creosote from the material.

9-09.3(3) PENTACHLOROPHENOL TREATMENT

9-09.3(3)A PENTACHLOROPHENOL

Pentachlorophenol shall conform to the requirements of AASHTO M 133. Solvents used in pentachlorophenol solutions shall be petroleum oils complying with the following requirements:

(a) Heavy petroleum solvent oils shall meet the requirements of AWPA P-9 Type A.

(b) The preservative solution used in the treatment shall consist of not less than 4-1/2 percent, not more than 5-1/2 percent by weight of pentachlorophenol dissolved in the proper petroleum solvent.

9-09.3(3)B TREATMENT

Pentachlorophenol pressure treatment shall be in accordance with the applicable portions of AASHTO M 133. The minimum net retention of the dry salt shall be 0.50 pound per cubic foot of wood, except as noted elsewhere in these Specifications. Treatment shall be by the empty cell process.

9-09.3(3)C PENETRATION

Penetration shall be per Section 9-09.3(2)C.

9-09.3(4) WATER-BORNE PRESERVATIVES

Water-borne preservatives shall conform to the applicable portions of AASHTO M 133.

The treatment process and the penetration and retention of the salts shall comply with the applicable portions of AASHTO M 133, except as noted elsewhere in these Specifications or in the Project Manual.

Penetration shall be per Section 9-09.3(2)C.

SECTION 9-10 PILING

9-10.1 TIMBER PILING

9-10.1(1) GENERAL

Timber piling shall be untreated or treated with the preservatives specified in the Drawings and completely described in Section 9-09.3.

Timber piles shall have the following limiting diameters:

Length in Feet	Min. Butt Dia. 3 feet above Butt in Inches	Max. Butt Dia. 3 feet above Butt in Inches	Min. Tip Dia. in Inches
Under 40	12	20	7
40-54	12	20	7
55-74	13	20	7
Over 74	14	20	7

Timber piles shall be strapped with at least three straps: one approximately 18 inches from the butt, one approximately 24 inches from the butt, and one approximately 12 inches from the tip. Additional straps shall be provided at approximately 15-foot centers between the butt and tip. Strapping shall encircle the pile once and be tensioned as tightly as possible. Straps shall be 1-1/4 inches wide, 0.031 inch thick, cold rolled, fully heat treated, high tensile strapping, painted, and waxed, with an ultimate tensile strength of 5100 pounds. The seal shall be 2-1/4 inches long, 20 gage, crimped with a notch type sealer to furnish a joint yielding 80 percent of the strap tensile strength. Treated timber piles shall be strapped after treatment.

9-10.1(2) UNTREATED PILING

Except where specifically provided otherwise, untreated timber piling shall be Douglas fir, Western red cedar, or larch. Piling for foundations shall be Douglas fir. Piling shall be cut from sound, live trees and shall contain no unsound knots. Sound knots will be permitted, provided the diameter of the knot does not exceed 4 inches, or 1/3 of the small diameter of the pile at the point where they occur, whichever is smaller. Any defect or combination of defects which will impair the strength of the pile more than the maximum allowable knot will not be permitted.

Piling shall be cut above the butt swell and shall have a uniform taper from butt to tip. A line drawn from the center of the tip to the center of the butt shall not fall outside the center of the pile at any point more than 1 percent of the length of the pile. A spiral grain or twist in excess of 1/4 turn in 10 feet of length will be cause for rejection.

Untreated timber trestle piling shall have an average of at least five annual rings per inch measured radially over a distance of 3 inches at the butt, beginning at a point 3-1/2 inches from the heart. At least 9 inches of heartwood shall show at the butt.

Ring count requirements for untreated timber foundation piling and detour trestle piling will be waived.

9-10.1(3) CREOSOTE TREATED PILING

For creosote treated piling, Douglas fir timber shall be used. All other requirements shall be the same as for untreated piling, except that the ring count requirement will be waived.

9-10.1(4) TIMBER COMPOSITE PILING

Timber composite piling shall consist of a pile made up of two timber sections. The lower section shall be untreated, and the upper section shall be creosote treated.

The treated and untreated sections of timber composite pile shall meet the respective requirements specified above for full length of treated and untreated timber piling.

9-10.1(5) PEELING

Untreated and creosote treated piles shall be peeled by removing all of the rough bark and at least 80 percent of the inner bark. No strip of inner bark remaining on the pile shall be over 3/4 inch wide or over 8 inches long, and there shall be at least 1 inch of clean wood surface between any two such strips. Not less than 80 percent of the surface on any circumference shall be clean wood. All knots shall be trimmed close to the body of the pile.

9-10.2 CONCRETE PILING

9-10.2(1) CONCRETE

Type II or Type III cement meeting the requirements of Section 9-01 shall be used in all precast concrete piles.

The concrete for precast-prestressed piles shall conform to the requirements of Section 9-19.1. The concrete for prestressed piles shall have a minimum compressive strength of 6,000 psi at the age of 28 days. The minimum compressive strength of concrete at the transfer of prestress shall be 3,300 psi.

The concrete for other precast piles shall be Class AX. Mixing, transporting, and placing concrete shall be in accordance with the provisions of Section 6-02.3.

The Contractor shall mold and test a sufficient number of concrete test cylinders to determine the strength of the concrete as required by the Specifications. Under the surveillance of the Engineer, the test cylinders shall be molded, cured, and tested in accordance with the procedures established by the Materials Laboratory.

In the event that a sufficient number of concrete test cylinders are not molded to satisfy all testing required on any one pile, cores measuring 4 inches in diameter by 5 inches in height shall be taken and tested by the Contractor. If the strength of the core meets the required compressive strength of the concrete, the pile may be accepted. The coring and testing of the core shall be done under the surveillance of the Engineer.

9-10.2(2) REINFORCEMENT

Reinforcement shall meet the requirements of Section 9-07.

9-10.3 CAST-IN-PLACE CONCRETE PILING

9-10.3(1) REINFORCEMENT

Reinforcement for cast-in-place concrete piles shall conform to the requirements of ASTM A615, Grade 60.

9-10.4 PRESTRESSED HOLLOW CONCRETE PILING

9-10.4(1) CONCRETE

The concrete for prestressed hollow concrete piles shall conform to the requirements of Section 9-19.1.

9-10.4(2) PRESTRESSING REINFORCEMENT

Prestressing reinforcement shall be high tensile wire strands conforming to the requirements of Section 9-07.10.

For centrifugally cast piles, prestressing reinforcement conforming to the requirements of AASHTO M 204 or approved equal may be used.

9-10.5 STEEL PILING

The material for steel piling, pile tips, and pile splices shall conform to the requirements of the Specifications for Structural Steel, AASHTO M 183. Steel piling may be accepted by the Engineer based on the Manufacturer's Certification of Compliance.

SECTION 9-11 WATERPROOFING

9-11.1 ASPHALT FOR WATERPROOFING

Asphalt for waterproofing shall conform to the requirements of ASTM D 312, Type 4.

The material used as primer shall conform to the requirements of AASHTO M 116, Primer for Use with Asphalt in Dampproofing and Waterproofing.

Acceptance shall be as provided in Section 9-02.2(1).

9-11.2 WATERPROOFING FABRIC

Waterproofing fabric shall be a saturated cotton fabric meeting the requirements of AASHTO M 117, Woven Cotton Fabrics Saturated with Bituminous Substances for Use in Waterproofing.

9-11.3 PORTLAND CEMENT MORTAR

Portland cement and sand for the mortar protection course shall conform to the following requirements:

Portland Cement	Section 9-01
Sand	Section 9-03

SECTION 9-12 MANHOLES, CATCH BASINS AND INLETS

9-12.1 REINFORCED CONCRETE

9-12.1(1) GENERAL

Reinforced concrete shall consist of portland cement, mineral aggregates and water, in which steel has been embedded in such manner that the steel and concrete act together.

All cast in place concrete placed under these Specifications shall have a minimum compressive strength of 3,000 psi at 28 days. Strength determination shall be in accordance with ASTM C 39, unless otherwise approved by the Engineer. Precast components shall conform to the strength requirements of ASTM C 478.

9-12.1(2) CEMENT

Portland cement shall conform to the requirements of the Specifications for Portland Cement ASTM C 150, any type, unless otherwise limited in the Project Manual; or it may be air-entraining portland cement conforming to ASTM C 175.

9-12.1(3) STEEL REINFORCEMENT

Reinforcement shall consist of wire conforming to ASTM A 82 or ASTM A 496, or wire fabric conforming to ASTM A 185, or ASTM A 497 or bars of Grade 60 steel conforming to ASTM A 615 or of bars of Grade 80 steel conforming to ASTM A 306.

9-12.1(4) AGGREGATES

Aggregates shall conform to ASTM C 33, except that the requirement for gradation shall not apply to precast items.

9-12.2 STEPS

9-12.2(1) GENERAL

Unless otherwise specified in the Project Manual, manhole steps may be either of the following, at option of the Contractor or option of the manufacturer of the manhole.

9-12.2(2) ALUMINUM STEPS

Aluminum steps shall be forged of 6005-T5 alloy having a minimum tensile strength of 38,000 psi. The cross section shall be not less than 3/4 inch wide by 7/8 inch deep with two non-skid grooves not to exceed 1/8 inch deep and 1/8 inch wide.

9-12.2(3) GALVANIZED DEFORMED BAR STEPS

Galvanized deformed bar steps shall be 1 inch diameter deformed bar conforming to ASTM A 615, Grade 40 or Grade 60, hot bent and galvanized after bending. For bending, the temperature shall be at least 1600° F. Galvanizing shall conform to ASTM A 123-84. Step dimensions and pattern shall conform to Standard Plan No. 232.

9-12.3 LADDERS

Ladder shall be made of steel, galvanized after fabrication, or aluminum conforming to the requirements for steps given in Sections 9-12.2(2) and 9-12.2(3).

9-12.4 MORTAR

9-12.4(1) MORTAR FOR JOINTING

Mortar for jointing precast or masonry manhole, catch basin, or inlet units shall be one part portland cement to not less than one part nor more than two parts plaster sand, mixed with the least amount of clean water necessary to provide a workable mortar. Joints between precast manhole elements shall also be rubber gasketed as noted in Section 7-05.3(6)C8.

9-12.4(2) MORTAR FOR PLASTER-COATING

Mortar for plaster-coating masonry unit manholes shall be proportioned according to either of the two alternates tabulated below:

	Parts by volume portland cement cement	Parts by volume masonry 301 lime putty	Parts by volume hydrated lime or 301 condition	Plaster sand measured in damp loose
Alt. 1	1	1 (Type II)	0	Not less than 2-1/4 and not more than 3 times the sum of volumes of cement and lime.
Alt. 2	1	0	1/4	

9-12.5 CONCRETE MASONRY UNITS

Concrete block shall conform to the Specifications for Concrete Masonry Units for Construction of Catch Basins and Manholes ASTM Designation C 139, except that nominal horizontal thickness shall be 6 inches measured radially, and blocks shall have semicircular mortar grooves approximately 1 inch radius at the ends.

9-12.6 CONCRETE BRICK

Concrete brick shall conform to the Specifications for Concrete Building Brick ASTM C 55 Grade A.

9-12.7 CLAY BRICK

Clay brick shall conform to ASTM C 32, Grade NA unless otherwise provided in the Project Manual.

9-12.8 METAL CASTINGS

9-12.8(1) MANHOLE RING AND COVER

Ring and cover dimensions shall conform to the Standard Plans. Rings shall be manufactured from cast iron ASTM A 48 Class 30 or ductile iron ASTM A 536, Grade 80-55-06. Covers shall be manufactured from ductile iron ASTM A 536, Grade 80-55-06. Rings and covers shall be free of porosity, shrink

cavities, cold shuts, and cracks. Rings and covers shall be free of surface defects which would impair serviceability. Repair of defects by welding or by the use of "smooth-on plasticized metals" or similar material will result in the casting being rejected. Manufacturer shall certify that the product conforms to the requirements of these Specifications. In accordance with Section 1-06.1, where source of material is different from manufacturer, the Contractor shall also provide the name and location of the manufacturer.

A bituminous coating equivalent to American Tar Company #2219 Gilsonite-Asphalt Paint shall be applied to all surfaces. The finished coating shall be continuous and smooth.

Castings shall be machine finished on the horizontal seating surface and the vertical facing surface common to the ring and cover, so as to assure full bearing (nonrocking) for the entire width and circumference of the bearing surface, and permit interchangeability with other castings of the same design, no matter what the source. The vertical face common to the ring and cover shall be beveled as shown on Standard Plan No. 230. Upon request of the Engineer, the manufacturer shall furnish at the foundry standard ring and covers for use by inspectors in testing fit and seating.

All covers shall be labeled with the following information:

(a) Name or symbol of the manufacturer;
(b) Owner's name (City of Seattle in minimum 1/2 inch high letter recessed flush with adjacent surface).
(c) Material label "DUC" for Ductile Iron;
(d) Identification of its use in 3-inch high lettering (Sewer, Water, Drain, Etc.)
(e) Country of manufacture/origin.

Items (b) and (d) shall be on the exposed face of the cover. Items (a), (c), and (e) shall be located at the manufacturers option. If located on the exposed face of the cover, items (a) and (c) shall be adjacent to each other and shall be a minimum of 1/2 inch high letters recessed flush with the surface.

Where lock-type castings are called for, the locking device shall permit the cover to be promptly released from the ring. All movable parts shall not bind and shall be made of non-corrosive metals and otherwise arranged to avoid possible binding. Upon request of the Engineer, the manufacturer shall make available at the foundry a testing device suitable for providing the capacity of the assembly to resist uplift pressure on the lid equal to 20 ft. head of water.

All manhole rings shall be labelled with the name or symbol of the manufacturer and the type of material.

9-12.8(2) METAL FRAME AND GRATE AND SOLID METAL COVER FOR CATCH BASINS OR INLETS

The frame and grate and solid metal cover shall conform to Standard Plan No's. 262 through 265.

The frame may be made of cast iron, ASTM A 48 Class 30, or ductile iron, ASTM A 536, Grade 80-55-06, at the manufacturer's option. The grate and cover shall be made of ductile iron only. Other applicable provisions of Section 9-12.8(1) shall apply, except item (d) for identification marking.

Catch Basins, Type 242A and 242B and Inlets, Type 250A and 250B shall be furnished with a vaned type grate as indicated on the Drawings.

9-12.8(3) CAST METAL INLETS

The castings for cast metal inlets shall be cast steel or ductile iron as specified in Section 9-06.8 or Section 9-06.14 and as shown in WSDOT Standard Plan No. B-4. Alternate plans are acceptable provided they conform to fabricator's Shop Drawings approved prior to award of contract.

9-12.9 VACANT

9-12.10 SHOP FABRICATED CORRUGATED METAL MANHOLES

Where corrugated metal manholes are specified, they shall be as shown on the Drawings and shall conform to the details as shown in the Drawings. The base material and gage, and coating if required, shall be as shown on the Drawings. All pipe connections to the manhole stubs shall be made with a standard band type as shown in the Drawings.

9-12.11 MONOLITHIC CONCRETE MANHOLES

Monolithic Concrete Manholes shall conform to the Standard Plans.

9-12.12 TRAPS

Where catch basin traps per Standard Plan No. 267a are required, they shall be constructed in accordance with the Standard Plan and be made of 0.0336 inch thick (22 ga.) galvanized sheet steel or 0.050 inch thick (18 ga.) aluminum.

Where catch basin traps per Standard Plan No. 267b are required, they shall be constructed in accordance with the Standard Plan and as specified therein.

9-12.13 GRATE INLETS AND DROP INLETS

Steel in grates, angles, and anchors for grate inlets and drop inlets shall conform with AASHTO M 183, except structural tube shall conform with ASTM A 500, Grade B. After fabrication, the steel shall be hot-dip galvanized with a minimum coating of 2 ounces of zinc per square foot in accordance with AASHTO M 111 or galvanized with a hot-sprayed (plasma flame applied) 6 mil minimum thickness zinc coating.

Steel grating shall be fabricated by weld connections. Bearing bars and cross bars shall be resistance welded at the intersecting joints. Welds, welding procedures, and welding materials shall conform to Standard Specifications for Welding issued by the American Welding Society.

Alternate grate designs will be permitted, with the approval of the Engineer, providing the hydraulic capacity is not decreased, the overall dimensions are the same allowing the grate to be interchangeable, and the strength is essentially equal to the grate shown in the Standard Plans or the Drawings.

The Contractor has the option of furnishing either cast-in-place or precast inlets unless otherwise shown in the Drawings. Alternate designs are acceptable provided they conform to fabricator's Shop Drawings approved prior to award of contract.

SECTION 9-13 RIPRAP AND SLOPE PROTECTION

9-13.1 GENERAL

Riprap shall consist of broken stone, concrete in sacks, or concrete slabs.

9-13.2 LOOSE RAP

9-13.2(1) GENERAL

The stone for loose riprap shall be hard, sound, and durable. It shall be free from segregation, seams, cracks, and other defects tending to destroy its resistance to weather.

Spalls are defined as broken rock in sizes ranging from 3-inch to 1/3 cubic foot. Loose riprap shall be free of rock fines, soil, or other extraneous material.

Should the riprap contain insufficient spalls within the definition and gradation requirements listed above, the Contractor shall furnish and place, as determined by the Engineer, supplementary spall material from a source approved by the Engineer, at the Contractor's expense.

The grading of the riprap shall be determined by the Engineer by visual inspection of the load before it is dumped into place, or, if so ordered by the Engineer, by dumping individual loads on a flat surface and sorting and measuring the individual rocks contained in the load.

9-13.2(2) HEAVY LOOSE RIPRAP

Heavy loose riprap shall meet the following requirements for grading:

	Minimum Size	Maximum Size
40% to 90%	1 ton (1/2 cubic yard)	
70% to 90%	300 lbs. (2 cu. ft.)	
10% to 30%		50 lbs. (spalls)

9-13.2(3) LIGHT LOOSE RIPRAP

Light loose riprap shall meet the following requirements for grading:

	Size Range	Maximum Size
20% to 90%	300 lbs. to 1 ton (2 cu. ft. to 1/2 cu. yd.)	
80%	50 lbs. to 1 ton (1/3 cu. ft. to 1/2 cu. yd.)	
10% to 20%		50 lbs. (spalls)

9-13.3 HAND PLACED RIPRAP

The stone shall be as nearly rectangular as possible, 60 percent shall have a volume of not less than 1 cubic foot. No stone shall be used which is less than 6-inches thick, nor which does not extend through the wall.

The stone shall be hard, sound, and durable. It shall be free from seams, cracks, and other defects tending to destroy its resistance to weather.

9-13.4 SACK RIPRAP

Sack riprap shall consist of concrete placed in sacks made of at least 10 ounce burlap and having a capacity of approximately 2.5 cubic feet. Each sack shall be filled with approximately 1 cubic foot of concrete having a consistency in conformance with Section 6-02.3(5) for nonvibrated concrete.

For sack riprap exposed to fresh water, the concrete shall be Class C; and for sack riprap exposed to salt water, the concrete shall be Class B as specified in Section 6-02.3.

The cement and fine and coarse aggregates shall conform to the requirements for cement and fine and coarse aggregate of Sections 9-01 and 9-03.1, respectively.

9-13.5 CONCRETE SLAB RIPRAP

Concrete slab riprap shall consist of concrete placed in slabs 4-inches thick, unless otherwise shown in the Drawings or directed by the Engineer.

For riprap exposed to fresh water, the concrete shall be Class C; and for riprap exposed to salt water, the concrete shall be Class B as specified in Section 6-02.3. The cement and fine and coarse aggregates shall conform to the requirements for cement and fine and coarse aggregate of Sections 9-01.2 and 9-03, respectively.

9-13.6 CONCRETE SLOPE PROTECTION

9-13.6(1) GENERAL

Concrete slope protection shall consist of reinforced portland cement concrete poured or pneumatically placed upon the slope with a rustication joint pattern or semi-open concrete masonry units placed upon the slope closely adjoining each other.

9-13.6(2) SEMI-OPEN CONCRETE MASONRY UNITS SLOPE PROTECTION

Precast cement concrete blocks shall conform to the requirements of ASTM C 90 for hollow block and C 145 for solid block, Grade N II, except that strength shall be calculated on wet concreted area.

9-13.6(3) POURED PORTLAND CEMENT CONCRETE SLOPE PROTECTION

Cement concrete for poured concrete slope protection shall be Class B in conformance with Section 6-02.3.

Wire mesh reinforcement shall conform to Section 9-07.7.

9-13.6(4) PNEUMATICALLY PLACED PORTLAND CEMENT CONCRETE SLOPE PROTECTION

Cement: This material shall be portland cement as specified in Section 9-01.

Aggregate: This material shall meet the requirements for fine aggregate as specified in Section 9-03.1. The moisture content of the fine aggregate at the time of use shall be between 3 percent and 6 percent by weight.

Reinforcement: Wire mesh reinforcement shall conform to the provisions of Section 9-07.4.

Water: Water shall conform to the provisions of Section 9-07.7.

SECTION 9-14 EROSION CONTROL AND ROADSIDE PLANTING

9-14.1 SOIL

9-14.1(1) TOPSOIL TYPE A

The topsoil shall be friable surface soil from the A horizon as determined by the United States Agriculture Soil Conservation Service Soil Survey. Topsoil shall be free from materials toxic to plant growth; noxious weed seeds, rhizomes, roots; subsoil; stones and other debris. One hundred percent of the topsoil shall pass through a 1 inch screen. Maximum electrical conductivity shall be 2.0 milliohms and the maximum exchangeable sodium percentage shall be 10 percent.

Topsoil Type A shall consist of a sandy clay loam, sandy loam, loam, clay loam, silty clay loam, or silt loam soil. These soil textural classes shall be determined by the United States

Department of Agriculture Classification System. These textural classes shall be restricted by the following maximum percentage compositions based on the material passing the Number 10 screen.

Separates	Maximum Percentage Allowable
Sand	50%
Clay	20%

The maximum allowable percentage of gravel retained on a 1/4 inch screen shall not exceed 20 percent by weight. Of the material passing the 1/4 inch screen, the maximum allowable percentage of gravel retained on a Number 10 screen shall not exceed 10 percent by weight. Total organic matter shall be 1 percent to 10 percent by volume. Organic matter shall be determined by the Walkley-Black sulphuric acid dichromate digestion process. The pH shall be 5.5 to 7.0.

9-14.1(2) TOPSOIL TYPE B

Topsoil Type B shall be native topsoil taken from within the project limits either from the area where roadway excavation is to be performed or from strippings from borrow, pit, or quarry sites, or from other designated sources. The general limits of the material to be utilized for topsoil will be indicated in the Drawings or specified in the Project Manual. The Engineer will make the final determination of the areas where the most suitable material exists within these general limits. The Contractor shall reserve this material for the specified use. Materials for topsoil Type B shall not be taken from a depth greater than 1 foot from the existing ground unless otherwise designated by the Engineer.

In the production of topsoil Type B, all vegetative matter, except large brush and trees over 4 feet in height, shall become a part of the topsoil. Prior to removal, the Contractor shall mow or otherwise reduce the height of the native vegetation such as sagebrush, snowberry, etc., to be a height not exceeding 1 foot. Noxious weeds, as designated by authorized State and County officials, shall not be incorporated in the topsoil, but shall be removed and disposed of as designated elsewhere or as approved by the Engineer. The designated depth of material shall then be taken from the designated areas and placed at locations which will not interfere with the construction of the project as approved by the Engineer. Areas beyond the slope stakes shall be distributed as little as possible in the above operations.

Topsoil Type B will not be considered as selected materials as defined in Section 2-03.3(10), and the conditions of said section shall not apply.

9-14.1(3) TOPSOIL TYPE C

Topsoil Type C shall be native topsoil meeting the requirements of Topsoil Type B but obtained from a source provided by the Contractor outside of the project site.

9-14.1(4) PLANTING SOIL TYPE D

Planting soil shall consist of approximately two-thirds soil and one-third organic material by volume thoroughly mixed together.

The ingredients to be used in mixing planting soil shall meet the following requirements:

(a) Soil shall be sandy loam or loamy sand consisting largely of sand, but with enough silt and clay present to give it a small amount of stability. Individual sand grains can be seen and felt readily. On squeezing in the hand when dry, it shall fall apart when the pressure is released; on squeezing when moist, it shall form a cast that will not only hold its shape when the pressure is released, but shall withstand careful handling without breaking.

The mixed soil shall meet the following:

Size	Sieve	Percent Passing
3/8	ASTM E-11	100
#10	ASTM E-11	85-100
#270	ASTM E-11	10-50
0.002 mm	CLAY	0-10

(b) Organic Matter: Organic matter shall be derived from well-rotted sawdust, sludge or approved substitutes such as fibrous sedge, wood or reed type peat. Substitutes shall contain less than 20 percent of ash by dry weight, shall have a moisture content of less than 50 percent of the wet weight and shall have been throughly aerated during the drying process. Mixed planting soil shall have a pH range of 5.0 to 6.5 with dolomitic limestone added as necessary to attain this range. The total organic matter of the mixed soil shall be 10 percent plus or minus 2 percent by dry weight when tested per ASTM D2974.

The mixture shall be fertilized with a slow release fertilizer with a 14-14-14 formulation, or with ureaform or urea-formaldehyde, calcium nitrate, superphosphate, and sulphate of potash magnesium at rates indicated from a soil test or as directed by the Engineer.

All materials shall be pre-mixed prior to bringing to the jobsite.

9-14.1(5) PLANTING SOIL FOR TREE PITS

Planting soil for tree pits shall consist of native soil excavated from the planting pit and thoroughly mixed with a commercial grade 14-14-14 formulation slow release fertilizer in an amount of 1 pound per inch of tree diameter.

9-14.2 SEED

9-14.2(1) GENERAL

Grasses, legumes, or cover crop seed of the type specified shall conform to the standards for "Certified" grade seed or better as outlined by the State of Washington Department of Agriculture "Rules for Seed Certification," latest edition. Seed shall be furnished in standard containers on which shall be shown the following information:

(1) Common name of seed
(2) Lot number
(3) Net weight
(4) Percentage of purity
(5) Percentage of germination (in case of legumes percentage of germination to include hard seed)
(6) Percentage of weed seed content and inert material clearly marked for each kind of seed in accordance with applicable State and Federal laws.

Upon request, the Contractor shall furnish to the Engineer duplicate copies of a statement signed by the vendor certifying that each lot of seed has been tested by a recognized seed testing laboratory within six months before the date of delivery on the project. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

9-14.2(2) SEED MIX #1 (Highway Mix)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Colonial Bentgrass (Highlands or Astoria)	10%
Red Fescue (Illahee Rainier or Pennlawn)	40%
Perennial Rye	40%
White Dutch Clover	10%

The rate of application shall be 4 pounds per 1000 square feet. The seed mixture shall be no less than 98% pure, and shall have a minimum germination rate of 90%.

9-14.2(3) SEED MIX #2 (Lawn Seed Mix)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Red Creeping Fescue	45%
Chewings Fescue	30%
Kentucky Bluegrass	15%
Highland Colonial Bentgrass	10%

The rate of application shall be 4 pounds per 1000 square feet. No noxious weeds will be permitted. The seed mixture shall be no less than 98% pure, and shall have a minimum germination rate of 90%.

9-14.2(4) SEED MIX #3 (Playground Mix)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Perennial Ryegrass	35%
Tall Alta Fescue	25%
Manhattan Perennial Rye	20%
Annual Rye	20%

The rate of application shall be 4 pounds per 1000 square feet. No noxious weeds will be permitted. The seed mixture shall be no less than 98% pure, and shall have a minimum germination rate of 90%.

9-14.2(5) SEED MIX #4 (Play and Shade Mix)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Perennial Ryegrass	35%
Manhattan Perennial Rye	25%
Red Creeping Fescue	20%
Annual Rye	20%

The rate of application shall be 4 pounds per 1000 square feet. No noxious weeds will be permitted. The seed mixture shall be no less than 98% pure, and shall have a minimum germination rate of 90%.

9-14.3 FERTILIZER

Fertilizer shall be a standard commercial grade of organic or inorganic fertilizer of the kind and quality specified herein. It may be separate or in a mixture containing the percentage of total nitrogen, available phosphoric acid and water-soluble potash in the amounts specified. All fertilizers shall be furnished in standard unopened containers with weight, name of plant nutrients and manufacturer's guaranteed statement of analysis clearly marked, all in accordance with State and Federal laws.

Acceptable commercial fertilizer may be supplied in one of the following forms:

(a) A dry free-flowing granular fertilizer suitable for application by agricultural fertilizer spreader.
(b) A soluble fertilizer ground to a fineness that will permit complete suspension of insoluble particles in water, suitable for application by power sprayer.
(c) A granular or pelleted fertilizer, suitable for application by blower equipment.
(d) A non-volatile liquid fertilizer.

Fertilizer shall be standard commercial grade of formulation. 50 percent of the nitrogen shall be derived from 38 percent ureaformaldehyde and apply at the rate of 12 pounds per 1,000 square feet.

The Contractor shall provide a sample of fertilizer to the Seattle Engineering Department Materials Laboratory.

9-14.3(1) LIME

Agriculture lime shall be of standard manufacture, flour grade, meeting the requirements of ASTM C-602.

9-14.4 MULCH AND AMENDMENTS

9-14.4(1) STRAW

All straw mulch material shall be in an air dried condition free of noxious weeds and other materials detrimental to plant life. Straw shall be seasoned before baling or loading. Straw mulch so provided shall be suitable for spreading with mulch blower equipment.

9-14.4(2) WOOD CELLULOSE FIBER

Wood cellulose fiber mulch shall be specially processed wood fiber containing no growth or germination inhibiting factors and shall be dyed a suitable color to facilitate inspection of the placement of the material. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material will be come uniformly suspended to form a homogenous slurry. When hydraulically sprayed on the ground, the material shall allow the absorption and percolation of moisture.

Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

Wood cellulose fiber shall be applied at the rate of 60 pounds per 1,000 square feet.

9-14.4(3) BARK

Bark mulch shall consist of Douglas fir, pine, or hemlock bark. It shall be ground so that a minimum of 95 percent of the material will pass through a 1-1/2 inch sieve and no more than 55 percent, by loose volume, will pass through a 1/4-inch sieve. The bark mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life.

9-14.4(4) SAWDUST

Sawdust mulch shall be well-rotted (minimum 1 year decomposition), free of chips, chunks, and large splinters, and shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life.

9-14.4(5) PEAT

The peat shall be derived from sphagnum and shall conform to ASTM D 2607 unless otherwise specified. Peat shall be shredded and granulated to pass a 1/2-inch sieve and

conditioned in storage piles for at least six months after excavation. The peat shall not contain substances harmful to plant life.

9-14.4(6) VERMICULITE/PERLITE/PUMICE

Vermiculite, perlite, or pumice shall be horticultural grade and free of any toxic materials.

9-14.4(7) TACKIFIER

Tackifier used as a tie-down for mulch shall conform to the following:

(1) **Type A:** Organic tackifier shall be derived from natural organic plant sources containing no growth or germination inhibiting materials. It shall be applied in quantities sufficient to equal the retention properties of a CSS-1 asphalt emulsion being applied at the rate of 400 gallons per acre. Tackifier shall hydrate in water and readily blend with other slurry materials. Wood cellulose fiber shall be added to the tackifier as a tracer at the rate of 150 pounds per acre. The tackifier shall be sprayed on the mulch after it is in place on the slopes.

(2) **Type B:** Asphalt emulsion tackifier, a CSS-1 emulsion conforming to the requirements of Section 9-02.1(6).

9-14.5 MATTING

9-14.5(1) JUTE MATTING

Jute matting shall be of a uniform open plain weave of unbleached, single jute yarn treated with a fire retardant chemical. The yarn shall be of a loosely twisted construction and shall not vary in thickness by more than 1/2 of its normal diameter. Jute matting shall be furnished in rolled strips approximately 50 yards in length. Matting width shall be 48 inches with an average weight of 0.92 pound per square yard. A tolerance of plus or minus 1 inch in width and 5 percent in weight will be allowed.

9-14.5(2) EXCELSIOR MATTING

Excelsior matting shall be a machine produced mat of wood excelsior covered on one side with a plastic netting or twisted paper composition.

The excelsior matting shall have a minimum dry weight of wood fibers of 0.8 pound per square yard, plus or minus 5 percent. It shall be of uniform thickness, with the fiber evenly distributed over the entire area of the mat.

The plastic netting shall have a 3 inch by 3 inch maximum mesh size.

The width of matting and net shall be 36 inches, and the rolls shall be approximately 150 feet long.

9-14.5(3) CLEAR PLASTIC COVERING

Clear plastic covering shall meet the requirements of the NBS Voluntary Product Standard, PS 17-69, for polyethylene sheeting having a minimum thickness of 6 mil.

9-14.6 PLANT MATERIALS

9-14.6(1) DESCRIPTION

Seedlings are plants grown from cuttings, seeds, or other approved propagation methods. These plant materials do not normally show form characteristic to species generally under three years of age and less than 24 inches in height. Measurement is by height in 3-inch increments or by age and number of times transplanted.

Whips are bareroot, broadleaf trees, generally unbranched and between 2 feet to 6 feet in height. Measurement is by 1-foot height increments.

Broadleaf trees are branched, over 6 feet in height and measured by caliper and/or height.

Coniferous trees are over 2 feet in height and measured in height and occasionally spread.

Shrubs and groundcovers begin to show form characteristic to their normal habit of growth and are measured by height and/or spread.

Container sizes may be specified in addition to other measurements, however, the other measurements shall govern.

9-14.6(2) QUALITY

All plant material furnished by the Contractor shall conform to the applicable requirements described in the current issue of "American Standard for Nursery Stock," and in addition thereto shall meet the following requirements:

(a) All plant material shall comply with State and Federal laws with respect to inspection for plant diseases and insect infestation. Inspection certificates required by law shall accompany each shipment of plant material and shall be filed with the Engineer. All plant material specified shall be first-class representatives of their normal species or varieties in healthy growing condition with normal well-developed branch system and vigorous root systems. They shall be free from disease and insect infestation, disfiguring knots, sun-scalds, abrasions of the bark, broken tops, torn roots and any other objectionable features. Plants cut back from large sizes to meet specified sizes will not be accepted. All plants shall be nursery grown stock unless otherwise specified. Trees must be self- supporting, with straight trunks and with single straight leaders. Trees having damaged or missing leader, multiple leaders, or "Y" crotches will be rejected. The tree canopy must be full.

(b) Plants shall not have cuts over 3/4 inch diameter which are not satisfactorily callusing over. Leader shall be intact on each plant.

(c) Plants furnished in pots or other containers shall be acclimated to outside conditions and equal to field grown stock.

(d) Collected plant material shall conform in quality, size, and grade to standards for nursery stock.

(e) Any plant material that is to be replaced shall be of the same species, cultivar and of equal size to the surviving plant material.

(f) Root balls of plant materials shall be solidly held together by a fibrous root system and shall be composed only of the soil in which the plant has been actually growing. The ball shall be securely wrapped with jute burlap or other packing material not injurious to the plant life. Root balls shall be free of weed or foreign plant growth.

Container grown plants must be plants transplanted into a container and grown in that container sufficiently long for new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container. Plant material which is rootbound, as determined by the Engineer, will be rejected.

Container sizes for plant material of a larger grade than provided for in the container grown specifications of the American Standard for Nursery Stock (A.S.N.S.) shall be determined by the volume of the root ball specified in the A.S.N.S. for the same size plant material.

All bare root plant materials shall have a heavy fibrous root system. Unless otherwise approved by the Engineer, all plants must be dormant at the time of planting.

Average height to spread proportions and branching shall be in accordance with the applicable sections, illustrations, and accompanying notes of the American Standard for Nursery Stock.

Plants, which have been determined by the Engineer to have suffered damage as the result of girdling of the roots, stem, or a major branch; have deformities of the stem or major branches; have a lack of symmetry; have dead or defoliated tops or branches; or have any defect, injury, or condition which renders the plant unsuitable for its intended use, will be rejected.

9-14.6(3) HANDLING AND SHIPPING

All plant material shall be dug with care by experienced workmen. The root system of all plant material shall not be permitted to dry out at any time.

Evergreen and deciduous plant materials shall be furnished balled and burlapped (B&B) unless otherwise specified. Broken or "Made" balls will not be accepted. Balled and burlapped plants shall be handled by the ball of earth and not the plant. Unless otherwise specified, plants may be supplied in suitable metal or other containers should the Contractor so desire. Container grown plants shall be well-developed to hold the earth intact after removal from the container without being root bound.

Handling and shipping shall be done in a manner that is not detrimental to the plants.

The nursery shall furnish a notice of shipment in triplicate at the time of shipment of each carload or other lot of plant material. The original copy shall be mailed to the Engineer, the duplicate to the consignee and the triplicate shall be accompany the shipment to the furnished to the Engineer at the jobsite. The notice shall contain the following information:

(a) Name of shipper.
(b) Date of shipment.
(c) Name of commodity (including all names as specified in the contract.)
(d) Consignee and delivery point.
(e) State contract number.
(f) Point from which shipped.
(g) Quantity contained.
(h) Certificate of grade (statement that material conforms to the specifications.)
(i) Size (height, runner length, caliper, etc. as required.)
(j) Statement of root pruning (date pruned and size of pruning.)
(k) Signature of shipper by authorized representative.
(l) Growing history of plant.

To acclimate plant materials to Northwest conditions, all plant materials used on a project shall be grown continuously outdoors north of the 42nd Latitude (Oregon-California Border) from not later than April 1 of the year prior to the time of planting.

All container grown plants shall be handled by the container.

All balled and burlapped plants shall be handled by the ball.

Plant material shall be packed for shipment in accordance with prevailing practice for the type of plant being shipped, and shall be protected at all times against drying, sun, wind, heat, freezing, and similar detrimental conditions both during shipment and during related handling. Where necessary, plant material shall be temporarily heeled in. When transported in closed vehicles, plants shall receive adequate ventilation to prevent sweating. When transported in open vehicles, plants shall be protected by tarpaulins or other suitable cover material.

9-14.6(4) TAGGING

Plants delivered shall have legible labels attached to each individual plant delivered as a separate unit or to each box, bundle, bale or container containing one or more plants. Labels shall give the necessary detailed information as to horticultural name, size, age, caliper or other data required to identify as conforming to Specifications. When the label is attached to a bundle, box, container, etc., containing more than one plant, information on the label shall show the quantity together with the other required information. Exception: All trees, whether furnished singly or bundled, shall be individually tagged with names, size or caliper, etc., needed as shown above. Contractor may refer to State of Washington Department of Agriculture, Orders 1229 and 1230, Nursery Stock Standards, regarding labeling of plant material. Plant material with illegible or missing tags will be rejected by the Engineer. All plants that are patented or trademarked shall have an individual tag on each plant.

9-14.6(5) INSPECTION

The Contractor shall, as soon as practical, inform the Engineer as to the source of plant materials for the project. Approval of plant material for a project shall not be considered as final acceptance. The Contractor shall notify the Engineer not less than 48 hours in advance of delivery of plants from the nursery to insure adequate time for inspection before planting.

All trees will be inspected by the Seattle Engineering Department Arborist or his representative at the project site prior to planting. The Contractor shall plant only that plant material approved by the Arborist or his representative.

Root condition of plants furnished in containers shall be determined by removal of the plant from the container. Plants not meeting the requirements herein specified shall be immediately removed from the project and replaced by the Contractor.

Plant material delivered, inspected and approved for planting shall be planted immediately. Plants not immediately planted by the Contractor may be temporarily stored upon written authorization from the City Arborist.

9-14.6(6) SUBSTITUTION OF PLANTS

No subsititution of plant material, species or variety, will be permitted unless evidence is submitted in writing to the Engineer that a specified plant cannot be obtained and has be unobtainable since the award of the contract. If substitution is permitted, it can be made only with written approval by the Engineer. The nearest variety, size, and grade as approved by the Engineer shall then be furnished.

9-14.6(7) TEMPORARY STORAGE

Plants stored under temporary conditions shall be the responsibility of the Contractor.

Plants stored on the project shall be protected at all times from extreme weather conditions by insulating the root balls with sawdust, soil, or other approved material and shall be kept moist at all times.

Plant material delivered and accepted shall be planted immediately. Plants that cannot be planted within 1 day after arrival shall be "heeled-in" in accordance with accepted horticultural practice,as follows:

(a) Bare root plants shall be placed in trenches with roots covered with moist earth, sawdust or other suitable material. All bare root material supplied in bundles shall have the bundle broken and placed in the trenches separately.

(b) Balled and burlapped plants shall have the root ball protected by moist earth, sawdust or other acceptable material.

9-14.6(8) SOD

All sod shall comply with the State and Federal laws, including guaranty, with respect to inspection, plant diseases and insect infestation. Sod shipments shall have a certificate of origin and/or certification of approved treatment when shipment originates in known infected areas.

Sod shall be mature, densely rooted grass composed of equal mix of Bluegrass and Colonial Bent Grass, and/or Creeping Red Fescue Grass, and a minimum of 60% Perennial Rye Grass blend. The sod shall be free of weeds and reasonably free of objectionable grasses.

9-14.6(9) FILL MATERIAL

Fill material shall be a "Mineral Aggregate, Type 10" meeting the requirements of Section 4-01, or may be a native sandy loam, of medium texture without clay or rocks, obtained from selected roadway or trench excavated material.

The fill material shall be free of toxic amounts of acid or alkaline elements, brush, roots, sticks and other objectionable material. A 1 cubic foot sample of the fill material shall be submitted to the Engineer for testing and approval.

9-14.7 STAKES, GUYS, AND WRAPPING

Stakes shall be wood or No. 5 deformed steel reinforcing bar as specified in Section 8-02.3(7) and shall be installed as shown in Standard Plan No's. 100 and 101.

The minimum size of wire used for guying shall be 14 gage, soft drawn. Commercial plant ties may be used in lieu of hose and wire guying upon approval of the Engineer.

Hose for guying shall be nylon, rubber, or reinforced plastic and shall have an inside diameter of at least 1/2 inch.

Tree wrap shall be a crinkled waterproof paper weighing not less than 4.0 pounds per 100 square feet and shall be made up of two sheets cemented together with asphalt.

9-14.8 SHEAR BOARDS

Shear Boards shall be 2-inch x 8-inch rough finished lumber.

9-14.9 PAVER BLOCKS

Paver blocks shall be exposed aggregate concrete of the size indicated on the Drawings. Pavers shall be made from the following mix:

Materials and Quantities Per Cubic Yard

Gray cement	564 pounds
5/8 inch minus gravel	2,400 pounds
building sand	1,030 pounds

A sample of exposed aggregate showing the desired amount of exposure is available at the Seattle Engineering Department Materials Laboratory at 707 South Plummer Street.

The Contractor shall provide two sample paver blocks, for the Engineer's approval, which are representative of those to be used in the project.

Exposed aggregate surface of all concrete paver units shall be sealed with a heavy-duty concrete enamel containing a 10% methylacrylate solution or approved equal. On request by the Engineer, the Contractor shall provide a 1 pint sample of sealant for testing. Sealant material shall be approved by the Engineer prior to application.

9-14.10 GRID BLOCKS

Grid blocks shall be 16-inch x 24-inch Layrite Grass Grid Blocks or approved equal.

9-14.11 CEDAR EDGING

Edging edging material shall be 2-inch x 4-inch cedar, construction grade or better with tight knots.

9-14.12 BOLLARDS

9-14.12(1) WOOD BOLLARDS

Bollards shall be nominal 8-inch x 8-inch, 90-day stack dry, select Douglas Fir. Bollards shall be pressure-treated (closed cylinder method) Pentachlorophenol after cutting and predrilling. Tops and 4 four sides of bollards (above the notch) shall be painted with 2 coats of white marine enamel as manufactured by Inter-Lux or approved equal applied per manufacturer's recommendations.

All metal parts (bolts, nuts, washers, etc.) shall be hot-dipped galvanized.

9-14.12(2) CONCRETE BOLLARDS

Concrete for bollards shall be Class 5 (3/4) concrete. Bollards shall be reinforced with four No. 4 deformed reinforcing steel pars lengthwise, with No. 8 gauge wire ties 1/4 inch clear below the surface of the concrete. After forms are removed, concrete shall show a smooth dense face. Any surface irregularities showing above grade shall be scraped or stoned off; the surface shall then be washed and a 1:1 mortar shall be brushed on. After the initial set but before the final set, the excess mortar shall be rubbed off using burlap sacking or pieces of carpeting. The bollards shall then be cured by being kept damp with water for not less than 2 days.

9-14.12(3) PADLOCKS FOR REMOVABLE BOLLARDS

The padlock shall be as manufactured by Best Lock Company, Lock number 2B672 with bronze body, 2-inch stainless steel shackle, and equipped with construction core or approved equal.

9-14.13 BENCHES

Benches shall be of the type indicated on the Drawings and as specified in the Project Manual.

9-14.14 TREE GRATES

Tree grates shall be two piece ductile iron conforming to ASTM A536 GR80-56-06, 3/4 inch thick and 48 inches square. Grates shall have concentric break-out center rings that allow for expansion of tree trunk area in increments such that the center hole can be expanded from 9 inches to 16 inches to 22 inches to 28 inches.

SECTION 9-15 IRRIGATION SYSTEM

9-15.1 PIPE, TUBING AND FITTINGS

9-15.1(1) GENERAL

Pipe shall be galvanized iron, PVC, or polyethylene, as specified in the Drawings or in the Project Manual.

9-15.1(2) GALVANIZED PIPE AND FITTINGS

Pipe shall be standard weight, hot-dipped galvanized iron or steel pipe, threaded and coupled. Pipe shall meet the requirements of ASTM Designation A 120.

9-15.1(3) POLYVINYL CHLORIDE PIPE AND FITTINGS

PVC pipe upstream of the control valves shall be Schedule 40 and conform to all requirements of ASTM D 1785.

PVC pipe downstream of the control valves shall be pressure rated for 200 psi and conform to all requirements of ASTM D 2241, SDR 21.

Fittings shall be of the solvent weld type except where risers, valves, etc., require threaded transition fittings. Fittings shall conform to the requirements of ASTM D 2466.

PVC pipe and fittings shall be non-toxic, free from taste and odor, and self-extinguishing.

Pipe shall be homogenous throughout and be free of defects cracks, holes, foreign materials, wrinkles, dents and blisters.

PVC pipe shall be continuously and permanently marked with the following information: manufacturer's name, kind of pipe, National Sanitation Foundation (NSF) approval and schedule number.

9-15.1(4) POLYETHYLENE PIPE

Polyethylene pipe shall be Class 80, SDR 15, medium density polyethylene pipe, meet the requirements of ASTM D 2239, conform to U.S. Commercial Standard CS-255, and be National Sanitation Foundation (NSF) approved.

9-15.2 CONTROL TUBING

Control tubing shall be copper refrigerator tubing meeting the current requirements of ASTM Designation B 280 in the size specified on the Drawings. Tubing and fittings shall be capable of withstanding a 300 p.s.i. operating pressure, and shall be of the size indicated on the Drawings.

9-15.3 AUTOMATIC CONTROLLERS

Automatic controllers shall be installed on a concrete base. They shall be an electrically timed device for automatically opening and closing control valves for predetermined periods of time and mounted so that all normal adjustments will be conveniently located for use by the operator. Controllers shall be enclosed in a weatherproof metal housing fabricated from 16 gage sheet aluminum alloy 6061-T6, or from 16 gage sheet steel metal. Each coat of paint shall be dry before application of the next coat and hard dry before shipment.

A pedestal or skirting shall be placed around the conduit leading to the metal housing shown in the Drawings. It shall be of the same material and finish as the housing. The Contractor shall submit a plan of the proposed design for the pedestal or skirting to the Engineer for approval before fabrication. All locks or locking devices shall be master keyed and three sets of keys provided. The controller shall be compatible with and capable of operating the irrigation system as designed and constructed and shall include the following operating features:

(a) Each controller station shall be adjustable for setting to remain open for any desired period of time–from five minutes or less to at least one hour.
(b) Adjustments shall be provided whereby any number of days may be omitted and whereby any one or more positions on the controller can be skipped. When adjustments are made, they shall continue automatically within a 14-day cycle until the operator desires to make new adjustments.
(c) Controls shall allow any position to be operated manually both on or off whenever desired.
(d) Controls shall provide for resetting the start of the irrigation cycle at any time and advancing from one position to another.
(e) Controllers shall contain an on-off switch and fuse assembly.
(f) Controller adjustments shall be such that the open cycle may be doubled or repeated not less than 3 times during the complete watering cycle.
(g) Controller shall have a power failure cutout.
(h) Controller shall be UL approved and marked accordingly.

9-15.4 SPRINKLER HEADS

Sprinkler heads shall be of the type, pattern, and coverage shown in the plans at rated operating pressure specified, discharging not more than the amount of gallons per minute listed.

Sprinkler heads shall be designed so that spray adjustments can be made by either an adjustment screw or interchangeable nozzles. Watering cores shall be easily removed without removing the housing from the pipe.

Sprinkler heads shall be of the style, pattern and coverage shown on the Drawings. All heads shall be constructed of heavy duty bronze, brass or stainless steel. Sprinklers shall be designed so that spray adjustments can be made by either an adjustment screw or interchangeable nozzles. Watering cores shall be precision machined for accurate performances and shall be easily removed without removing the housing from the pipe. All turn heads shall be designed with turf flanges having 2 gripping holes to facilitate removal of the head.

9-15.5 VALVE BOXES AND PROTECTIVE SLEEVES

All automatic control valves, flow control valves, and pressure reducing valves shall be provided with valve boxes. Valve boxes shall conform to Standard Plan No. 120 or 122 and shall be extendable to obtain the depth required. All manual drain valves and manual control valves shall be equipped with a protective sleeve and cap as shown in the Standard Plans.

9-15.6 GATE VALVES

Gate valves when called for on the Drawings shall be heavy duty bronze conforming to the requirements of ASTM Designation B 62. Valves shall be of the same size as the pipes on which they are placed and shall have union or flange connections. Service rating (for non-shock cold water) shall be 300 p.s.i. Valves shall be of the double disk, taper seat type, with rising stem, union bonnet and handwheel. Manufacturer's name, type of valve and size shall be cast on the valve.

9-15.7 CONTROL VALVES

9-15.7(1) MANUAL CONTROL VALVES

Manual valves shall be bronze or brass, angle type with hex brass union. Service rating shall be not less than 150 psi nonshock cold water. Valves shall be designed for underground installation with suitable cross wheel for operation with a standard key. The Contractor shall furnish three suitable operating keys per contract. Valves shall have removable bonnet and stem assembly with adjustable packing gland and shall house long acme threaded stem to ensure full opening and closing. Valve discs shall be full floating with replaceable seat washers.

9-15.7(2) AUTOMATIC CONTROL VALVES

Valves shall be of a "normally closed" design and shall be electric solenoid operated, having maximum rating of 6.5 watts utilizing 24 volts AC power. Solenoids shall be directly attached to the valve bonnets or body with all control parts and ports completely internal. Valves shall be of 150 p.s.i. brass or bronze, or iron body bronze-mounted combination. The opening and closing speed of the valve shall be a minimum of 5 seconds for closure with a constant rate of closing, and a minimum of 3 seconds for opening with a constant rate of opening and closing. A manual control bleed cock shall be

included on the valve to operate the valve without the requirement of electric current. A manual shutoff stem with cross handle for wrench operation is required for manual adjustment from fully closed to wide open. Once the manual adjustment is set, the valve shall operate automatically in the adjusted position. Water flow shall be completely stopped when the control valve is closed either manually or automatically. Automatic control valves and automatic controllers need not be of the same manufacturer.

9-15.7(3) AUTOMATIC CONTROL VALVES WITH PRESSURE REGULATOR

The automatic control valve with pressure regulator shall be similar to the automatic control valve and shall also reduce the inlet pressure to a constant lower pressure regardless of supply fluctuations. The regulator must be fully adjustable.

9-15.8 QUICK COUPLING EQUIPMENT

Quick coupler valves shall have a service rating not less than 125 psi for nonshock cold water. The body of the valves shall be of cast leaded semi-red brass alloy No. C84400 conforming to ASTM B 584. The base of the valve shall have standard female pipe threads. The design of the valve shall be such that it will open only upon inserting a coupler key and will close as the coupler is removed from the valve. Leakage of water between the coupler and valve body when in operation will not be accepted. The valve body receiving the coupler shall be designed with double worm slots to allow smooth action in opening and closing of the valve with a minimum of effort. Slots shall be notched at the base to hold the coupler firmly in the open postion. Couplers shall be of the same material as the valve body with stainless steel double guide lugs to fit the worm slots. Couplers shall be of one piece construction with steel reinforced side handles attached. All couplers shall have standard male pipe threads at the top. Couplers shall be furnished with all quick coupler valves unless otherwise specified.

9-15.9 DRAIN VALVES

The Contractor shall install 3/4 inch male automatic ball check drain valve at the low point in the system. The drain valve shall be drained to a pocket containing a minimum of 1/2 cubic yard of coarse gravel or crushed rock (3/8 inch to 3 inches size).

9-15.10 HOSE BIBS

Hose bibs shall be constructed of bronze or brass, angle type threaded to accommodate a 3/4 inch hose connection, and shall be key operated. Design shall be such as to prevent operation by wrench or pliers.

9-15.11 BACKFLOW PREVENTION DEVICES

9-15.11(1) ATMOSPHERIC VACUUM BREAKERS

Atmospheric vacuum breakers shall be of a type included in the Washington State Department of Social and Health Services listing of "Acceptable Atmospheric (Non-Pressure) Type Vacuum Breaker," or other types with IAPMO approval. They shall be installed downsteam of the last shutoff valve and a minimum of 6 inches above the highest outlet or overflow level of the irrigation system.

A vacuum breaker shall be attached to each hose bib.

9-15.11(2) PRESSURE VACUUM BREAKERS

Pressure vacuum breakers shall be of a type included in the Washington State Department of Social and Health Services listing of "Acceptable Pressure Type Vacuum Breaker" or other types with IAPMO or USC approval. They shall be installed a minimum of 12 inches above the highest outlet or overflow level of the irrigation system and located so that adequate room is available for maintenance and testing.

9-15.11(3) DOUBLE CHECK VALVE ASSEMBLIES (DCVA)

Double check valve assemblies shall be of a type included in the Washington State Department of Social and Health Services listing of "Approved Double Check Valve Assemblies." Inspection of the installation and the initial test of the unit, to insure proper operation, will be conducted by the Seattle Water Department. DCVA's shall be inspected and tested periodically during the life of the contract by backflow device testers certified by the Washington State Department of Social and Health Services. Units found to be defective shall be repaired or replaced.

Installations shall be according to procedures outlined in the current edition of "Accepted Procedure and Practice in Cross-Connection Control Manual," published by the Pacific Northwest Section, American Water Works Association.

9-15.11(4) REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION DEVICES (RPBD)

Reduced pressure principle backflow prevention devices will be required if fertilizers or other chemicals are to be injected into the irrigation system. These units shall be of a type included in the Washington State Department of Social and Health Services listing of "Approved Reduced Pressure Backflow Devices." Inspection of the installation and the initial test of the unit, to insure proper operation, will be conducted by the Seattle Water Department. RPBD's shall be inspected and tested periodically during the life of the contract by backflow device testers certified by the Washington State Department of Social and Health Services. Units found to be defective shall be repaired or replaced.

Installation shall be according to procedures outlined in the current edition of "Accepted Procedure and Practice in Cross-Connection Control Manual," published by the Pacific Northwest Section, American Water Works Association.

9-15.12 CHECK VALVES

Check valves shall be heavy duty bronze or steel. The valves shall function by means of a hinged disc suspended from the body and able to close of its own weight. Valves shall be of the size as the pipes on which they are placed, unless otherwise specified, and shall have union or flanged connections. Service rating (for non-shock cold water) shall be 300 p.s.i. Manufacturer's name, type of valve and size shall be cast on the valve.

9-15.13 PRESSURE REDUCING VALVES

Pressure reducing valves shall have a minimum of 150 psi working pressure with an adjustable outlet range of 20 to 70 psi. The valves shall be factory set as shown in the plans. Pressure reducing valves shall be rated for safe operation at 175 psi nonshock cold water.

9-15.14 THREE WAY VALVES

Three way valves shall be tight closing, three port, ball or plug type, constructed to permit straight through and 90 degree flow only. The valve shall be of bronze or approved corrosion resistant body materials and shall have a minimum of 150 psi working pressure. The head of the valve, or handle when applicable, shall be permanently marked to indicate port position. Whenever handles are included as an integral part of the valve, the Contractor shall remove the handles and give them to the Engineer for ultimate distribution to the Maintenance Division.

9-15.15 FLOW CONTROL VALVES

Valve body materials shall be plastic or metal. Internal parts shall be stainless steel. Valves shall have no external adjustment and be tamper proof when installed. One-quarter inch and smaller flow control valves shall have a minimum pressure absorption range of 2 to 32 psi. One and one-half inch and larger flow control valves shall have a minimum pressure absorption range of 3 to 50 psi.

Flow shall be controlled to 5 percent of design volumes.

9-15.16 AIR RELIEF VALVE

The air relief valve shall automatically relieve air and break a vacuum in the serviced pipe. Body materials shall be installed exactly at all high points.

9-15.17 ELECTRICAL WIRE

Wire from controller to valves shall be #14 UF direct burial (UL approved), red or black for the hot side, white for neutral (solid copper). The auxiliary wires, where required, shall be any third color (except green). UF and UL designations shall be clearly marked on the insulation jacket of all wires.

9-15.18 DETECTABLE MARKING TAPE

Detectable marking tape shall consist of inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents, and solvents likely to be encountered in the soil, with a metallic foil core to provide the most positive detection and pipeline locators.

The tape shall be color coded and shall be imprinted continuously over its entire length in permanent black ink. The message shall convey the type of line buried below and shall also have the word "Caution" prominently shown. Color coding of the tape shall be as follows:

Utility	Tape Color
Water	Blue
Sewer	Green
Electrical	Red
Gas-Oil	Yellow
Telephone-CATV	Orange

The width of the tape shall be as recommended by the manufacture for the depth of installation.

9-15.19 SLEEVE

Pipe sleeves shall be PVC Schedule 40. Sizes and installation shall be in accordance with the Drawings and Standard Plans.

Conduit shall meet the requirements of Section 9-34.

SECTION 9-16 FENCE AND GUARDRAIL

9-16.1 CHAIN LINK FENCE AND GATES

9-16.1(1) GENERAL

All material used in the construction of chain link fence and gates shall be new. Iron or steel material shall be galvanized unless specified otherwise. Imperfectly galvanized material or material upon which serious abrasions of galvanizing occur will not be acceptable.

The base material for the manufacture of steel pipes used for posts, braces, top rails, and gate frames shall conform to the requirements of ASTM Designation A 120, except the weight tolerance on tubular posts shall be applied as provided below. The base material for the manufacture of steel H columns shall meet the requirements of ASTM Designation A 663.

Roll-formed posts, braces, and rails shall be made from sheet steel and shall conform with the details as shown in the Drawings or Standard Plan No. 450b. The material for end, corner, and pull posts shall have a minimum yield strength of 35,000 psi. The minimum yield strength for Alternate A roll-formed line posts shall be 40,000 psi and for Alternate B roll-formed line posts 45,000 psi. Top rail and braces to be used with Alternate A or B line posts shall conform to the minimum yield strength as required for either post respectively.

All posts, braces, top rails, and gate frames shall be hot-dip galvanized. They shall have a minimum average of 1.8 ounces zinc coating per square foot of surface area with no individual test being below 1.6 ounces zinc coating per square foot of surface area. In the case of members made from pipe, this area is defined as the total area inside and outside. A sample for computing the average weight of coating is defined as a 12 inch piece cut from each end of the galvanized member. Fittings shall be galvanized in accordance with the requirements of ASTM F 626. Other materials shall be galvanized in accordance with the requirements of ASTM A 153.

9-16.1(2) POSTS

All posts for chain link fence shall be of the shape, size, and weight per foot shown in Standard Plan No. 450b. Roll-formed end, corner, and pull posts shall be made from 0.1345 inch thick sheet steel and shall have integral fastening loops to connect to the fabric for the full length of each post. Roll-formed line posts shall be made from 0.120 inch thick sheet steel.

An acceptance tolerance for posts for chain link fence will allow deviation from the weight per linear foot specified in the Standard Plans. This tolerance shall be applied on an individual post basis and shall be plus or minus 5 percent for tubular and H-section posts and plus or minus 6 percent for roll form sections. Materials that exceed the weight per foot or wall thickness specification may be accepted, providing they do not interfere with the proper construction of the fence.

9-16.1(3) TOP RAIL, BRACES, AND TRUSSES

Top rail and compression braces shall be of the type and size shown in Standard Plan No. 450b. Tension truss rods shall be 3/8-inch round galvanized rods with drop forged turnbuckles, or other approved type of adjustment. Couplings for tubular sections shall be outside sleeve type and at least 6-inches long. Roll-formed top and brace rails shall be made from 0.0747-inch thick sheet steel and shall be an open rectangular section with internal flanges. The acceptable thickness tolerance for sheet steel members shall be plus or minus 0.006 of an inch.

9-16.1(4) TENSION WIRE AND ATTACHMENTS

Top and bottom wire shall be 7 gage coil spring steel wire of good commercial quality and shall have a zinc coating averaging 0.8 ounce per square foot of surface area. All tension wire attachments shall be hot-dip galvanized steel unless otherwise specified. Eye bolts shall be 3/8-inch diameter and of sufficient length to fasten to the type of posts used.

9-16.1(5) VACANT

9-16.1(6) FITTINGS

All fittings and miscellaneous hardware shall be malleable cast iron or pressed steel. Fittings shall be galvanized in accordance with ASTM F 626. Galvanizing of miscellaneous hardware not covered by ASTM F 626 shall be in conformance with ASTM A 153. Fittings for any particular fence shall be those furnished by the manufacturer of the fence.

9-16.1(7) CHAIN LINK FENCE FABRIC

Chain link fabric shall consist of 11 gage wire (0.120 inch diameter) for Types 3, 4, and 6 fence; and 9 gage wire (0.148 inch diameter) for Type 1 fence. The fabric wire may be one of the following materials provided that only one type shall be selected for use in any one contract:

Galvanized steel wire conforming to ASTM A 392.
Galvanizing shall be Class I performed by the hot-dip process.
Class II aluminum coated steel wire conforming to ASTM A 491.
Class II aluminum wire conforming to 6061-T94 alloy.
The wire shall be woven into approximately 2-inch diamond mesh.

The width and top and bottom finish of the fabric shall be as shown in Standard Plan No's. 450a and 450c.

9-16.1(8) FABRIC BANDS AND STRETCHER BARS

Fabric bands shall be 1/8 inch by 1 inch nominal and stretcher bars 3/16 inch by 3/4 inch nominal. Nominal shall be construed to be the area of the cross-section of the shape obtained by multiplying the specified width by thickness. A variation of plus or minus 5 percent from this theoretical area shall be construed as "nominal" size. Both shall be hot-dip galvanized to meet the requirements of ASTM F 626.

9-16.1(9) TIE WIRE

Tie wire shall be 9 gage aluminum wire complying with the ASTM B 211 or 9 gage galvanized wire meeting the requirements of AASHTO M 279. Galvanizing shall be Class 1. Hog rings shall meet the requirements of AASHTO M 279. Galvanizing shall be Class 1.

9-16.1(10) CHAIN LINK GATES

Gate frames shall be constructed of not less than 1-1/2 inch inside diameter hot-dip galvanized pipe with nominal weight of 2.72 pounds per linear foot. The corners of the gate frame shall be fastened together and reinforced with a malleable iron or pressed steel fitting designed for the purpose, or they may be welded. Welding shall conform to the requirements of Section 6-03.3(25). All welds shall be ground smooth and painted with a high zinc dust content paint meeting the requirements of MIL-P-21035. The paint shall be applied in one or more coats to provide a dry film thickness of 3.5 mils minimum.

Cross trussing shall be 3/8-inch galvanized steel adjustable rods.

Chain link fence fabric for filling the gate frame shall meet the fabric requirement specified for chain link fence of the type being furnished.

Each gate shall be furnished complete with necessary hinges, latch, and drop bar locking device designed for the type of gate posts and gate used on the project. Gates shall have positive type latching devices with provisions for padlocking.

Gate frames constructed of steel sections, other than pipe, that are fabricated in such a manner as to form a gate of equal or better rigidity may be used provided they are approved by the Engineer.

9-16.1(11) MISCELLANEOUS

All concrete shall be Class C as specified in Section 6-02.

9-16.2 WIRE FENCE AND GATES

9-16.2(1) GENERAL

All materials used in the construction of the wire fence shall be new. All iron or steel material shall be galvanized. Imperfectly galvanized material or material upon which serious abrasions of galvanizing occur shall not be used.

9-16.2(2) STEEL FENCE POSTS AND BRACES

Steel fence posts and braces shall be of good commercial quality iron or steel and shall be approved by the Engineer prior to construction. Posts shall be not less than 7 feet in length.

Line posts may be channel, T, U, Y, or other approved shape, manufactured solely for use as fence posts. One type of line post shall be used throughout the project. Line posts shall be studded, slotted, or properly adapted for attaching either wire or mesh in a manner that will not damage the galvanizing of posts, wire, or mesh during the fastening. Line posts shall have a minimum weight of 1.33 pounds per linear foot and shall be provided with a tapered steel anchor plate attached securely having a minimum weight of 0.67 pounds and having a surface area of 20 square inches plus or minus 2 square inches.

End, corner, gate, and pull posts shall meet the requirements specified for line posts, except that the posts shall have a minimum weight of 3.1 pounds per linear foot and anchor plates and special studs, slots, or adaptors for the attachment of wires will not be required.

Braces shall have a minimum weight of 3.1 pounds per linear foot.

All posts, braces, anchor plates, and hardware not covered by ASTM F 626 shall be galvanized in accordance with the requirements of ASTM A 123, or A 153.

A tolerance of minus 5 percent on the weight of individual posts, braces, or anchor plates will be permitted.

9-16.2(3) WOOD FENCE POSTS AND BRACES

Douglas fir, Western red cedar, hemlock, or larch shall be used in the construction of wood fence posts and braces. The material shall be of good quality and approved by the Engineer before use. Peeler cores shall not be used for round posts. Wood fencing materials shall have sufficient sapwood in the outer periphery to obtain the specified penetration of preservative. Fencing materials shall be cut to the correct length before pressure treatment.

Line posts shall be 3 inch minimum diameter round posts or nominal 3 inch by 3 inch square sawed posts. If the posts are to be pointed for driving, they shall be pointed before treatment. Line posts shall be at least 7 feet in length.

Pull posts and brace posts shall be 6 inch diameter round posts or nominal 6 inch by 6 inch material not less than 7 feet in length.

End, gate, and corner posts, and posts at an intersecting fence shall be 6 inch diameter round posts or nominal 6 inch by 6 inch material not less than 7 feet 10 inches in length.

All sawed posts and timbers shall meet the requirements in the table under Section 9-09.2.

The preservatives used to pressure-treat wood fencing materials shall meet the requirements of Section 9-09.3.

The retention and penetration of the preservative shall be as follows:

Preservative	Minimum Retention in Pounds Per Cubic Foot Sawed Posts	Minimum Penetration
Creosote	8.00	3/8 inch or 90% of
Pentachlorophenol	0.40	sapwood impregnated
CCA, ACA, or ACZA	0.40	
Round Posts		
Creosote	6.00	75% of sapwood
Pentachlorophenol	0.30	impregnated
CCA, ACA, or ACZA	0.30	

9-16.2(4) BRACE WIRE

Brace wire shall be 9 gage galvanized wire meeting the requirements of ASTM A 116, galvanizing Class 2.

9-16.2(5) STAPLES AND WIRE CLAMPS

The staples used to attach the wire fencing to wood posts shall be galvanized 9 gage, 1-1/2 inches long meeting the requirements of AASHTO M 279, galvanizing Class 1.

The wire clamps used to attach the wire fencing to steel posts shall be galvanized 11 gage wire meeting the requirements of AASHTO M 279, galvanizing Class 1.

9-16.2(6) BARBED WIRE

Barbed wire shall conform to the requirements of AASHTO M 280, and shall consist of two strands of 12-1/2 gage wire, twisted with four point 14 gage barbs with the barbs spaced an average of 5 inches apart. Galvanizing shall be Class 2 or 3.

9-16.2(7) WIRE MESH

Wire mesh shall conform to the requirements of AASHTO M 279, and shall consist of seven horizontal wires with vertical stays spaced 6 inches apart. The top and bottom wires shall be 10 gage, and the intermediate wires and vertical stays shall be 12-1/2 gage. The mesh shall have a total width of 26 inches (Design No. 726-6-12-1/2). Galvanizing shall be Class 2. The zinc-coated wire as represented by the test specimens shall be capable of being wrapped in a close helix at a rate not exceeding 15 turns/minute around a cylindrical steel mandrel having a diameter the same as the specimen being tested, without cracking or flaking the zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers.

9-16.2(8) VERTICAL CINCH STAYS

Vertical cinch stays shall be 9-1/2 gage galvanized wire meeting the requirements of AASHTO M 279, except that the minimum weight of zinc coating shall be 0.3 ounce per square foot of uncoated wire surface.

9-16.2(9) WIRE GATES

Gate frames shall be constructed of galvanized standard weight pipe with a nominal diameter of not less than 1 inch. The pipe shall conform to the requirements of ASTM A 120. Wire gates shall be not less than 48 inches in height and shall be designed to fit openings of the widths called for in the plans or as indicated by the bid items. Each gate shall be provided with two upright braces of the same material as the frame, spaced at 1/3 points in the gate. All gates shall be provided with adjustable 3/8 inch diameter diagonal truss rods from corner to corner.

The gate frame shall be provided with wire mesh conforming to the requirements specified in Section 9-16.2(7), except that it shall consist of 10 horizontal wires and have a total width of 47 inches (Design No. 1047-6-12-1/2).

Each gate shall be furnished complete with necessary hinges and latch designed for use with the type of gate posts used on the project. The hinges shall be so designed as to be securely attached to the gate post and to enable the gate to be swung back against the fence.

Double gates shall be hinged in the same manner as single gates and shall be provided with an approved drop bar locking device.

9-16.2(10) MISCELLANEOUS

Bolts, nuts, and hinges used in the construction of fence and gates shall be galvanized in accordance with AASHTO M 232.

All concrete shall be Class C as specified in Section 6-02.

9-16.3 BEAM GUARDRAIL

9-16.3(1) RAIL ELEMENT

The W-beam rail element and terminal sections shall consist of 12 gage steel formed into a beam not less than 12 inches wide and 3 inches deep. Guardrail Type 10 (three beam) and the transition sections shall consist of 10 gage steel formed into a beam not less than 20 inches wide and 3 inches deep. Design F terminal sections shall consist of 10 gage steel. The rail elements and terminal sections shall be formed from open hearth, electric furnace, or basic oxygen steel. The physical properties of the steel shall conform to the following minimum requirements:

Ultimate tensile strength	70,000 psi
Elongation in 2 inches	12%

The rail splices shall have a minimum total ultimate strength of 80,000 pounds at each joint.

The 6-inch channel rails and splice plates shall be in conformance with AASHTO M 183. All fabrication shall be complete before galvanizing.

The holes in the plate shall be slotted to facilitate erection and to permit expansion and contraction. The edges of the rail shall be rolled or rounded so they will present no sharp edges. Where the rail is on a curve, the plates at the splice shall make contact throughout the area of splice. When the radius of curvature is less than 150 feet, the rail shall be shaped in the shop.

9-16.3(2) POSTS AND BLOCKS

Posts and blocks may be of creosote treated timber, pentachlorophenol treated timber, waterborne chromated copper arsenate (CCA), ammoniacal copper arsenate (ACA), ammoniacal copper zinc arsenate (ACZA), treated timber or galvanized steel; except only treated timber posts and blocks may be used for weathering steel beam guardrail. Except for anchor assemblies, all posts for any one project shall be of the same type. Posts and blocks shall be of the size and length shown in WSDOT Standard Plan No's. C-1 and C-1a and meet the requirements of these Specifications.

Timber posts and blocks shall conform to the grade specified in Section 9-09.2, except pine lumber No. 1 grade may be used for the blocks. Timber posts and blocks shall be fabricated as specified in the Standard Plans before being treated. Timber posts and blocks shall be treated by the empty cell process to provide a minimum retention, depending on the treatment used, according to the following:

Creosote oil	8 lbs. pcf of lumber
Pentachlorophenol	0.40 lbs. pcf of lumber
CCA	0.40 lbs. pcf of lumber
ACA	0.40 lbs. pcf of lumber
ACZA	0.40 lbs. pcf of lumber

Treatment shall be in accordance with Section 9-09.3.

Steel posts, blocks, and base plates, where used, shall conform to AASHTO M 183, and shall be galvanized in accordance with AASHTO M 111. Welding shall conform to Section 6-03.3(25). All fabrication shall be completed prior to galvanizing.

Timber posts shall be square, 8 inches by 8 inches S4S and shall conform to the grade specified in Section 9-09. The posts shall be shaped as shown on the Standard Plans before being treated.

9-16.3(3) GALVANIZING

Beam rail elements and terminal sections shall be galvanized in accordance with AASHTO M-180, Class A, Type 2, except that the rail shall be galvanized after fabrication, with fabrication to include forming, cutting, shearing, punching,

drilling, bending, welding, and riveting. In addition, the minimum average weight of zinc coating shall be 2 ounces per square foot of surface (not sheet), the average to be determined on the basis of three individual tests, no one of which may be less than 1.8 ounces per square foot of surface (not sheet). The aluminum content of the zinc bath during actual galvanizing operations shall not exceed 0.01 percent. Channel rails, splice plates, WF steel posts, and base plates shall be galvanized in accordance with ASTM A 123. Anchor cables shall be galvanized in accordance with Federal Specification RR-W-410, Table II, galvanized at finished size. Bolts, nuts, washers, plates, rods, and other hardware shall be galvanized in accordance with ASTM A 153.

9-16.3(4) HARDWARE

Bolts, unless otherwise specified, shall be made from commercial bolt stock having a tensile strength of not less than 50,000 psi. Washers shall, unless otherwise specified, be malleable iron, or cut from medium steel or wrought iron plate.

9-16.3(5) ANCHORS

All materials shall be in accordance with these Specifications and WSDOT Standard Plan No's. C-6 through C-6e.

Welding shall conform to Section 6-03.3(25).

All welding shall be equal in strength to the parent metal.

All fabrication shall be complete and ready for assembly before galvanizing. No punching, drilling, cutting, or welding will be permitted after galvanizing unless authorized by the Engineer.

The anchor plate assembly and eye bolt for Type 1 anchor shall develop a minimum tensile strength of 40,000 pounds. The eye may be drop forged or formed with a full penetration weld and shall develop 100 percent of the rod strength.

The anchor plate, W8 x 17 and metal plates shall be fabricated of steel conforming to the specifications of ASTM A 36.

Anchor cable for Type 1 anchor shall be 3/4 inch preformed, 6 x 19 wire strand core or independent wire rope core (IWRC), galvanized, right regular lay manufactured of improved plow steel with a minimum breaking strength of 42,800 pounds. Two certified copies of mill test reports of the cable used shall be furnished to the Engineer.

Swaged cable fittings shall develop 100 percent of the specified breaking strength of the cable. One swaged fitting attached to 3 feet of cable shall be furnished to the Engineer for testing.

The swaged fitting and stud assembly shall be of steel conforming to the requirements of American Iron and Steel Institute C-1035 and shall be annealed and galvanized suitable for cold swaging.

Welded wire fabric for Type 1 anchor shall conform to ASTM A 185.

All metal components of the anchor and cable assembly and not less than the top 14 inches of the W8 x 17 for the Type 2 anchor shall be hot-dip galvanized in accordance with Section 9-16.3(3).

Cement concrete, of the class specified, shall conform to the applicable requirements of Section 6-02.

Cement grout shall consist of one part portland cement and two parts sand.

9-16.3(6) INSPECTION AND ACCEPTANCE

The Contractor shall give notice to the Engineer before the rail elements are fabricated in order that inspections may be provided. The Contractor shall arrange for all facilities necessary for the inspection of material and workmanship at the point of fabrication of the rail element, and inspectors shall be allowed free access to necessary parts of the premises.

The Inspector shall have the authority to reject materials or workmanship which do not fulfill the requirements of these Specifications. In cases of dispute, the Contractor may appeal to the Engineer, whose decision will be final.

The Inspector may accept a mill test report certifying that the steel used in fabricating the rail element meets the requirements of the specifications. The State reserves the right, however, to require the Contractor to furnish samples of the steel proposed for use and to determine to its satisfaction that the steel meets the specification requirements. Steel rail elements, fittings, terminal section hardware, and bolts may be accepted by the Engineer based on the Manufacturer's Certification of Compliance.

9-16.4 WIRE MESH SLOPE PROTECTION

9-16.4(1) GENERAL

All metal material used in the construction of wire mesh slope protection shall be new and galvanized. Imperfectly galvanized material or material upon which serious abrasion of galvanizing occurs will not be acceptable.

9-16.4(2) WIRE MESH

The galvanized wire mesh shall consist of No. 9 gage (0.148 inch diameter) commercial quality zinc coated steel wire, 3-1/2 inch x 5-1/2 inch diamond mesh chain link conforming to the requirements of AASHTO M 181. Galvanizing shall conform to the requirements of ASTM A 392 except the weight of zinc coating shall be 0.80 ounce per square foot minimum, of uncoated wire surface. Galvanizing shall be done before weaving.

The wire mesh fabric shall have knuckled selvages.

9-16.4(3) WIRE ROPE

Wire rope shall be 1/2-inch diameter zinc coated steel structural wire rope conforming to the requirements of ASTM A 603, Class B.

9-16.4(4) HARDWARE

All rings shall be drop-forged steel, heat treated after forging. Lightweight wire rope thimbles weighing approximately 13.8 pounds per hundred shall be used with the 1/2-inch diameter wire rope. Wire rope clips may be drop-forged steel or cast steel for use with 1/2-inch wire rope. All rings, thimbles, wire rope clips, and U-bolts shall be galvanized in accordance with AASHTO M 232, Class C, except castings shall be Class A, and forgings shall be Class B.

9-16.4(5) HOG RINGS AND TIE WIRE

Hog ring fasteners and tie wire shall be manufactured of 9 gauge steel wire meeting Federal specification QQ-W-461 (AISI numbers 1010 and 1015) finish 5; medium hardness and tensile strength; Class 3 coating.

9-16.4(6) GROUT

When required, grout for anchors shall consist of one part portland cement and three parts of clean sand. The portland cement shall conform to the requirements of Section 9-01.2(1).

9-16.4(7) ANCHOR RODS

Anchor rods shall be of good quality steel. The eye may be drop forged or formed with a full penetration weld and shall develop 100 percent of the rod strength. The anchor rod shall be galvanized in accordance with ASTM A 153.

9-16.5 VACANT

9-16.6 GLARE SCREEN

9-16.6(1) GENERAL

All material used in the construction of the fence shall be new. Iron or steel material shall be galvanized or aluminum coated as specified. Imperfectly galvanized or aluminum coated material, or material upon which serious abrasions of galvanizing or aluminum coating occur, will not be acceptable.

9-16.6(2) GLARE SCREEN FABRIC

Glare screen fabric shall consist of diamond woven wire mesh. The fabric wire may be 0.148 inch diameter aluminum alloy complying with the Aluminum Association requirements for alloy 6061T94, or it may be 0.148 inch diameter (9 gage) iron or steel wire which shall meet all of the requirements of ASTM A 392 galvanized or A 491 for aluminum coated, except that galvanizing of Type 2 glare screen fabric shall be not less than 0.8 ounce per square foot and shall be done before weaving. Aluminum coating shall be Class II.

Type 1 glare screen mesh size shall be approximately a 1-inch diamond. Type 2 glare screen mesh size shall be a maximum of 3-1/2-inch vertical and 5-1/2-inch horizontal. The design shall permit the slats to be installed in a vertical position as shown in the Standard Plan without distortion of the slats.

9-16.6(3) POSTS

Line posts for Type 1 glare screen shall be 1.5 inches by 1.875 inches hot-dip galvanized steel H column with a minimum weight of 2.8 pounds per linear foot. Line posts for Type 2 glare screen shall be 1.95 inches by 2.25 inches hot-dip galvanized steel H column with a minimum weight of 4.0 pounds per linear foot, or 2-inch inside diameter hot-dip galvanized steel pipe with a nominal weight of 3.65 pounds per linear foot provided only one type shall be used on any one project.

End, corner, brace, and pull posts shall be 2-inch inside diameter hot-dip galvanized steel pipe with nominal weight of 3.65 pounds per linear foot. Intermediate pull posts (braced line posts) shall be H column as specified for line posts. Brace post sleeves shall be 2-1/2-inch inside diameter hot-dip galvanized steel pipe with nominal weight of 5.79 pounds per linear foot.

The base material for the manufacture of steel pipes used for posts shall conform to the requirements of ASTM A 120, except the weight tolerance on tubular posts shall be applied as provided below. The base material for the manufacture of steel H columns shall meet the requirements of ASTM A 663.

Posts provided for glare screen will have an acceptance tolerance on the weight per linear foot, as specified, equal to plus or minus 5 percent for tubular and H-section posts. This tolerance will apply to each individual post.

All posts, braces, and top rails shall be hot-dip galvanized. They shall have a minimum average of 1.8 ounces zinc coating per square foot of surface area with no individual test being below 1.6 ounces zinc coating per square foot of surface area. In the case of members made from pipe, this area is defined as the total area inside and outside. A sample for computing the average of weight of coating is defined as a 12-inch piece cut from each end of the galvanized member.

9-16.6(4) TENSION WIRE

Top and bottom tension wire shall be 7 gage coil spring steel wire of good commercial quality and shall have a zinc coating averaging 0.8 ounces per square foot of surface area.

9-16.6(5) CABLE

The tension cable shall be 1/4-inch diameter aluminum coated or hot-dip galvanized, 7 wire strand steel cable conforming to the requirements of ASTM A 474 for aluminum coated or A 475 for galvanized, High-Strength Grade. Galvanizing shall be Class A.

9-16.6(6) CABLE AND TENSION WIRE ATTACHMENTS

All tension wire and cable attachments shall be hot-dip galvanized steel conforming to the requirements of AASHTO M 232 unless otherwise specified. Eye bolts shall have either a shoulder or a back-up nut on the eye end and be provided with an eye nut where needed or standard hex nut and lock washer and be 5/8-inch diameter for tension cable and 3/8-inch diameter for tension wire and of sufficient length to fasten to the type of posts used. Where the eye bolt is to be installed through a pipe section, two lead washers and one steel washer shall also be provided. Turnbuckles shall be of the shackle end type, 1/2-inch diameter, with standard takeup of 6 inches and provided with 3/8-inch diameter pins. Thimbles shall be light weight wire rope thimbles for use with 1/4-inch diameter cable. Wire rope clips shall have a U-bolt diameter of 5/16 inch for use with 1/4-inch diameter cable. Anchor shackles shall be 3/8-inch diameter with a minimum distance between eyes of 11/16 inch and a pin diameter of 7/16 inch. Seizing shall be 0.032 inch diameter galvanized annealed iron wire.

9-16.6(7) SLATS

9-16.6(7)A WOOD SLATS

Wood slats shall be 3/8 inch by 2-3/8 inch by the height designation of the fence. Material shall be finished and treated cedar or redwood and shall be free from loose knots, cracks, and other imperfections. A dimensional tolerance of plus or minus 1/16 inch in width or thickness is allowed provided that the maximum space between slats does not exceed 3/4 inch.

9-16.6(7)B PLASTIC SLATS

Plastic slats shall be 3/8 inch by 2-3/8 inch by the height designation of the fence. They shall be manufactured from tubular polyethylene color pigmented material consisting of high density virgin polyethylene and color pigments, designed to retard ultraviolet penetration. The material shall have a minimum wall thickness of .0030 inch plus or minus .0003 and shall remain flexible without distortion and without becoming brittle through a temperature range of -70 F to + 250 F. Tensile strength shall be at least 3600 psi and the melt index shall not exceed .25.

Plastic slats shall be retained in place by means of U-shaped retainer members at the bottom and top of the fence. Retainer members shall be of the same material as the slats.

The color for plastic slats will be approved by the Engineer from samples submitted by the Contractor or supplier.

9-16.6(8) FITTINGS

Fittings shall be malleable cast iron or pressed steel and galvanized in accordance with the requirements of AASHTO M 232.

Fittings for any particular fence shall be those furnished by the manufacturer of the fence.

9-16.6(9) FABRIC BANDS AND STRETCHER BARS

Fabric bands shall be 1/8 inch by 1 inch nominal and stretcher bars 3/16 inch by 3/4 inch nominal. Nominal shall be construed to be the area of the cross-section of the shape obtained by multiplying the specified width by thickness. A variation of minus 5 percent from this theoretical area shall be construed as "nominal" size. Both shall be hot-dip galvanized to meet the requirements of ASTM F 626.

9-16.6(10) TIE WIRE

Tie wire shall be 9 gage aluminum wire complying with the ASTM B 211 for alloy 1100-H14 or 9 gage galvanized wire meeting the requirements of AASHTO M 279. Galvanizing shall be Class 1.

9-16.7 ROCK PROTECTION FENCE

9-16.7(1) GENERAL

All steel materials used in the construction of the fence shall be new and galvanized. Post and braces shall be galvanized in accordance with requirements of ASTM A 120. Fittings, attachments, and hardware shall be galvanized in accordance with the requirements of ASTM F 626. Imperfectly galvanized material, or material upon which serious abrasion of galvanizing occurs, will not be acceptable.

9-16.7(2) POSTS

Fence posts for position A shall be 2-inch inside diameter hot-dip galvanized steel pipe with a nominal weight of 3.65 pounds per linear foot. Fence posts and braces for position B and C shall be 3-1/2-inch inside diameter hot-dip galvanized steel pipe with a nominal weight of 9.1 pounds per linear foot. The posts shall have a hot-dip galvanized steel post cap securely mounted on the top or shall be capped with 1/4-inch steel plate welded in place to completely close the top of the post. All cutting, welding, and drilling shall be completed before the post is galvanized.

9-16.7(3) CABLE

Cable shall be 3/8-inch diameter, hot-dip galvanized, 7 strand, high strength grade, steel cable conforming to the requirements of ASTM A 475. Galvanizing shall be Class A.

9-16.7(4) HOOK BOLTS AND OFFSET BLOCKS

Each post for position A shall have a hook bolt for suspending the cable. Each post for position B and C shall have a hook bolt and offset block for suspending the cable at the post. The hook bolts shall conform to the dimension shown in the Standard Plan and be manufactured of 1/2 inch diameter structural grade steel and hot-dip galvanized after bending and threading. Offset blocks shall be to the dimensions shown in WSDOT Standard Plan No. D-8 and manufactured of gray iron casting AASHTO M 105 and shall be hot-dip galvanized after complete fabrication.

9-16.7(5) HOG RING FASTENERS

Hog ring fasteners shall be 9 gage steel wire with galvanizing in conformance with AASHTO M 279, Class 1.

9-16.7(6) SPRING ANCHORAGE ASSEMBLIES

Spring anchorage assemblies shall be constructed at both ends of each run of rock protection fence and at intermediate points if the run exceeds 1,000 feet in length. The anchorage assembly shall consist of anchor, anchor rod, anchor spring, spring holder, turnbuckle, wire rope clips, and wire rope thimble. The Contractor shall have the option of furnishing either cast iron or cement concrete anchors. Concrete anchors may be precast or cast in place. Disc anchors shall be an 18-inch grey iron casting AASHTO M 105. The anchor rod shall be manufactured of 3/4-inch merchant quality hot-rolled carbon steel conforming to ASTM A 575 and shall be hot-dip galvanized after cutting and threading. The anchor spring shall be a helical steel spring meeting the requirements of ASTM A 125. The spring shall have a free length of approximately 9 inches with a 1-1/8-inch pitch and shall develop a minimum compressed strength of 6,000 pounds. The spring holder shall consist of cast iron spring washer, 1-inch thick steel plate, four 3/4-inch bolts, and a 3/4-inch eye and bolt turnbuckle with 8-inch take-up all dimensioned and assembled as shown in the Standard Plans. Wire rope clips shall have a diameter of 7/16 inch for use with 3/8-inch diameter cable. Thimbles shall be light weight wire rope thimbles for use with 3/8-inch diameter cable.

9-16.7(7) CHAIN LINK FENCE FABRIC

Chain link fabric shall consist of 9 gage galvanized steel wire conforming to ASTM A 392. Galvanizing shall be Class I and done after weaving. It shall be woven into approximately 2-inch diamond mesh. The fabric wire shall be furnished in roll widths of 8 feet for position A and 12 feet for positions B & C. The chain link fence fabric shall be finished with a knuckled selvage at the top and bottom.

9-16.7(8) POST ANCHOR RODS FOR POSITIONS B AND C

Post anchor rods for fence positions B and C shall be manufactured of 3/4 inch merchant quality hot-rolled carbon steel conforming to ASTM A 575 and shall be hot-dip galvanized after cutting, forging, bending, and threading. The dimensions shall be as shown in WSDOT Standard Plan No. D-8 except the length of the rod shall be designated by the Engineer for each individual location as dictated by the slope at that location.

9-16.8 WEATHERING STEEL BEAM GUARDRAIL

9-16.8(1) RAIL AND HARDWARE

Steel for rail elements and terminal sections shall conform to ASTM A 606 and A 607. Bolts, nuts, and washers for installation of the weathering steel shall be manufactured from steel conforming to ASTM A 242 and shall not be galvanized. If required, 6 inch channels and fittings shall conform to ASTM A 242. In addition, all steel for the guardrail components shall conform to one of the following chemical compositions, percent (ladle):

Composition	C	Mn	P	S	Si	Cu	Cr	Ni	Zr
No. 1	0.12 Max.	0.20 to 0.50	0.07 to 0.15	0.05 Max.	0.25 to 0.75	0.25 to 0.55	0.30 to 1.25	0.65 Max.	
No. 2	0.12 Max.	0.50 to 1.00	0.12 Max.	0.05 Max.	0.20 to 0.90	0.50 Max.	0.40 to 1.00	1.00 Max.	0.10 Max.

Blast cleaning or pickling to remove mill scale will not be required. All fabricated steel parts shall be handled with care to avoid gouges, scratches, and dents. The steel shall be kept clean of all foreign material, such as paint, grease, oil, chalk marks, crayon marks, concrete spatter, or other deleterious substances. Natural oxidation of the steel will not be considered foreign material. Storage in transit, in open cars and trucks, for an extended period will not be permitted. Steel parts stored outside in yards or at job sites shall be positioned to allow free drainage and air circulation.

9-16.8(2) ANCHORS

Guardrail anchors may either be furnished as provided in Section 9-16.3(5) or they may be nongalvanized and fabricated from steel conforming to ASTM A 242 with the exception that all Type 1 anchors shall have galvanized cable and fittings as specified in Section 9-16.3(5).

SECTION 9-17 GUIDE POSTS

9-17.1 POSTS

U flange posts shall be fabricated from steel meeting the requirements of AASHTO M 183, or from aluminum meeting the requirements of ASTM B 221, Alloy 6061-T6. Posts fabricated from steel having less than the required minimum elongation specified in AASHTO M 183 will be accepted provided the elongation exceeds 10 percent in 8 inches and the posts are capable of being bent to a 45 degree angle around a 6 inch mandrel and then straightened without fracture.

After fabrication, U flange steel posts shall be galvanized in conformance with the requirements of AASHTO M 111.

Flexible guide posts shall conform to applicable details of WSDOT Standard Plan No. H-1 and the Project Manual. Flexible guide posts may be accepted by the Engineer on the basis of a Manufacturer's Certificate of Compliance.

9-17.2 ALUMINUM PLATE

9-17.2(1) SHEET ALUMINUM STOCK

General: The plates shall be fabricated of aluminum alloy conforming to ASTM B 209, grade 6061-T6, or 5052-H36 0.063 inch thick. The physical dimensions including drilled or punched holes shall be according to WSDOT Standard Plan No. H-1. One side of the aluminum for prismatic reflector guide post plates shall be coated with a baked enamel coating. Enamel coating shall not be required for fully reflectorized plates.

Treatment: The sheet shall be degreased and etched for 3 minutes by immersion in a 6 percent to 8 percent dilute phosphoric acid solution (the "Alodine" 1200 application, or equal). The process shall be in strict conformance with the specifications of the manufacturer. The metal shall be handled by device or clean gloves between all cleaning and etching operations and the application of paint priming or reflective sheeting.

Enamel: The enamel shall meet the requirements of Federal Specification TT-E-529, Enamel, Alkyd, Semi-gloss, Class B, Baking. The primer shall be compatible with the enamel. The color of the enamel for Type A guide posts shall be White and for Type B guide posts shall be Interstate Yellow (Federal Standard 595, Color No. 13538).

Enamel Application: A full coat of primer and two or more coats of enamel shall be applied to one side only of the treated plates and baked at the temperature required to develop the full properties of the coating as recommended by the coating manufacturer. The minimum cured film thickness shall be 2.5 mils for the completed system.

Inspection: Mill test certificates will be required on all lots of aluminum sheeting, and manufacturer's certificates will be required on all lots of enamel and primer. Manufacturer's certificates or tests performed by the Materials Laboratory will be required for all reflective sheeting. Further inspection may be required at the option of the Engineer. Acceptance of individual components does not obligate acceptance of the finished product and further inspection may be conducted at the time of use.

9-17.2(2) PRECOATED COIL STOCK

General: The plates shall be fabricated from aluminum coil stock conforming to the requirements of ASTM B 209 as listed under 3000 and 5000 series alloys and with a temper suitable for the required surface treatment. The physical dimensions, including drilled or punched holes, shall be according to WSDOT Standard Plan No. H-1 and 0.063 inch thick.

Surface Preparation: Cleaning and treatment of material for preparing the aluminum surfaces shall be compatible combinations of solvent or alkaline cleaners and chemical conversion or anodic coating materials as specified in ASTM D 1730 with the methods selected being limited to those recommended for use under severe service conditions.

Surface preparation for fully reflectorized plates shall be the "Alodine" 1200 application, or equal, and shall be compatible with the reflective sheeting. The metal shall be handled by device or clean gloves between all cleaning and etching operations and the application of reflective sheeting.

Coating: The prismatic reflector plate coating system shall consist of 0.1 to 0.2 mils of a compatible corrosion inhibiting epoxy primer applied to the prepared surface, followed by 0.6 mil minimum film of high bake enamel meeting Federal Specification TT-E-489 Class B.The cured coating shall have the following properties:

(a) 0.8 mils minimum totalo dry film thickness.
(b) Hardness–"F" pencil minimum.
(c) Flexibility–pass 4T bend at 90 degrees.
(d) Gloss (60 degrees)–90 minimum.
(e) The color of enamel for type A guide posts shall be White and for type B guide posts shall be Interstate Yellow (Federal Standard 595, Color No. 13538).
(f) Free of wax or surface contaminants.
(g) The coating shall show not more than five units loss in gloss and no color change after exposure for 500 hours in the Atlas Twin-Arc Weatherometer.

Fabrication: The plate complete with all holes and to the proper dimension as detailed in the Standard Plans shall be stamped or cut from the coated coil stock. All edges shall be clean and true with no evidence of flaking, chipping, or loss of adhesion of the coating at the cut edges.

Inspection: Mill test certificates will be required on all lots of aluminum coil stock and manufacturer's certificates certifying the quality of the coating and its application. Acceptance of the coated coil stock does not obligate acceptance of the finished product. Failure of the coated stock to permit stamping and cutting will be cause for rejection. Additional tests may be run at the option of the Engineer.

9-17.3 REFLECTORIZATION

Reflectorization of guide post plates shall, at the Contractor's option, be either reflective sheeting applied to an aluminum plate or prismatic reflectors applied according to WSDOT Standard Plan No. H-1, or in the case of flexible guide posts, reflective sheeting shall be applied directly to the face of the post unless otherwise specified in the Project Manual. The reflective sheeting shall meet the requirements of Section 9-28.(4).

Prismatic reflectors shall consist of glass or plastic reflecting elements and shall be resistant to shock and vibration and shall be waterproof when tested in accordance with the requirements of Federal Standard MIL-R-12144.

The reflecting element shall be bonded to the backing so as to preclude the entrance of water, water vapor, or other foreign material between the reflecting element and the backing. Prismatic reflectors shall have the following minimum coefficient of retroreflection values expressed in units of candle power per foot-candle per square foot:

Entrance Angle	Observation Angle: Crystal (White) 1/3°	Crystal (White) 1/6°	Amber 1/3°	Amber 1/6°	Red 1/3°	Red 1/6°
0°	1000	2200	600	1300	250	550
10°	900	2000	540	1200	230	500
20°	600	1300	360	780	150	330

The basis of acceptance of reflective elements will be on Materials Laboratory tests or on certified test reports from the manufacturer, at the option of the Engineer. If reflective elements are to be accepted on the basis of test reports, the Contractor shall provide the Engineer, prior to acceptance, with four copies of certified test reports signed by a responsible representative of the manufacturer. The certified test reports signed by a responsible representative of the manufacturer. The certified test reports shall contain the following information:

(a) Description of the type and quantity of items covered by the test report.
(b) Project for which the material is intended, or name and address of the Contractor to whom the material was delivered, or other suitable description enabling the Engineer to identify positively that the test report covers the material delivered to the particular project.
(c) The test report shall show coefficient of retroflection values at 1/3 degrees and 1/6 degrees observation e pressed in units of candle-power per foot-candle per square foot, at entrance angles of 0 degree, 10 degrees, and 20 degrees.
(d) Minimum coefficient of retroflection values for reflective sheeting at 0.2 degree, 0.5 degree, and 2.0 degrees observation expressed as average candelas per foot candle per square foot of material at entrance angles of 40 degrees and minus 4 degrees for both wet and dry conditions, 85 degrees gloss rating, liner removal after aging, and quality after accelerated weathering.
(e) Certified quality of application of reflective sheeting to the aluminum plate.

It is expressly understood that the furnishing of certified test reports will not relieve the Contractor from the obligation to replace material found to be defective for any reason after delivery to the project, nor will certified test reports prevent the Engineer from sampling material when it arrives on the project and subjecting it to such additional laboratory tests as he may deem appropriate or significant.

9-17.4 HARDWARE

Hardware or fittings shall be aluminum blind rivets.

SECTION 9-18 PRECAST TRAFFIC CURB AND BLOCK TRAFFIC CURB

9-18.1 PRECAST TRAFFIC CURB

9-18.1(1) AGGREGATES AND PROPORTIONING

The cement, fine and coarse aggregate, and reinforcing steel to be used in the manufacture of precast concrete traffic curb shall meet the following requirements:

(a) Aggregates shall conform to the requirements of Section 9-03 except that they shall be uniformly graded up to a maximum size of 3/8 inch and shall contain sufficient fine fractions to permit securing the type of surface finish specified herein. The aggregate shall be approved by the Materials Laboratory before it is used.
(b) Reinforcing steel shall conform to the requirements of Section 9-07.
(c) The cement concrete mix shall be composed of not less than 1 part portland cement to approximately 2 parts of fine aggregate and 3-1/4 parts of coarse aggregate adjusted to secure proper workability. The Contractor will be allowed to use a different concrete mix if approved by the Engineer, provided that it develops not less than 4,000 psi compressive strength when tested at the age of 28 days.

9-18.1(2) MIXING

Mixing concrete shall be done in accordance with Section 6-02.

9-18.1(3) FORMS

Forms shall be of concrete or steel. The use of forms or molds made of plaster of paris, wood, or other absorptive material will not be permitted.

Bulkheads shall be tight fitting so that there is no leakage of mortar between the bulkhead and form.

The materials and methods used for lubricating the forms shall be such that they will not result in discoloration of the curb at any time. A minimum quantity of lubricant shall be used and all excess lubricant shall be removed.

9-18.1(4) PLACING CONCRETE

The concrete shall be consolidated by external vibration, or by other means if approved by the Engineer, to produce a dense concrete throughout, having a minimum of air bubbles and honeycombing.

Reinforcing steel shall be placed and maintained in its proper position as shown in detail drawings.

Curb or buttons shall not be manufactured in an atmospheric temperature of less than 50°F.

9-18.1(5) REMOVAL OF FORMS

The curb shall be removed from the molds or forms in accordance with the instructions or by some other method acceptable to the Engineer.

The loosening of the curb from the molds shall be carefully performed to avoid excessive shock and straining of the curb. When, in the opinion of the Engineer, undue shock is required to remove the curb from the molds, the stripping operation shall be deferred until such time as the curb may be removed without breakage.

9-18.1(6) CURING CONCRETE

Immediately after the concrete has been placed and consolidated in the mold, each unit shall be placed in a curing room fitted with water sprays and maintained at a relative humidity of not less than 90 percent and a temperature of not less than 60 degrees F, nor more than 100 degrees F. Each unit shall remain in the curing room for a period of not less than 10 days, except that if Type III cement is used, the period in the curing room may be reduced to 5 days.

9-18.1(7) FINISH

The curb shall have a smooth, glassy finish on all exposed surfaces.

Excess honeycombing in the back of the curb may be cause for rejection of the curb. Honeycombing areas in the back of the curb which, in the opinion of the Engineer, are not detrimental to the curb need not be patched. The workmanship of the bottom finish shall be such that no mechanical interlocking of the mortar bed and the curb bottom or anchor groove will occur.

9-18.1(8) SURFACE TREATMENT

As soon as the units have been taken out of the curing room and thoroughly surface dried to a depth of at least 1/4 inch, two coats of a water-repellent compound, meeting the requirements of Section 9-18.4, shall be brush applied. When the first coat has dried, the second coat of water- repellent compound shall be applied.

9-18.1(9) DIMENSIONS AND SHAPE

The curb shall conform to the dimensions and shape shown in the Drawings within a tolerance of 1/4 inch in length and 1/8 inch in alignment.

9-18.1(10) CURB LENGTHS

Curb shall be made in pieces not less than 3 feet nor more than 6 feet in length, except in special cases where shorter lengths are specified. Circular curbing shall be made only for such radii as called for in the detail Drawings.

9-18.1(11) DEFECTIVE CURB

Not more than 2 percent of the top area in any one piece of curb shall be defective, and not more than 5 percent of the total length of the top corners of reflecting faces in any one piece of curb shall be broken or rounded. There shall be not more than 30 air holes in any linear foot of curb nor more than 50 in any 3 linear feet of curb. All curb having defects in excess of any of the above will be rejected immediately upon inspection after removal from the forms. However, failure to reject the curb at that time will not ensure its final acceptance. 90 percent of the curb laid shall not have more than 10 percent of the maximum allowable number of defects specified above.

An air hole shall be defined as any hole 1/8 inch or larger in diameter or depth.

All defects within the limits permitted, apparent upon removal of forms, shall be repaired immediately.

The sum of the length of the lines of discoloration caused by a cracked mold in any one piece of curb shall not exceed 50 percent of the length of the curb, and the maximum length of any single line of discoloration shall not exceed 18 inches. 75 percent of the curb laid shall be entirely free from lines of discoloration. The employment of heat to obliterate lines of discoloration will not be permitted. The process used to obliterate lines of discoloration shall be subject to the approval of the Engineer.

The repairing of molds which are chipped or broken shall be done in a manner that the broken or chipped areas will not be apparent on the curb made in those molds.

All curb in which surface checking develops during the first five days after manufacture will be rejected.

Hidden air holes at or immediately below the exposed surface of the curb, in excess of the limits specified that are disclosed by testing the surface by means of a rubber hammer will be cause for rejection of the curb.

All curb in which cracking is in evidence immediately after removal from the molds will be rejected. A crack is defined as any separation of the concrete of a continuous length greater than 3 inches.

All curb which varies in dimensions, alignment, or surface contour in excess of the tolerance specified will be rejected.

Failure to comply with Standard Plan No. 413, Specifications, Drawings, or instructions of the authorized representative of the Engineer in the manufacture and laying of any curb will be cause for rejection of such curb.

9-18.1(12) REPAIRING CURB

Curb having defects which are not sufficient cause for its rejection shall be neatly repaired immediately after removal from the molds in a manner subject to the approval of the Engineer. However, no patching or other repairs shall be made without the permission of the Engineer. Patches shall be undercut if, in the opinion of the Engineer, this operation is necessary to achieve a satisfactory patch.

All holes larger than 1/16-inch diameter in the exposed surface of acceptable curb or buttons shall be filled with cement mortar.

9-18.1(13) IDENTIFICATION MARKING

The date of manufacture, the length, and identification number corresponding to the detail layout shall be marked in black paint on the back or end of each piece of curb.

Rejected curb shall be marked on the back or end surfaces in a practical and semi-permanent manner to identify each cause of rejection.

9-18.1(14) SHIPPING

No unit of curb shall be shipped from the manufacturing plant prior to 21 days after manufacture, except, however, that if Type III cement has been used, the units may be shipped 14 days after manufacture.

9-18.1(15) SAMPLING AND INSPECTION

The Contractor shall submit, for the approval of the Engineer, an advance sample of curb which shall be at least equivalent in color, surface texture, and bottom finish to the standard as set forth in these Specifications. No repairing of any kind shall be done on the advance sample. Upon approval, the advance sample shall be stored at the plant or site of manufacture in a location readily accessible to the Inspector where there is adequate daylight for examination. The advance sample shall be protected from damage and discoloration and shall be used as a standard of comparison for color, surface texture, and bottom finish for all curb manufactured. All curb furnished shall be equivalent in the foregoing respects.

The inspection at the plant will be made just prior to shipment, at which time examination will be made of the alignment, contour, color, cracks, surface damage or discoloration, broken corners or edges, and any other defects which may have developed, and to check the laboratory test reports for strength. However intermediate inspections may be made to determine surface checking and hidden air holes if it is impractical to examine for these defects at the final inspection.

9-18.2 VACANT

9-18.3 BLOCK TRAFFIC CURB

In construction of the block traffic curb, the Contractor shall have the option of using either length block shown in Standard Plan No. 414, provided the same length block is used throughout the entire project.

The curb units shall be made from portland cement and high quality sand and gravel, the proportions of which will be left to the discretion of the producer as long as the unit develops a minimum compressive strength of 1,600 psi at 28 days when tested for end loading.

The proportions of sand, gravel, and cement, the type of forms used, and the method of compacting the concrete in the forms shall all be such that as dense, smooth, and uniform a surface as is practicable for a concrete masonry unit is obtained on the finished curb units. The faces that are to be exposed shall be free from chips, cracks, air holes, honeycomb, or other imperfections except that if not more than 5 percent of the curb units contain slight cracks, small chips not larger than 1/2 inch, or air holes not more than 1/2 inch in diameter or depth, this shall not be deemed grounds for rejection. The units used in any contiguous line of curb shall have approximately the same color and surface characteristics.

9-18.4 WATER-REPELLENT COMPOUND

The water-repellent compound shall be a clear, penetrating type, silicone resin base compound containing no filler or other material which will leave a film on the surface of the masonry after it is applied. It shall be of such consistency that it can be

applied readily by brush or spray to the masonry at atmospheric temperature down to minus 20 degrees F.

The average absorption of three test specimens treated with the water-repellent compound, when tested in accordance with the methods used in the Materials Laboratory, shall not exceed 2 percent after being partially immersed in water for 72 hours immediately after curing.

The average moisture vapor transpiration (breathing) of three test specimens, when tested in accordance with the methods used in the Materials Laboratory, shall be not less than 50 percent at seven days.

The water-repellent compound shall be approved by the Materials Laboratory before it is used.

9-18.5 SODIUM METASILICATE

Sodium metasilicate shall comply with ASTM D 537.

SECTION 9-19 PRESTRESSED CONCRETE GIRDERS

9-19.1 AGGREGATES AND PROPORTIONING

The concrete for prestressed girders shall have the minimum compressive strengths as specified in the Drawings. Aggregates used in the mix shall conform to the requirements of Section 9-03.1 except that the manufacturer may revise the grading of the coarse aggregate provided that the concrete mix design is qualified with the modified gradation.

The Contractor shall submit for approval a proposed mix design for each design strength to be used. Included shall be evidence satisfactory to the Engineer that the proposed mix will meet design requirements. Approval of the mix design will not preclude any requirements for the concrete as placed in the girder.

Water used in mixing the concrete shall conform to the requirements of Section 9-25.1.

Cement shall be Type II or Type III conforming to the requirements of Section 9-01.

Any chemical admixtures that are used shall conform to the provisions of Section 9-23.7.

The total chloride ion (Cl^-) content of the mixed concrete, expressed as a percent by weight of cement, shall not exceed 0.06 percent for prestressed concrete.

9-19.2 REINFORCEMENT

Reinforcement shall meet the requirements of Section 9-07.

SECTION 9-21 PLASTIC TRAFFIC BUTTONS AND LANE MARKERS

9-21.1 PLASTIC TRAFFIC BUTTONS AND LANE MARKER TYPE 1

9-21.1(1) GENERAL

Plastic Traffic Buttons and Lane Marker Type 1 shall be essentially in the form of a single- based spherical segment, composed of thermosetting resins and pigments, and of uniform composition throughout. The color shall be yellow or white to correspond to the delineation line color.

9-21.1(2) PHYSICAL AND CHEMICAL PROPERTIES

The exposed surface shall be free of chips, cracks, mold marks, and other irregularities which interfere with appearance or application. The bottom surface may have molded patterns but shall not show general convexity or concavity in excess of 1/8 inch.

The molding process shall be such that coarse aggregate particles on the curved surface are covered by not less than 1/16 inch of pigmented material.

The plastic traffic buttons and lane marker Type 1 shall meet the following requirements:

LANE MARKER/ TRAFFIC BUTTON (Description)	LANE MARKER TYPE 1	PLASTIC TRAFFIC BUTTON, TYPE 700C
Diameter	3-7/8" to 4-1/8"	4" x 10" ± 1/4"
Weight (pounds)	0.1294 min	1.0 max
State Reflectance	80% min.	70% min.
Impact Resistance (Inches - pounds)	15 min.	15 min.
Planeness of Base: Cancavity (Inches)	0.02 max.	0.125 Max.
Convexity (Inches)	0.05 max.	0.125 max.
Titanium Dioxide (% by weight)	21 min.	—
Resin Content (% by weight)	20 min.	20 min.

Plastic traffic buttons shall be Guidelite Traffic Diverters Model 410 or approved equal.

9-21.1(3) TEST METHODS

Test methods shall be as follows:

(a) **Reflectance:** Reflectance will be measured with a photovolt Reflectance Meter or its equivalent by comparing the buttons to a 75 percent brightness standard.

(b) **Impact Resistance:** Impact resistance will be measured by allowing a 1 pound steel ball to fall 15 inches (free fall) onto the lane marker, supported by but not bonded to a steel base plate.

(c) **Titanium Dioxide Content:** The titanium dioxide content will be determined by ashing representative portions of the lane marker, treating the ash with a boiling $(NH4)_2SO_4$ H_2SO_4 solution, filtering, and measuring the absorbance of the filtrate at about 410 millimicrons. Calibration shall be with known samples using ASTM Designation D 921.

(d) **Resin Content:** Resin content will be determined by ashing and igniting representative portions of the marker.

Additional information on the test methods is available from the Materials Laboratory of the Seattle Engineering Department.

9-21.2 LANE MARKER TYPE 2

The markers shall consist of an acrylic plastic shell filled with a tightly adherent potting compound. The shell shall contain prismatic reflective faces as shown in Standard Plan No. 700 to reflect incident light from opposite directions.

9-21.2(1) PHYSICAL PROPERTIES

The shell shall be molded of methyl methacrylate or acrylonitrile butadiene styrene (ABS).

Filler shall be a potting compound selected for strength, resilience, and adhesion adequate to pass physical requirements as outlined herein.

The outer surface of the shell shall be smooth except for purposes of identification and shall contain methyl methacrylate reflective faces in the color specified. As an option, thin untempered glass may be bonded to the prismatic reflective faces to provide an abrasion resistant surface.

The base of the marker shall be substantially free from gloss or substances that may reduce its bond to adhesive. This shall be done by embedding sand or inert granules on the surface of the potting compound prior to its curing.

The markers shall be fabricated as follows:

Lane Marker (Description)	Lane Marker Tye 2A	Lane Marker Tye 2B
Dimensions of Plastic Shells	4" x 4" x 0.65" or octagonal W/4" across flats	4.7" x 2.3" x 0.52"
Slope of Reflecting Face	20° to 30°	20° to 30°
Area of Each Reflecting Surface	3.0 to 3.25 square inches	1.87 square inches

9-21.2(2) OPTICAL REQUIREMENTS

(a) **Definitions:** Horizontal entrance angle shall mean the angle plane between the direction of incident light and the normal to the leading edge of the marker.

Observation angle shall mean the angle at the reflector between observer's line of sight and direction of the light incident on the reflector.

Specific intensity (S.I.) shall mean candlepower of the returned light at the chosen observation and entrance angles for each foot-candle of illumination at the reflector on a plane perpendicular to the incident light.

(b) **Optical Requirements:** The specific intensity of each crystal reflecting surface at 0.2 degrees observation angle shall be not less than the following when the incident light is parallel to the base of the marker.

Hor. Ent. Angle	S.I.
0°	3.0
20°	1.2

Yellow reflectors shall be not less than 60 percent and red reflectors not less than 25 percent of the above values.

(c) **Optical Testing Procedure:** A random lot of markers will be tested. The markers to be tested shall be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inch.

The photocell width shall be 0.05 inch. It shall be shielded to eliminate stray light. The distance from light source center to the photocell center shall be 0.21 inch. If a test distance of other than 5 feet is used, the source and receiver dimensions and the distance between source and receiver shall be modified in the same proportion as the test distance.

Failure of more than 4 percent of the samples shall be cause for rejection of the lot.

9-21.2(3) STRENGTH REQUIREMENTS

Markers shall support a load of 2,000 pounds as applied in the following manner:

(a) A marker shall be centered over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be 1-inch high with an internal diameter of 3 inches and wall thickness of 1/4 inch. The load shall be slowly applied to the top of the marker through a 1-inch diameter by 1-inch high metal plug centered on the top of the marker.

(b) Failure shall consitute either a breakage or significant deformation of the marker at any load of less than 2,000 pounds.

SECTION 9-22 MONUMENT FRAMES AND COVERS

9-22.1 GENERAL

Monument castings shall be cast iron and as indicated on the Standard Plans.

Castings shall conform to the requirements of ASTM Designation A 48, Class 30 and shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability. Repair of defects by welding, or by the use of "smooth-on" or similar material, will not be permitted. The manufacturer shall certify that the product conforms to the requirements of these specifications.

A bituminous coating meeting the requirements of Section 9-05 shall be applied to all faces.

Monument castings shall be machine finished or ground on seating surfaces to assure non-rocking fit in any position, and interchangeability. There shall be made available at the foundry standard frames and standard covers for use by the Engineer in testing fit and seating.

SECTION 9-23 CONCRETE CURING MATERIALS AND ADMIXTURES

9-23.1 SHEET MATERIALS FOR CURING CONCRETE

Sheet materials for curing concrete shall meet the requirements of AASHTO M 171, Sheet Materials for Curing Concrete, except that only white reflective type shall be used.

9-23.2 CHLORINATED RUBBER TYPE CURING COMPOUNDS

Composition:

Vehicle Ingredients	Type I Clear Lbs./100 Gals.	Type II White Pigmented Regular Lbs./100 Gals.	Type III White Pigmented Heavy Bodied Lbs./100 Gals.
Vehicle Ingredients Chlorinated Paraffin, MIL-C-429, Type II (70% Cl)	67.9	66	63.2
Chlorinated Paraffin, MIL-C-429, Type I (40% Cl)	67.9	66	63.2
Chlorinated Rubber (Note 1)	170.3	165.4	158.3
Ethylene Glycol Monoethyl Ether Acetate MIL-E-7125 (Note 2)	272.8	265.0	253.6
Mineral Spirits, TT-T-291, Type II (Note 2)	272.8	265.0	253.6
Epoxy Resin (Note 3)	2.1	2.0	2.0
Bentone	—	—	5.3
Soya Lecithin	5.4	5.3	5.3
Pigment Ingredients			
Titanium Dioxide, ASTM D 476, Types III or IV	—	100.0	250.0

Note 1. Chlorine percent: 65-68
Viscosity 20% in Toluene, Centipoises at 25° C: 9-14
Specific Gravity: 1.555 to 1.565
Index of Refraction: 1.550 to 1.560

Note 2. A solvent blend may be substituted for the solvents in the formulation provided:
(a) The solvent blend shall have a flash point of 70° F tag open cup, minimum.
(b) The finished curing compound shall conform to the requirements in this Section for "characteristics of finished material" of said compound with the exception that appropriate deviations will be permitted in properties affected by the density of the solvent.
(c) All containers in which modified curing compound is shipped shall be marked "MODIFIED".
(d) A 25 percent concentration of the blended solvent in toluene shall show no haziness or turbidity, and when stored for one week at 77° F shall not corrode the tin plate in a covered tin-coated can.

Note 3. Liquid, color five max. (Gardner), Viscosity 100-160 poises at 25° C, epoxide.

At the discretion of the manufacturer, an anti-settling agent other than the specified soya lecithin may be used to ensure against caking and excessive settling of the pigment in the package. The total amount of anti-settling agent used shall not exceed 6.0 pounds per 100 gallons of the concrete curing compound. There shall be no caking or excessive settling of the pigment in the package that cannot be readily dispersed with a paddle.

Characteristics of Finished Material	Type I	Type II	Type III
Pigment, by weight, percent	—	9.7 min.	21.5 min.
Weight per gallon in pounds at 77° F (Note 4)	8.3 min.	9.1 min.	10.2 min.
Volatiles, by weight, percent	65 max.	58 max.	49.5 max.
Fineness of grind, Hegman	—	5 min.	5 min.
Viscosity at 77° F, K.U.	60 max.	64 max.	65-80
Daylight Reflectance, percent (ASTM C 309)	—	60 min.	75 min.
Drying time, on concrete			
Set to touch, hours at 77° F	2.0 max.	2.0 max.	2.0 max.
Dry through, hours at 77° F	4 max.	4 max.	4 max.
Water retention, grams net loss at 72 hours (Note 5)	2.50 max.	2.50 max.	2.50 max.
Sag Index	—	—	10 min.
I.R. Curve	Match Std.	Match Std.	Match Std.

Note 4. May be affected by use of a solvent blend.
Note 5. Test Method WSDOT 407

Packaging: The compound shall be packaged in new 5 gallon steel containers or clean 55 gallon drums with removable head to permit thorough stirring.

Test: Testing will be performed prior to use by applicable methods from ASTM, Federal Test Method Std. No. 141, or WSDOT Testing Procedures.

9-23.3 TRANSPARENT CURING COMPOUND

The compound, at the time of application, shall be a liquid that is free from suspended matter and sufficiently low in viscosity to result in an even, uniform coating when applied by spraying.

The compound shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from that of the natural concrete at the conclusion of the curing period. The compound shall contain a dye of color strength sufficient to render the film distinctly visible on the concrete for at least 4 hours after application.

The loss of moisture shall not exceed 2 grams per specimen when subjected to the Test for Moisture Retaining Effectiveness of Concrete Curing Compounds. Details of the test method are available from the Materials Laboratory.

9-23.4 VACANT

9-23.5 BURLAP CLOTH

Burlap cloth shall meet the requirements of AASHTO M 182, Class 4.

9-23.6 AIR-ENTRAINING AND CHEMICAL ADMIXTURES

Air-entraining admixture shall meet the requirements of AASHTO M 154.

Chemical admixtures for concrete shall conform to the requirements of AASHTO M 194, Type A, B, or D. Chemical admixtures containing more than 1 percent chloride ion (C1-) by weight shall not be used.

Acceptance for air entraining or chemical admixture will be based on the Manufacturer's Certification of Compliance.

If required by the Engineer, the air-entraining or chemical admixture shall be sampled and tested by the Materials Laboratory before use.

9-23.7 AIR-ENTRAINING AND CHEMICAL ADMIXTURES FOR PRECAST PRESTRESSED CONCRETE

Air-entraining admixture shall meet the requirements of AASHTO M 154

Chemical admixtures shall conform to the requirements of AASHTO M 194, Type A, B, D, or F. Approval of specific admixture products shall be required as a part of the annual approval of prestressed fabricators. Chloride ion content of chemical admixtures shall not exceed one percent by weight.

Acceptance will be on the basis of the Manufacturer's Certification of Compliance.

If required by the Engineer, the air entraining or chemical admixture shall be sampled and tested by the Materials Laboratory before use.

9-23.8 WHITE PIGMENTED CURING COMPOUND RESIN BASE

Resin base curing compound shall conform to the requirements of AASHTO M 148 for Type 2, Class B, white pigmented curing compound, except that the water retention of the liquid membrane-forming compound, when tested as specified in WSDOT Test Method 407, shall restrict the loss of water to not more than 2.50 grams in 72 hours.

9-23.9 CONCRETE MIXES INCORPORATING FLY ASH

Concrete mixes incorporating fly ash may be utilized for all classes of concrete, unless otherwise noted in the Project Manual. Mix proportions will be subject to approval by the Engineer and shall be in compliance with the following conditions:

(a) Fly ash may be used to replace up to 20 percent of portland cement at the rate of 1 1/4 pounds fly ash for each pound of portland cement replaced. In concrete mix designs where a specific cement content is not specified, the fly ash content shall not exceed 25 percent of the total cementitious material. Cementitious material shall be the sum of portland cement plus fly ash.

(b) Cement replacement in concrete mixes specifying a cement content shall be subject to strength confirmation testing and approval of the proposed mix by the Engineer for the following classes of concrete:

Concrete Class A
Concrete Class B when used in bridges, culverts, and retaining walls
Concrete Class AX

For these classes of concrete, the Contractor shall design the concrete mix to meet an average 28 day compressive strength of 1.34 times the minimum ultimate compressive strength shown in Section 6-02.3(2) for concrete Plants with a coefficient of variation of 20 percent.

For concrete Plants with a coefficient of variation other than 20 percent, the required average strength shall be:

$$f'cr = (1/(1 - 1.28\ V)) \times f'c$$

where $f'cr$ = required average 28 day compressive strength
$f'c$ = minimum ultimate compressive strength at 28 days
V = coefficient of variation (CV) expressed as a decimal
i.e. CV = 20% V = 0.20

The required average 28-day compressive strength will be determined from five 6-inch by 12-inch cylinders tested in accordance with WSDOT test methods 801 and 811.

A CV of 20 percent will be assumed unless the concrete supplier can justify a lower value.

To establish a CV for a concrete Plant, a minimum of 30 sets of two cylinder compression test breaks will be required. The cylinders will be 6-inch by 12-inch test specimens and will be made, handled, and stored in accordance with WSDOT test Method 809 (Method 1) and tested in accordance with WSDOT test Methods 801 and 811. Each set of two cylinders will be produced from separate batches of production concrete. The equipment used for the production concrete must be the same as will be used for the proposed class of concrete.

The concrete mix design shall be approved by the Engineer and verified by submission of ingredients and testing of specimens made in accordance with this mix design prior to the use of the project.

(c) Cement replacement may be used without strength confirmation testing of the proposed mix for concrete Class C, Class D, and Class DX and Concrete Class B for applications other than those listed in Item (b).

(d) In making calculations relative to cement factor or allowable water content, the total cementitious material shall be considered to be the weight of portland cement plus the weight of fly ash substituted.

(e) All concrete of the same class within a structure shall contain the same proportion of fly ash.

(f) Acceptance of concrete containing fly ash will be on the same basis as for comparable class of concrete without fly ash.

As an alternative to the use of fly ash and cement as separate components, a blended hydraulic cement may be used. Concrete made with blended hydraulic cement shall

meet the requirements listed. In addition, the origin and percentage of fly ash shall be certified on the cement mill test certificate. The blended hydraulic cement shall comply with ASTM C-595-83 Type 1P(MS).

Fly ash shall conform to the requirements of ASTM C 618 Class F with optional chemical and physical requirements as set forth in Tables 1A and 2A and with a further limitation that the loss of ignition be a maximum of 1.5 percent.

9-23.10 COLORING AGENT

The coloring agent for matching the color of new concrete to the color of adjacent existing concrete shall be dry lamp black, added to the concrete during mixing in an amount not to exceed 1-1/2 pounds per cubic yard of concrete.

Use of liquid concrete coloring agent will be permitted when approved by the Engineer.

SECTION 9-24 PLASTIC WATERSTOP

9-24.1 MATERIAL

The waterstops shall be fabricated from a plastic compound, the basic resin of which shall be polyvinyl chloride. The compound shall contain any additional resins, plasticizers, inhibitors, or other material such that when the material is compounded, it shall meet the performance requirements given in this specification.

Single-pass reworked material of the same composition generated from the fabricator's waterstop production may be used. No reclaimed polyvinyl chloride shall be used.

All waterstops shall be molded or extruded in such a manner that any cross section will be dense, homogeneous, and free from porosity and other imperfections.

The waterstops shall be symmetrical in shape, nominal 4 inches in width, by 3/16 inch thick, and a minimum of four ribs on each side of the bulb. The bulb thickness and diameter shall be as noted in the plans.

9-24.1(1) TESTS OF MATERIAL

The waterstops shall meet all of the physical and other test requirements of this material as defined in the Corps of Engineers Specifications for Polyvinyl Chloride Water Stop CRD-C572, except that the tear resistance of the material shall be not less than 160 pounds per inch. The Contractor shall furnish such sample material as required by the Engineer for the purpose of making tests.

SECTION 9-25 WATER

9-25.1 WATER FOR CONCRETE

Water for use with cement in mortar or concrete shall be reasonably clear and free from oil. It shall not contain chlorides calculated as sodium chloride in excess of 2,500 parts per million, nor sulfates calculated as sodium sulfate in excess of 1,000 parts per million. It shall not contain any impurities in amounts sufficient to cause unsoundness or marked change in time of setting in the cement with which it is mixed, nor a reduction in mortar strength of more than 5 percent compared to the results obtained with distilled water.

The properties enumerated above shall be determined in accordance with AASHTO T 26.

9-25.2 WATER FOR IRRIGATION

Water for irrigation shall not contain dissolved or suspended matter which will be harmful to the plant material on which it is to be used.

SECTION 9-26 EPOXY RESINS

9-26.1 GENERAL

These Specifications cover 2-component epoxy resin systems for bonding plastic concrete or mortar to metal or hardened concrete, or for bonding hardened concrete or other materials to hardened concrete.

Epoxy resins used for patching external concrete shall have a concrete-gray color.

The epoxy resin systems shall be furnished in the type, grade, and class as specified according to the following systems:

(a) **Types:** Three types of systems which are distinguished by the requirement of Section 9-26.1(1) are recognized.
Type I - For use in bonding hardened concrete and other materials to hardened concrete.
Type II - For use in bonding freshly mixed concrete to hardened concrete.
Type III - For use in bonding skid resistant materials to hardened concrete and as a binder in epoxy mortars or epoxy concretes.

(b) **Grades:** Three grades of systems are defined according to their flow characteristics and are distinguished by the viscosity and consistency requirements in Section 9-26.1(1).
Grade 1 - Low viscosity
Grade 2 - Medium viscosity
Grade 3 - Non-sagging consistency

(c) **Classes:** Three classes of systems are defined according to the range of temperatures for which they are suitable. The classes are distinguished by the test temperatures at which the gel times are determined.
Class A - For use below 40° F
Class B - For use between 40° F and 60° F
Class C - For use above 60° F

9-26.1(1) PHYSICAL REQUIREMENTS OF EPOXY RESIN SYSTEMS

All testing shall be in accordance with ASTM C 881 unless otherwise stated.

TYPE	I	II	III
Viscosity, Poise (Pa-s):			
Grade 1, max.	20(2.0)	20(2.0)	20(2.0)
Grade 2, min.	20(2.0)	20(2.0)	20(2.0)
max.	100(10.0)	100(10.0)	100(10.0)
Consistency, in (mm)			
Grade 3, max.	1/4(6.4)	1/4(6.4)	1/4(6.4)
Gel time, Minutes, min.	30	30	30
Bond strength, psi, hardened concrete to hardened concrete, 7 day cure compressive shear WSDOT test method 404	600	600	600
Bond strength, psi, plastic concrete to hardened concrete, 7 day cure Diagonal shear test WSDOT test method 405	1,000	1,000	1,000
Volatile content, cured system max., %	3	3	–
Absorption, 24h, max., %	1.5	1.5	1.5

9-26.1(2) AGGREGATE

Aggregate for epoxy mortar or concrete shall be clean, surface dry and inert (will not affect cure rate or physical properties of the epoxy resin system), and shall be of a quality and gradation suitable for portland cement mortar or concrete. Sand meeting the requirements of Section 9-03.1(2) will be satisfactory.

9-26.1(3) SAMPLING

A representative sample of each component (one pint of each) shall be taken either from a well-blended bulk lot prior to packaging or by withdrawing thief samples from no less than 5 percent of the containers comprising the lot or shipment. Instead of the foregoing, packaged materials may be sampled by a random selection of containers of each component from each lot.

9-26.1(4) REJECTION

Except as noted otherwise, the entire lot of both components may be rejected if samples submitted for test fail to meet any requirements of this specification.

9-26.1(5) PACKAGING AND MARKING

9-26.1(5)A PACKAGING

The two components of the epoxy resin system furnished under these Specifications shall be supplied in separate containers which are nonreactive with the materials contained. The contents of each container shall be such that the recommended proportions of the final mixture can be obtained by combining one container of one component with one container of the other component.

9-26.1(5)B MARKING

Containers shall be identified as "Component A–contains Epoxy Resin" and "Component B–contains Curing Agent" and shall show the type, grade, class, and mixing directions as defined by these Specifications. Each container shall be marked with the name of the manufacturer, the lot or batch number, the date of packaging, and the quantity contained in pounds and gallons.

Potential hazards shall be so stated on the package in accordance with the Federal Hazardous Products Labeling Act and State of Washington, Department of Labor and Industries Regulations for Shipment of Hazardous Products.

9-26.1(6) CERTIFICATION

If requested by the Engineer, the manufacturer of the epoxy resin system shall certify that components A and B meet the requirements of this specification before a sample will be accepted for testing by the Owner. Such certification shall consist of either a copy of the manufacturer's test report or a statement of the manufacturer, accompanied by a copy of the test results, that components A and B have been sampled and tested. Such certifications shall indicate the date of testing and shall be signed by an authorized agent of the formulator or manufacturer.

9-26.1(7) ACCEPTANCE

Acceptance of a batch lot or shipment of the material for use on the project shall be on the basis of laboratory tests of samples, as specified in Section 9-26.1(3) representing the particular batch or shipment of materials supplied. These tests will be performed at the Materials Laboratory. A period of 10 days should be allowed for testing, following receipt of samples in the laboratory.

9-26.2 ADHESIVE FOR LANE MARKERS

9-26.2(1) DESCRIPTION

The adhesive shall be furnished as two components, each packaged separately. The components shall have the following composition:

	Parts by Weight
Package A	
Epoxy Resin	100.0
Titanium Dioxide	7.31
Resin Grade Asbestos	5.00
Talc	37.64
Package B	
N-Aminoethyl Piperazine	23.16
Nonylphenol	52.00
Carbon Black	0.22
Talc	77.37
Resin Grade Absestos	1.00

At the time of use, the contents of packages A and B shall be thoroughly dispersed by mixing. One volume or weight of Package A shall be mixed with one volume or weight of Package B until a uniform gray color is achieved. The maximum acceptable variation in mix ratio shall be five from the 50/50 ratio (45A to 55B or 55A to 45B). The mix ratio shall be determined by analysis for Nitrogen percentage in the mixed and cured adhesive.

9-26.2(2) RAW MATERIALS

Raw materials for the adhesive shall meet the following specifications:

(a) Epoxy Resin—Viscosity, 5-7 poises at 25 degrees C.; epoxide equivalent 175-205; color (Gardner) 5 maximum; manufactured from epichlorohydrin and bisphenol A. The reactive diluent shall be butyl glycidal ether.

(b) Titanium Dioxide–ASTM D 476 Type III or IV.

(c) Resin grade Asbestos–Density, grams per milliliter 2.45; moisture content, percent by weight, 2.0 maximum; surface area, square meters per gram–60 approximately; reflectance, G.E. brightness, 72-76; nature of surface change, electropositive (cationic); pH in water, 9.5; bulking value, gallons per 100 pounds, 4.8; oil absorption (DOP) pounds per 100 pounds, 120; refractive index nd 25 degrees C., 1.54 - 1.56; wet bulk density in water, after dispension, 2 grams per liter, settling after 1 hour, 100 ml clean maximum; dry bulk density, pounds per cubic foot, 4.

(d) Talc—Percent passing U.S. No. 325 sieve, 94-96; maximum particle size, 70 microns; oil absorption (Gardiner-Coleman), 6-7 ml per 20 grams; fineness in oil (Hegman) 1-2; specific surface, 0.5 - 0.6 square meter per gram; consistency (40 percent suspension in linseed oil), 55-60 K.U.

(e) N–Aminoethyl Piperazine—COLOR (APHA) 50 maximum; amine value, 1250-1350 based on titration which reacts with 3 nitrogens in the molecule; appearance, clear and substantially free of suspended matter.

(f) Nonyl Phenol—Color (APHA) 50 maximum; hydroxyl number, 245-255; distillation range, degrees C at 760 mm, first drop 295 minimum, 5 percent 298 minimum, 95 percent 325 maximum; water, percent (K.F.) 0.05 maximum.

(g) Carbon Black–TT-P-343, Form I, Class B.

9-26.2(3) PHYSICAL REQUIREMENTS OF MIXED ADHESIVE

Mixed adhesive shall be a blend of 1 part of component A and 1 part of component B, as specified in Section 9-26.2(1), and shall meet the following properties:

Gel time (100 gm Batch)	5-30 minutes
Tensile strength 1/16 in film between steel blocks cured 24 hours at 70° F	
Tested at 70° F	1,000 psi (Min.)
Shore D Hardness Tested at 70° F	70-80 (Cured 24 hours at 70° F)
Tested at 120° F	(Min.) 30
Deformation Temp.	(Min.) 120° F

9-26.2(4) ACCEPTANCE

Adhesive for lane markers may be accepted by the Engineer based on the Manufacturer's Certificate of Compliance. The manufacturer shall certify that each batch of adhesive conforms to these Specification.

The lot or batch number shall appear on the certificates, on all samples, and on all lots of adhesives delivered. A one pint sample of the A and B components shall be sent to the Materials Laboratory by the supplier not less than 10 days before using.

SECTION 9-27 CRIBBING

9-27.1 PLAIN METAL CRIBBING

9-27.1(1) GENERAL

Metal cribbing shall be galvanized metal members and fittings which are designed, formed and patterned to be field-assembled into a continuous closed faced wall of connected bins. The designs, shapes, and patterns of the various members and their assembly shall be in accordance with the details shown in WSDOT Standard Plan No's. D-5 and D-5a.

9-27.1(2) BASE METAL AND SPELTER COATING

The galvanized sheets used in fabricating the several members shall conform to the requirements of the current specifications for Corrugated Metal Culvert Pipe, AASHTO M 36. Bolts, nuts and miscellaneous hardware shall be galvanized in accordance with the requirements of AASHTO M 232.

9-27.1(3) GAGE

The various members of the wall shall be of the gage designated in WSDOT Standard Plan No's. D-5 and D-5a for the type of metal cribbing to be constructed.

9-27.1(4) FABRICATION

All members shall be so fabricated that members of the same nominal size and gage shall be fully interchangeable.

No drilling, punching, or drifting to correct defects in manufacture shall be permitted. Any members having holes improperly punched shall be replaced.

9-27.2 VACANT

9-27.3 GABION CRIBBING

9-27.3(1) WIRE

Wire used in the construction of the gabion baskets may either be carbon or cold drawn steel. Carbon steel wire shall meet the requirements of ASTM A510, Grade Numbers 1010 or 1015. Cold drawn steel wire fabric shall meet the requirements of AASHTO M55.

Wire shall be galvanized in accordance with ASTM A641 with a Class 3 Coating and Medium Temper. For galvanized baskets, wire used in the body of the mesh shall not be thinner than 11 gage, selvedge wire shall not be less than 10 gage and lacing and tie wire shall be 13 gage.

When PVC coated gabion baskets are specified, wire used in the body of the mesh shall not be less than 12 gage, selvedge wire shall not be less than 10 gage and lacing and tie wire shall be 13 gage.

Diaphragms shall be made of the same mesh and gage and shall be coated the same as the body of the basket.

9-27.3(2) CLIP FASTENERS

Clip fasteners may be the locking spring steel type, clamp-on type or other type that provides a positive lock and conforms to the following specifications.

For galvanized baskets, either galvanized steel or stainless steel clips may be used. The clips shall be capable of sustaining a load of 600 pounds within the opening when tested in tension along the longest axis of the clip. The hardness of the steel shall be such that the clips can be moved 1/4 inch without permanent deformation. Galvanizing on the steel clips shall be a minimum of 0.80 ounces per square foot. The stainless steel clips shall be 10 gage 431 stainless steel.

For PVC coated baskets, clips shall be 10 gage 431 stainless steel.

9-27.3(3) STONE

Stone for filling gabions shall have a Degradation Factor of at least 30. The stone shall be dense enough to pass the unit-weight test described in Section 6-09.3(6)F. Stone shall meet the following requirements for gradation:

Passing 8" square sieve	100%
Passing 6" square sieve	75 - 90%
Passing 4: square sieve	0 - 10%
Fracture	75%

All percentages are by weight.

9-27.3(4) MESH OPENINGS

Openings of the mesh shall be approximately 4 inches in the longest dimension.

9-27.3(5) NONRAVELING CONSTRUCTION

The wire mesh shall be fabricated to be nonraveling. This is defined as the ability to resist pulling apart at any of the connections forming the mesh when a single strand in a section of mesh is cut.

SECTION 9-28 SIGNING MATERIALS AND FABRICATION

9-28.1 SIGNS

9-28.1(1) GENERAL

Signs to be mounted on wood utility poles (other than City Light) and signs installed overhead shall be High Density Overlay plywood. Other signs shall be either High Density Overlay plywood or sheet aluminum.

Parking and pedestrian control signs may be nonreflectorized. All other traffic signs shall be reflectorized.

STOP and YIELD sign backs and edges shall be painted with one coat of red enamel to match the red on the sign face.

Regulatory and warning signs shall have rounded corners with the exception of STOP signs. All other signs shall have square cut corners. Borders for signs having square cut corners shall have a corner radius approximately 1/8 of the lesser side dimension of the sign up to a maximum radius of 12 inches. For signs with rounded corners, the borders shall be concentric with the rounded corners.

9-28.1(2) PLYWOOD

Plywood signs shall be constructed of High Density Overlay plywood, meeting the requirements of "Products Standard PS 1-83 for Softwood Plywood, Construction and Industrial" published by the Product Standards Section of the U.S. Department of Commerce. The plywood shall be free of contaminants which would adversely affect the application or life of the sheeting to be applied. Face veneers shall be Grade B or better.

Core and crossband veneers shall be solid. Core veneers shall be jointed, and core gaps shall not exceed 1/8 inch in width. The entire area of each contacting veneer surface shall be bonded with a waterproof adhesive that meets the requirements of the U.S. Department of Commerce for exterior type plywood.

The overlay shall be of the high density type. It shall have a minimum weight of 60 pounds per thousand square feet of surface and shall be at least 0.012 inches thick before pressing. The overlay shall have a sufficient resin content to bond itself to the plywood, with a minimum resin content of 45 percent based on the dry weight of the impregnated fiber.

Thickness-Single Panel Plywood Signs:

Up to 18 inches inclusive in width	3/8 inch
Over 18 inches to 36 inches inclusive in width	5/8 inch
Over 36 inches in width	3/4 inch
Overhead signs	3/4 inch

Street designation signs and signs mounted on span wires or mast arms shall have the sign back and edges primed with 1 coat of white exterior enamel undercoat and finished with 1 coat of International Green (Forest Green) exterior enamel. All other plywood signs shall have just the edges primed with 1 coat of white exterior enamel undercoat and finished with 1 coat of white exterior enamel. The primer shall be as recommended by the supplier of the finish coat. The finish enamel shall meet the requirements of Federal Specification TT-E-489.

9-28.1(3) SHEET ALUMINUM

Sheet aluminum signs shall be constructed of alloy 6061-T6.

After the sheeting has been fabricated, the sheeting shall be degreased and etched by immersion for a minimum of 5 minutes in a 6 ounce per gallon caustic etch solution at 120 degrees F, followed, in order, by a water rinse, de-oxidation, water rinse, hot water rinse, and drying. The etching process shall produce a dull aluminum finish on both sides of the panel which will last the life of the sign. The treated panel surface shall be compatible with the sign face sheeting to be applied. Reflectorized aluminum signs shall be comprised of panels 4 feet or less in width. The Contractor shall use the widest panels possible. Parts necessary for assembly shall be constructed of aluminum. Sheet aluminum thickness shall be 0.080 inch.

Metal shall be handled by device or clean canvas gloves between cleaning and etching operations and the application of sign face sheeting.

9-28.1(4) REFLECTIVE SIGN FACE SHEETING

Reflective sheeting shall consist of spherical lens elements either embedded within a transparent plastic or adhered to a synthetic resin and encapsulated by a transparent plastic. The sheeting shall have a flat, smooth outer surface, be weather resistant, and have a pre-coated adhesive backing with a protective liner.

The sheeting shall have the following minimum brightness values expressed as average candle power per foot candle per square foot of material. Measurements shall be conducted in accordance with standard testing procedures for reflex-reflectors in Federal Specification L-S-300.

(a) With Embedded Lens Elements:

	Silver White #1			Silver-White #2			Yellow		
Div. Ang.	0.2°	0.5°	1.5°	0.2°	0.5°	1.5°	0.2°	0.5°	1.5°
Inc. Ang.									
-4°	70.0	30.0	4.0	80.0	41.0	4.0	50.0	25.0	5.0
40°	14.5	8.5	1.5	16.5	9.5	2.0	11.5	7.0	1.5
	Red			Blue			Green		
Inc. Ang.									
-4°	14.5	7.5	1.0	4.0	2.0	0.6	9.0	4.5	1.0
40°	3.0	1.5	0.3	0.9	0.4	0.08	1.8	1.5	0.2
	Orange			Brown					
Inc. Ang.									
-4°	25.0	13.5	1.5	1.0	0.35	0.1			
40°	1.0	0.8	0.1	0.2	0.1	0.01			

(b) With Encapsulated Lens Elements:

	Silver White			Yellow		
Div. Ang.	0.2°	0.5°	1.5°	0.2°	0.5°	1.5°
Inc. Ang.						
-4°	250.0	95.0	4.0	170.0	62.0	3.0
40°	120.0	54.0	2.0	80.0	35.0	1.5
	Orange			Green		
-4°	70.0	25.0	1.1	30.0	12.0	0.5
40°	33.0	14.0	0.5	14.0	6.8	0.2
	Red					
-4°	35.0	13.0	0.7			
40°	16.0	7.4	0.3			

The brightness of the reflective sheeting, totally wet by rain, shall be not less than 90 percent of the above values. Wet performance measurements shall be conducted in conformance with the Standard Rainfall Test specified in Federal Specification L-S-300.

The diffuse day color of the reflective sheeting shall be visually evaluated by comparison with the applicable Highway Color Tolerance Chart. Color comparisons shall be made under north daylight or a scientific daylight having a color temperature of from 6500 degrees to 7500 degrees Kelvin. Color shall be illuminated at 90 degrees and viewed at 45 degrees.

The sheeting surface shall be smooth and facilitate cleaning and wet performance and exhibit 85 degree glossmeter rating of not less than 50 (ASTM D 523). The sheeting surface shall be readily processed and compatible with transparent and opaque process colors and show no loss of the color coat with normal handling, cutting, and application. The sheeting shall permit cutting and color processing at temperatures of 60-100 degrees F. and 20-80 percent relative humidity.

The sheeting surface shall be solvent resistant such that it may be cleaned with gasoline, VM&P Naptha, mineral spirits, turpentine, methanol, or xylol.

The embedded lens sheeting, when applied according to manufacturer's recommendations to cleaned and etched 0.020-inch x 2-inch x 8-inch aluminum, conditioned 24 hours, and tested at 72 degrees F. and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when bent around a 3/4-inch diameter mandrel.

Conditioned for 48 hours, the tensile strength of the embedded lens sheeting shall be 5 to 20 pounds per inch width when tested in accordance with ASTM Designation D 828. Following liner removal, the sheeting shall not shrink more than 1/32-inch in 10 minutes nor more than 1/8-inch in 24 hours in any dimension per 9-inch square at 75 degrees F. and 50 percent relative humidity.

The encapsulated lens sheeting, with liner removed, conditioned for 24 hours at 72 degrees F. and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when bent around a 1/8-inch diameter mandrel with adhesive side contacting the mandrel.

The protective liner attached to the adhesive shall be easily removable by peeling without soaking in water or other solvents.

The pre-coated adhesive backing shall be a tack free heat activated type or a pressure sensitive type, either of which shall adhere to the sheeting without the necessity of additional coats of adhesive.

The adhesive shall form a durable bond to smooth corrosion and weather-resistant surfaces and permit the reflective sheeting to adhere securely 48 hours after application at temperatures of 30 degrees F. to 200 degrees F. The adhesive bond shall be sufficient to render the applied sheeting vandal-resistant and prevent its shocking off when jabbed with a spatula at 10 degrees F. The sheeting shall resist peeling from the application surface when a 5-pounds per inch width force is applied as outlined in ASTM Designation D 903.

9-28.1(5) NON-REFLECTIVE SIGN FACE SHEETING

The non-reflective sheeting shall consist of a white plastic film having a smooth, flat outer surface. The sheeting shall be weather-resistant and have a protected pre-coated adhesive backing.

9-28.1(6) SHEETING APPLICATION

Plywood sign faces shall be cleaned with lacquer thinner, heptane, benzene, or solvent recommended by the sheeting manufacturer. The surface shall be sanded with light sandpaper or steel wool and wiped dry and clean with clean cloth. Aluminum sign faces shall be cleaned with a solvent recommended by the sheeting manufacturer.

Sign face sheeting shall be applied by a vacuum applicator recommended by the sheeting manufacturer, or by a continuous roll applicator.

Heat-activated adhesive backed sheeting shall be applied by the vacuum method. The adhesive on the back of the sheeting shall be activated by a minimum temperature of 185 degrees F. and with a minimum vacuum pressure of 25 inches of mercury. This operation shall be in effect for a minimum of 3 minutes on plywood and 5 minutes on metal. After aging for 48 hours at 75 degrees F., the adhesive shall form a bond equal to or greater than the strength of the sheeting.

Pressure sensitive adhesive backed sheeting shall be applied by a continuous roll applicator. The process shall be in conformance with the recommendation of the sheeting manufacturer.

Edges and splices of sign face sheeting shall be coated with an edge sealer recommended by the sheeting manufacturer.

9-28.1(7) LETTERS, ARROWS, AND SYMBOLS

Letters, arrows, and symbols shall be of the type, size, and color specified on the Drawings, Specifications, and the "Standard Highway Signs" by United States Department of Transportation.

Letters, arrows, and symbols shall be of material compatible with the sign surface material, as recommended by the sign surface manufacturer or approved by the Engineer.

9-28.1(8) HARDWARE

Bolts, nuts, and washers shall be of the same material for each attachment. All parts necessary for assembly shall be constructed of the materials listed below:

Hardware	Specification
Bolts	ASTM B 209 2024-T4 Aluminum ASTM A 307 Steel ASTM F 593 Stainless Steel
Washers	ASTM B 209 2024-T4 Aluminum AASHTO M 183 Steel ASTM A 240 Stainless Steel
Nuts	ASTM B 209 6061-T6 Aluminum ASTM A 307 Steel ASTM F 594 Stainless Steel
Locknuts	ASTM B 211 2017-T4 Aluminum ASTM A 307 Steel ASTM F 594 Stainless Steel
Rivets	ASTM B 209 6061-T6 Aluminum ASTM B 316 6053-T61 Aluminum
Post Clips	ASTM B 179 356-T6 Aluminum
Wind Beams	ASTM B 209 6061-T6 Aluminum
Angle and Z-Bar	ASTM B 209 6061-T6 Aluminum AASHTO M 183 Steel
Strap and Mounting Bracket	ASTM A 276 Stainless Steel

All steel parts shall be galvanized per ASTM A 123. Steel bolts and related hardware shall be galvanized per ASTM 153.

9-28.2 POSTS

9-28.2(1) WOOD SIGN POST

Wood sign post shall be Standard Grade Western Cedar. The top of each sign post shall be chamfered at approximately 45 degrees. STOP and YIELD sign posts shall be painted with 2 coats of white primer. The first coat shall be quick dry alkyd white primer, meeting the requirements of Federal Specification TT-P-636. The second coat shall be reinforcing white primer, semigloss oil base, meeting the requirements of Federal Specification TT-P-102, Class A. They shall also have alternating 6-inch red and white paint stripes of sash and trim type exterior enamel, as indicated on Standard Plan No. 625 for Wood Traffic Sign Posts.

9-28.2(2) DIRECT BURIAL METER POST

Direct burial meter post shall be fabricated from standard black 2-inch inside diameter pipe or standard Schedule 40 galvanized pipe, 50 inches in length, and with 3 inches on one end flattened. Direct burial meter post shall be primed with rust inhibitive paint and painted with 2 coats of aluminum, yellow or green paint, according to the time limit usage designated by the Engineer.

9-28.2(3) METER POST FOR PARKING SIGN

Meter post shall be fabricated from standard black 2-inch inside diameter pipe or standard Schedule 40 galvanized pipe, 40 inches in length, and 5/16-inch x 5-inch x 5-inch steel base plate. Meter post shall be primed with rust inhibitive paint and painted with 2 coats of aluminum paint.

A parking meter base canopy shall be provided with all meter posts. Where a meter post is used as a sign post with no parking meter, a parking meter wood final shall be provided. The wood final shall be finished with 1 coat exterior enamel undercoat and a final coat of aluminum exterior enamel.

9-28.2(4) STREET NAME SIGN POST

Street name sign post shall be 2-1/2 inches x 10 feet 6 inches standard gauge galvanized pipe, with a 6 inch end section flattened to form a wedge.

9-28.3 SIGN COVERING

Sign covering shall consist of 4 mil minimum thickness black polyethylene sheeting.

SECTION 9-29 PAVEMENT MARKING

9-29.1 GENERAL

Materials for pavement markings shall be paint or plastic material as specified on the Drawings or in the Project Manual.

9-29.2 PAINT

9-29.2(1) GENERAL

Paint shall comply with specifications for no heat, instant dry pavement marking. White sharp sand shall comply with specifications for E-16 sand.

9-29.2(2) PHYSICAL PROPERTIES OF THE COATING

(a) Viscosity (in Krebs Units).
  (1) At 70 degrees F. - 70-75 KU
  (2) At 50 degrees F. - 86 KU max.
  (3) At 122 degrees F. - 66 KU min.
(b) Weight per gallon at 70 degrees F.
  White 12.00 pounds min.
  Yellow 12.10 pounds min.
(c) Contract ratio at spread rate of 320 sq. ft. per gallon.
  White .92 min.
  Yellow .92 min.
(d) Daylight reflectance (at 10 mils wet film thickness).
  White 86 min.
  Yellow 64 min.
(e) Non-volatile content (total at 212 degree F.) - 65%-68%.
(f) Pigment content of total weight - 53% max.
(g) Dispersion, Hegman standard gauge - 2 min.
(h) Flexibility - Pass 1/2 in. mandrel bend.
(i) Dry to no-pick-up (beaded) - 15-35 sec.
(j) Bleeding over asphalt - 90% min.
(k) The material shall not show evidence of heavy caking or settling which requires mechanical means to return the produce to usable condition for a period of one year from the date of manufacture or date first shipped to the Owner.
(l) Color - The paint shall match a standard color sample which may be obtained upon application to the Materials Engineer at the Materials Laboratory.

9-29.2(3) TEST METHODS

The properties enumerated in these specifications shall be determined in accordance with the following methods of test:

(a) Viscosity - Federal test method standard 141A, Method #4281.
(b) Weight per gallon - Federal test method standard 141A, Method #4184.1.
(c) Contrast ratio - Federal test method standard 141A, Method #4121 procedure "B", method "B".
(d) Daylight reflectance - Federal test method standard 141A, Method #6121 using standards as prescribed in Par. 1.3.2.
(e) Non-volatile content - Federal test method standard 141A, Method #4021.1.
(f) Pigment content - Federal test method standard 141A, Method #4021.1.
(g) Dispersion - Federal test method standard 141A, Method #4411.1.
(h) Flexibility - The paint shall show no cracking, flaking, or loss of adhesion when tested in the following manner:
  Apply a wet film thickness of .005 inches with a film applicator to a 3 x 5 tin panel weighing 0.39 to 0.51 lbs. per square foot previously cleaned with benzene and lightly buffed with steel wool. Dry the paint film at 70 - 80 degrees F. in a horizontal position for 18 hours, then bake in an oven 3 hours at 212°± 4 degree F. Cool to room temperature for at lease 1/2 hour and bend over a 1/2 inch diameter rod and examine.
(i) Dry to no-pick-up - The reflectorized line, when applied at a rate of 10 mils wet film thickness and 4 pounds of glass spheres per gallon of paint, shall dry to no-pick-up in 15-35 seconds. For test purposes, the line shall be applied using a striper with accurate thickness control capable of maintaining a uniform thickness with 4 pounds of glass spheres per gallon either dropped or blown onto the stripe. The line shall be dry to no-pick-up within specified time range when the pavement temperature is 55 degree F. or more and the relative humidity is 50 percent or less, providing that the pavement is dry. Dry to no-pick-up tests will be performed by having a standard size sedan or equivalent test vehicle, coast across the paint stripe (no turning or accelerating). A successful no-pick-up test will be considered one in which at least 3 out of 4 samples show no visible paint from the stripe being tracked onto the adjacent pavement when viewed standing 50 feet from the point where the test vehicle crosses the stripe. All paint samples shall have successfully completed all lab tests prior to the no-pick-up test being performed. All field testing shall be performed blind in that the persons conducting the field test shall have no knowledge of which sample is from which manufacturer. All testing shall be performed without the manufacturer's representatives present. Each manufacturer will be provided test results for their sample(s) upon request.
(j) Bleeding over asphalt - ASTM D969 using substrate as in Par. 3.2 except reflectance measurement over asphalt paper area is compared to reflectance measurement over taped area.
  Reflectance over asphalt paper area X 100 = % Bleeding
  Reflectance over taped area over asphalt

9-29.2(4) COMPOSITIONAL REQUIREMENTS

(a) **Pigment Composition:** Pigments shall be first quality point grade pigments. Medium chrome yellow for the yellow traffic paint shall meet the requirements of ASTM D 211-67, Type III. The Titanium Dioxide for the white traffic paint shall meet the requirements of ASTM D 476-73 Type II, III or IV. The inert or filler pigments must be

of a type and quality generally recognized as first quality paint grade produces and shall not contribute to settling of the paint on storage or be so hard as to cause excessive wear of the spray application equipment.

(b) **Vehicle or Resinous Binder Composition**: The vehicle may be any combination of natural or synthetic resinous materials. Chlorinated rubber combined with other natural and/or synthetic resins and plasticizers is the preferred system. All resins used must be permanently capable of re-dissolving in the solvent combination used in the paint. Therefore, resins which dry by the process of oxidation and/or polymerization such as alkyd resins are specifically excluded as suitable resinous binders in this specification. The purpose of the above requirement is to minimize build-up of the paint on the sides of tanks, paint lines, and clogging of spray equipment from undissolvable skins.

9-29.3 THERMOPLASTIC

One of the following types of thermoplastic pavement marking material Types "A" or "B" shall be used at the Contractor's option and in compliance with the manufacturer's recommendations:

Type "A": Hot-laid, liquid thermoplastic material, containing reflective glass bead (with additional glass beads applied separately), 120 mil (3.0 millimeters) or greater thickness. The approved thermoplastic material suppliers are as follows:

(a) Lafrentz brand, 125 mil thickness, hot extruded thermoplastic manufactured by Lafrentz Road Services Ltd., Edmonton, Alberta, Canada T6E4N7, or

(b) Catatherm ABITOL formulation, 125-mil thickness, hot extruded thermoplastic manufactured by Ferro Corporation, Cataphote Division, P.O. Box 2369, Jackson, Mississippi 39205, or

(c) M.L.E. Code #R200/80 formulation, 125-mil thickness, hot extruded thermoplastic manufactured by M.L.E. Industries Ltd., Calgary, Alberta, Canada T2C1N6, or

(d) Pave-Mark SD formulation, 125-mil thickness, hot extruded thermoplastic manufactured by Pave-Mark Corporation, Smyrna, Georgia 30081.

Type "B": Cold-laid, prefabricated glass bead reflective thermoplastic ribbon, 60 mil (1.5 millimeters) or greater thickness.

The approved thermoplastic material suppliers are as follows:

(a) Prismo brand thermoplastic pavement marking material, 60 mil thickness (HT60), coated with pressure sensitive adhesive, manufactured by Prismo Universal Corporation, 300 Lanidex Plaza, Parisippany, N.J. 07054, or

(b) Prismo brand thermoplastic pavement marking material, 90 mil thickness (HT90), coated with pressure sensitive adhesive, manufactured by Prismo Universal Corporation, 300 Lanidex Plaza, Parsippany, N.J. 07054, or

(c) 3M, Stamark brand pliant polymer pavement marking film, 60-mil thickness, coated with pressure-sensitive adhesive, manufactured by 3M Company, 3M Center, St. Paul, Minnesota 55101.

The glass beads shall comply with specifications for Type II waterproof overlay glass spheres.

The skid resistance of the material when installed on the roadway shall be not less than 40 BPN when tested with a British Portable Tester in accordance with ASTM E 303.

Primer, if required, shall be as recommended by the thermoplastic material manufacturer.

9-29.4 PRESSURE SENSITIVE TAPE

Pressure-sensitive tape shall be a 4 inch wide, pressure-sensitive, reflective-type tape of the form suitable for marking asphalt and concrete pavement surfaces. Biodegradable tape with paper backing is unacceptable.

The following pressure-sensitive tape has been approved as a temporary pavement marking tape:

(a) 3-M Scotch name brand pavement marking tape, coated with pressure-sensitive adhesive, manufactured by 3-M Company, 3-M Center, St. Paul, Minnesota 55101.

Surface preparation and application shall be in conformance with all the manufacturer's specifications.

SECTION 9-30 WATER DISTRIBUTION MATERIALS

9-30.0 GENERAL

All materials for water distribution and transmission shall be new. Except that materials used for temporary water mains and temporary service connections shall be either new or previously used only on temporary potable water supplies, and shall be subject to Seattle Water Department inspection and approval prior to installation.

Prior to ordering any pipe to be used in a potable water supply, the Contractor shall submit the material source, in accordance with Section 1-06.1 and obtain the Engineer's approval.

9-30.1 PIPE

9-30.1(1) DUCTILE IRON PIPE

(a) Ductile iron pipe shall be centrifugally cast in 18-foot nominal lengths conforming to AWWA C151 and shall have a cement-mortar lining conforming to AWWA C104. Ductile iron pipe to be joined using restrained joints shall be Standard Thickness Class 52. All other ductile iron pipe shall be Standard Thickness Class 52 or the thickness class as shown on the Drawings and/or Project Manual.

(b) Non-restrained joints shall be rubber gasket, push-on type, or mechanical joint conforming to AWWA C111.

(c) Tension joints shall be as specified in Section 9-30.2(6).

(d) Pipe coatings shall be in accordance with Section 9-30.2(10).

(e) Pipe with threaded flanges shall not be used.

9-30.1(2) VACANT

9-30.1(3) CONCRETE CYLINDER PIPE

Concrete cylinder pipe shall be modified, pretensioned concrete cylinder pipe with steel cylinder core. The pipe shall conform to AWWA C303, and shall be designed for the minimum pressure as specified on the Drawings or Project Manual. The pipe manufacturer shall provide design calculations, tabulated layout, and details of specials and fittings. Specials and fittings shall be subjected to the same hydrostatic test required for straight sections. Tension joints shall be provided where shown on the Drawings.

Identification marks shall include design pressure and other items outlined in Section 1.6 of AWWA C303.

Sizes, class, marking, specials, lengths, etc., shall be as indicated on the Drawings or the Project Manual. All items listed in Section 1.5 of AWWA C303 shall be provided for the Engineer by the pipe supplier. Cement mortar lining roughness tolerance shall be not more than + 1/16-inch.

9-30.1(4) STEEL PIPE

9-30.1(4)A STEEL PIPE LESS THAN 4 INCHES DIAMETER

Steel pipe smalier than 4 inches in diameter shall conform to ASTM Designation A 120, Schedule 40 and shall (including couplings) be hot dip galvanized inside and out. The pipe shall be coupled by using malleable iron screw coupling in accordance with ANSI Specification B16.3.

9-30.1(4)B STEEL PIPE 4 INCH DIAMETER AND LARGER

Steel pipe 4 inches in diameter and larger shall conform to AWWA C200. The type of protective coating and lining and other supplementary information required by AWWA C204 shall be included on the Drawings and/or in the Project Manual.

9-30.1(4)C STEEL CASING PIPE

Steel casing pipe shall conform to the above sections and shall have a diameter and wall thickness as shown on the Drawings and/or in the Project Manual. The pipe shall be smooth and bare.

9-30.1(5) POLYVINYL CHLORIDE (PVC) PIPE (4 INCHES AND OVER)

PVC pressure pipe shall conform to the requirements of AWWA C900, Class 200 (DR 14). Standard lengths shall be 20 feet (nominal). PVC pipe shall have the same outside dimensions as ductile iron pipe. PVC pipe for distribution pipelines shall be pressure Class 150. The pipe shall bear the seal of the National Sanitation Foundation for potable water pipe. The Contractor shall furnish the Engineer an affidavit that all delivered materials comply with this specification. In addition to the affidavit, the manufacturer shall furnish a sample marked in accordance with AWWA C900. Pipe joints shall be made with a rubber ring and thickened bell. Solvent welded pipe joints will not be permitted. All pipe shall be listed by Underwriters' Laboratories, Inc.

All PVC pipe shall be considered flexible conduit. Joints shall conform to ASTM D 3139 using a restrained rubber gasket conforming to ASTM F 477.

9-30.2 FITTINGS

9-30.2(1) DUCTILE IRON PIPE

Fittings for ductile iron pipe shall be ductile iron conforming to AWWA C110 and C111 or AWWA C153 and shall be cement-mortar lined conforming to AWWA C104.

Except where restrained joint systems are required, mechanical or push on joints may be used.

Where restrained joint pipe is required, threaded flanges by restrained joint adapters shall not be longer than three pipe diameters. Threaded flanges and pipe shall conform to AWWA C115. The exterior flange lip overlapping the pipe barrel shall be sealed with a bituministic mastic.

Sleeves less than 12 inches diameter shall be 12 inches minimum length and shall be mechanical joint.

Sleeves greater than 12 inches diameter shall be of the long body type and shall be 15 inches minimum length and shall be mechanical joint.

Hub-by-flange fitting length shall conform to AWWA C110 or AWWA C153. Threaded flanges and pipe thickness shall conform to AWWA C115. Hub-by-flange fittings shall be mortar lined per AWWA C105. The exterior flange lip overlapping the pipe barrel shall be sealed with a bituminous mastic. Threaded flanges will be allowed only on hub-by-flange fittings. Pipe with threaded flanges will not be allowed.

9-30.2(2) VACANT

9-30.2(3) CONCRETE CYLINDER PIPE

Fittings for Concrete Cylinder Pipe shall meet requirements of AWWA C303 and shall be in accordance with details in the Drawings or Project Manual.

9-30.2(4) STEEL PIPE

Fittings for steel pipe 3-1/2 inches in diameter and smaller shall be malleable iron threaded type with a pressure rating of 150 psi. Dimensions shall conform to ANSI B 16.3. Threading shall conform to ANSI B 2.1 Material shall conform to ASTM A 47, Grade 32510. All fittings shall be bended and hot-dip galvanized inside and out.

Unions shall be malleable iron with a pressure rating of at least 150 psi. Material shall conform to ASTM A 47, Grade 32510. Unions shall be ground joint, bronze to iron type.

Steel fittings for pipe 4 inches in diameter and larger shall be in accordance with AWWA C208. The class of the fittings shall be at least the same as that of the pipe. Coatings for the fittings shall be the same as specified for the pipe. Field couplings shall be compression type. When flanges are required, they shall conform to AWWA C207. All couplings shall be coated the same as the pipe.

9-30.2(5) POLYVINYL CHLORIDE (PVC) PIPE

Fittings for PVC pipe shall be the same as specified for ductile iron pipe. Dimensions of fittings and design of bell may be modified to conform with the pipe being used.

9-30.2(6) RESTRAINED JOINTS

Restrained joints, where required on the Drawings, shall be TR Flex Restrained Joint Pipe as manufactured by U.S. Pipe Co., or approved equal.

Where restrained joint pipe is required, threaded flanges by restrained joint adapters shall not be longer than three pipe diameters. Threaded flanges and pipe shall conform to AWWA C115. The exterior flange lip overlapping the pipe barrel shall be sealed with a bituministic mastic.

9-30.2(7) TRANSITION REDUCING, FLEXIBLE COUPLINGS AND SLEEVES

Transition couplings, reducing couplings, transition reducing couplings, sleeves, and flexible couplings for water mains shall be compression type, Smith-Blair, Dressler or approved equal, constructed with gray or ductile iron sleeves and ductile or malleable iron followers. Bolts and nuts shall be ductile iron unless otherwise noted on the Drawings and/or in the Project Manual. Couplings and sleeves shall be the long body pattern with a minimum length of 10 inches for pipe up to 12 inches diameter and 15 inches minimum length for pipe greater than 12 inches diameter. Factory finish shall be the standard of the manufacturer.

9-30.2(8) RESTRAINED FLEXIBLE COUPLINGS AND SLEEVES

Restrained flexible couplings or sleeves shall be in accordance with the Drawings and the Project Manual.

9-30.2(9) SPECIAL FITTINGS

Special fittings shall be in accordance with the Drawings and Project Manual.

9-30.2(10) PIPE COATINGS

9-30.2(10)A SPECIAL PIPE COATINGS

Special pipe coatings shall be in accordance with the Project Manual.

9-30.2(10)B MULTI-LAYERED POLYETHYLENE TAPE COATING

Multi-layered polyethylene tape coating shall be Polyken YG111 as manufactured by Kendall Company, or Tapecoat CT 10/40 W as manufactured by Tapecoat Company, or approved equal. The multi- layered polyethylene tape coating shall conform to AWWA C214, unless otherwise specified.

(a) The multi-layered polyethylene tape coating system shall consist of the following components:
(1) One layer of pipeline coating primer.
(2) One layer of pipeline inner wrap coating.
(3) One layer of outer wrap coating.

(b) The primer shall be fast drying and shall form an instantaneous, firm bond when the adhesive on the tape coating comes in contact with the primed pipe surface.
Coating primer shall be compatible with the adhesive and from the same manufacturer.

(c) The inner wrap coating shall consist of of polyethylene backing with a butyl-based adhesive laminated to one side of the backing. The polyethylene backing and adhesive shall be made by the calendering process in order to ensure the maximum bonding of the adhesive to the backing. The adhesive shall be formulated so that it forms a firm bond upon contact with the pipe primed surface.

(d) The pressure sensitive adhesive outer wrap shall consist of a polyethylene backing with a butyl-adhesive laminated to one side of the backing. The pressure sensitive adhesive on the outer wrap shall form a firm continuous bond to the backing of the tape coating.

(e) Cutbacks on the spigot end shall be 6 inches or less and shall be made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. No cutback shall be made on the bell end of the pipe.

(f) Following the application of the outer wrap, the coating shall be electrically tested for holidays with a pulse tape holiday detector. The detector voltage range for this coating is 7000-9800 volts. The testing shall conform to NACE RP-02-74.
All defects electrically detected shall be repaired by priming and patching with a suitable primer and tape as specified by the manufacturer.

9-30.2(11) TWO-INCH BLOW OFF ASSEMBLY

Two-inch blow off assembly shall be as indicated on the Drawings.

Two-inch plastic service tube shall be polyethylene PE 3406, and shall conform to Section 9-30.6(4)B. Two-inch gate valve and operator shall be Kennedy 427, Nibco-Scott 123, Stokum B-110, or approved equal. Plastic foam material shall conform to Section 9-30.2(12). Ring and Cover shall conform to Section 9-30.3(12)H. Meter Box shall conform with Section 9-30.6(8).

9-30.2(12) PLASTIC FOAM

Plastic foam used in water main construction for meter boxes, valve chambers, valve boxes, pipe protection and various pipeline uses shall meet the Federal Spec. PPP-C-1752B Type 1, Class 2.

9-30.2(13) PORTLAND CEMENT CONCRETE

Portland Cement Concrete for pipe support saddles and cradles and for thrust blocking shall be Class 5(1-1/2).

9-30.2(14) POLYETHYLENE ENCASEMENT

Polyethylene film for encasement of ductile iron pipe and fittings shall conform to Section 9-30.8.

9-30.2(15) STEEL CASING PIPE

Steel casing pipe shall conform to Section 9-30.1(4) and shall have a diameter and wall thickness as specified on the Drawings. Pipe shall be smooth and bare.

9-30.2(16) STEEL PIPE CASING SEALS AND SPACERS

Casing seals shall be used to seal the ends of the casing with the water main. These seals may be Multiflex Molded Type or Pull On Fabricated Type as manufactured by F.H. Maloney Company, or approved equal.

Crossing Insulators (Spacers) shall be used to isolate the steel casing pipe from the water main. The Insulators (Spacers) shall be Maloney Model 60 as manufactured by F.H. Maloney Company, or as manufactured by Cascade Manufacturing Company, or approved equal.

9-30.3 VALVES

9-30.3(1) GENERAL - MANUFACTURE AND MARKING

The valves shall be a standard pattern of a manufacturer whose products are approved by the Seattle Water Department and shall have the name or mark of the manufacturer, year valve casting was made, size. and working pressure plainly cast in raised letters on the valve body.

9-30.3(2) GATE VALVES

Gate valves 3-inch through 12-inch shall conform to AWWA C500, be equipped with non-rising stems, and "O" ring stuffing box, and unless specifically required elsewhere in the Contract Documents, either double disc with bronze wedging device or resiliant seat conforming to AWWA C509. Gate valves used in conjunction with restrained joint pipe shall have a ductile iron body; elsewhere valve bodies may be either ductile iron or cast iron.

Valves shall open to the left, counterclockwise when viewed from above, and shall be equipped with a standard AWWA 2-inch square operating nut.

Three certified copies of performance tests complying with AWWA C500 shall be submitted to the Engineer.

Unless otherwise indicated on the Drawings, valve ends may be mechanical or push on joint. Where restrained joints are called out, valve ends shall be flanged with appropriate flange by restrained joint adaptors per Section 9-30.2(1).

The valves shall be as manufactured by Rensselaer, Stockham, Ludlow, Clow, M & H, American-Darling, Crane, RP & C, Mueller and Kennedy or approved equal in size 12 inches or less.

The Contractor has the option of furnishing butterfly valves specified in Section 9-30.3(4) in lieu of gate valves for 3 inches through 12 inches size valves, except for 6-inch size auxiliary valves for fire hydrants.

Gate valves 2-1/2 inches and smaller shall be bronze, non-rising stem, F.I.P.T. inlet and outlet threading conforming to ANSI B 2.1, with hand wheel type operator and shall be minimum 150 pounds water working pressure rated unless otherwise noted on the Drawings and/or in the Special Provisions. The 2-1/2 inches and smaller valves shall be manufactured by Kennedy, Nibco-Scott, Stokum or approved equal.

9-30.3(3) VACANT

9-30.3(4) BUTTERFLY VALVES

Butterfly valves shall conform to AWWA C504 and shall be Class 150B. The valve shall be short- body type. If flanged ends are required they shall be sized and drilled in conformance with ANSI B 16.1 Class 125. Valve shall be suitable for direct burial installation.

Unless otherwise indicated on the Drawings, valve ends may be mechanical or push on joint. Where restrained joints are called out, valve ends shall be flanged with flanged by restrained joint adapters per Section 9-30.2(1).

Valves shall be mounted on the water main or pipeline such that the operating nut is accessible from directly above. Operator shall be manual, fully enclosed, and suitable for buried service. It shall open left (counterclockwise when viewed from above), and shall be equipped with a standard AWWA 2 inches square operating nut.

Operators for 16-inch and larger valves shall be equipped with external indicators, visible from above, which show the position of the valve disc.

The minimum number of turns from fully open to fully closed shall be as follows:

Diameter	Turns
4 inches to 8 inches –	16 turns
10 inches to 12 inches –	28 turns
14 inches to 18 inches –	30 turns
20 inches to 24 inches –	44 turns
30 inches –	60 turns
36 inches –	72 turns
42 inches –	84 turns
48 inches –	96 turns
54 inches and larger –	200 turns

An affidavit of compliance stating that the valves furnished fully comply with AWWA C504 and the modifications contained herein shall be furnished to the Engineer by the manufacturer.

The valve bodies shall be cast iron mounted with approved noncorrosive metals. Wearing surfaces shall be bronze or other approved noncorrosive material and there shall be no moving bearing or contact surface of iron in contact with iron. Contact surfaces shall be machined and finished in the best workmanlike manner, and all wearing surfaces shall be easily renewable.

The butterfly valves shall be manufactured by Henry Pratt Company, Dresser Industries, Kennedy Valve Division of ITT Grinell Valve Company, Inc., American Darling, or approved equal.

9-30.3(5) VALVE BOXES

Unless otherwise noted on the Drawings or in the Project Manual, valve boxes shall be installed on all buried valves. The box and lid shall be cast iron, 2-piece slip type with cast iron extension as necessary, conforming to requirements and dimensions of the latest City of Seattle Water Department Standards.

The cover shall have the work "WATER" or the letters "WW" cast in it.

Valve boxes, lids and extensions of the following manufacture and pattern are approved for use.

Olympic Foundry (1984) Inc. -	Lid Section # 1908-33 Top Section # 1106-33 Base Section # 1301-33
Rich -	Top Section and Lid #045 with Rich standard base and extension.

Each top and lid section shall be tested for accuracy of fit and shall be marked in sets for delivery.

Valve box extension pieces shall be provided for valves with ground cover in excess of the depth of the standard valve box.

9-30.3(6) VACANT

9-30.3(7) COMBINATION AIR RELEASE/AIR VACUUM VALVES

Combination air release/air vacuum valves shall have a maximum operating pressure of 300 psi. The air venting orifice shall have a capacity of 840 CFFAM at 5 psi. The air release orifice shall have a capacity of 22 CFFAM at 300 psi.

9-30.3(8) END CONNECTIONS

The dimensions of hub or bell end connections shall conform to the dimensions of AWWA C100. The dimensions for the mechanical joint connections shall conform to the ANSI A21.11.

The end flanges of flanged valves shall conform in dimensions and drilling to the standard ANSI B 16.1 for cast iron flanges and flanged fittings. Class 125, unless specifically provided otherwise. The bolt holes shall straddle the vertical center line.

9-30.3(9) TAPPING SLEEVE AND VALVE ASSEMBLY

Tapping sleeves for use on pipes, not having special coatings or protection, shall be Mechanical Joint Type, Ductile Iron, flanged joint outlet conforming to ANSI B 16.1, Class 125, Drilling. Sleeves shall have a tapping Gate valve retaining ring groove.

Tapping sleeves shall be of a size designed by the manufacturer to fit the pipe called for on the Drawings and/or in the Project Manual. It is the Contractors responsibility to determine the outside dimension of the pipe and secure proper sleeve fit. The outlet size shall be as shown on the Drawings.

Tapping sleeves for use where Drawings and/or Project Manual requires special pipe coating or protection systems shall meet the above requirements and shall be coated with Coal-Tar Epoxy according to AWWA C210. Bolts shall be stainless steel.

Prior to ordering tapping sleeves, the Contractor shall submit manufacturer's data, installation instructions and maximum air test pressure information to the Engineer for approval.

Tapping gate valves shall be of the size shown on the Drawings and shall conform to the gate valve provisions of Section 9-30.3(2).

In addition, the inlet end shall be flanged with retaining ring extended beyond the flange face.

The outlet end shall be mechanical joint unless otherwise noted on the Drawings and/or the Project Manual.

The valve seat ring openings shall be larger than normal size to permit entry of full diameter tapping machine cutters.

9-30.3(10) OPERATING NUT EXTENSIONS

An operating nut extension conforming to the latest Department Standards Plans shall be furnished and installed by the Contractor on all valves where called for on the Drawings or where the finished grade is more than 30 inches above the valve operating nut.

9-30.3(11) PLASTIC FOAM RINGS

Valve boxes shall have a 2 inches thick plastic foam ring conforming to the dimensions of the latest Seattle Water Department Standards, installed between the base and the valve casting. The plastic foam shall conform to specifications in Section 9-30.2(12).

9-30.3(12) VALVE CHAMBERS AND VAULTS

9-30.3(12)A PRECAST VALVE CHAMBER

Size, shape, and materials shall be as indicated in the Drawings, or Project Manual.

The chambers shall be furnished in precast concrete sections with sufficient strength to withstand H-20 traffic loading together with ladder and access frames and covers to provide the minimum clearance dimensions as shown.

The chambers shall be watertight after assembly. Gasket material shall be installed in the grooves of the keyway of each of the chamber sections as they are installed. There shall be no evidence of moisture seeping into the chambers through the walls, floor, roof, or joints.

9-30.3(12)B CONCRETE BLOCKS FOR VALVE CHAMBERS

Portland cement concrete blocks shall be solid, and shall conform to the requirements of ASTM Designation C 139. Overall thickness of block shall be 6 inches with optional lengths and widths. Curved manhole blocks shall be used for round valve chambers.

9-30.3(12)C CONCRETE BRICK FOR VALVE CHAMBERS

Concrete brick shall be solid and conform to ASTM Designation C 55, Grade A.

9-30.3(12)D CLAY BRICK FOR VALVE CHAMBERS

Clay brick shall conform to ASTM C62, Grade SW.

9-30.3(12)E MORTAR

Portland cement mortar shall be 1 part portland cement to not less than 1-1/2 parts nor more than 3 parts of plaster sand, mixed with the least amount of water necessary to provide a workable mix. Dehydrated lime, in an amount not exceeding 50 percent of the portland cement by weight, may be added to the mix at the option of the Contractor.

9-30.3(12)F PORTLAND CEMENT CONCRETE

Concrete for chamber foundation shall be Class C.

9-30.3(12)G CAST IN PLACE CONCRETE VALVE CHAMBER

The design, size, shape, and materials for cast-in-place concrete valve chambers shall be in accordance with the Drawings and Project Manual. The Contractor shall submit complete Shop Drawings of the chamber for approval by the Engineer per Section 1-05.3.

9-30.3(12)H RING AND COVER AND VALVE BOX CASTINGS

Castings for cast iron ring and cover and for cast iron parts of valve boxes shall conform to the requirements of ASTM Designation A-48, Class 30 and shall conform to the Standard Plans.

The word "WATER" shall be cast in the cover in 3-inch letters as indicated on the Standard Plans.

Each ring and cover section shall be tested for accuracy of fit and shall be marked in sets for delivery.

9-30.3(12)I MORTAR FOR PLASTER-COATING

Mortar for plaster-coating masonry unit manholes shall be proportioned according to either of the two alternates tabulated below:

	Parts by volume portland cement	Parts by volume masonry cement	Parts by volume hydrated lime or lime putty
Alt. 1	1	1 (Type II)	0
Alt. 2	1	0	1/4

Plaster sand for either Alternate 1 or Alternate 2 above shall be measured in a damp, loose condition, and shall be not less than 2, and not more than 3 times the sum of volumes of cement and limE.

A bituminous coating shall be applied to all surfaces after plastering.

9-30.3(12)J LADDERS

Ladder shall be made of steel, and shall be galvanized after fabrication. They shall be made of 1 inch deformed bar conforming to ASTM A 615, intermediate or standard grade, hot bent at least 1600 degree F. Galvanization shall conform to ASTM A 123.

9-30.3(13) PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces shall be painted inside and out with two coats of asphalt varnish, Federal Specification TT-V-51A or approved equal.

9-30.3(14) WATER PRESSURE REGULATING VALVES

(a) **Water Pressure Regulating Valves, 3-inch through 12-inch Sizes:**

Valve shall be flanged both ends, Class 125 ASA drilling, with cast iron body. Valve shall be a diaphragm operated, single sea, globe valve. It shall be spring loaded and hydraulically operated. Seat ring shall be replaceable. The diaphragm shall be fully guided top and bottom. All necessary repairs shall be possible without removing valve from the line. Packing glands are not permitted. Disc shall be synthetic rubber and have a rectangular cross section. The stem shall be guided by a bearing in the valve cover and an integral bearing in the valve seat. There shall be no piston operating the main valve.

Valves shall be designed to maintain a constant downstream pressure regardless of varying inlet pressure. They will be used handling clean, cold water.

No control pilots or optional equipment is to be furnished. Valves shall be CLA Valve No. 90 or approved equal.

(b) **Water Pressure Regulating Valves, 2-inch Size:**

Valves shall be Mueller No. H-9310 2-inch Water Pressure Reducing Valves or approved equal.

9-30.3(15) POLYETHYLENE ENCASEMENT, MULTI-LAYERED POLYETHYLENE TAPE COATING, AND SPECIAL TAPE COATING FOR VALVES

Polyethylene encasement, multi-layered polyethylene tape coating and special tape coating shall be per Sections 9-30.8, 9-30.2(10)B and 9-30.2(10)A respectively.

9-30.4 VACANT

9-30.5 HYDRANTS

9-30.5(1) GENERAL

Fire hydrants shall conform to AWWA C502 and shall be of standard manufacture and of a pattern approved by the Seattle Water Department. The name or mark of the manufacturer, size of the valve opening and year made shall be plainly cast in raised letters on the hydrant barrel to be visible after the hydrant is installed.

Hydrants of the following manufacture and pattern have been approved for use by the City of Seattle:

(a) Pacific States
(b) Clow Model 5110 (Iowa)
(c) Mueller "Centurion" Model A-423
(d) American-Darling Model B-62B
(e) Kennedy "Guardian"

9-30.5(2) END CONNECTIONS

The end connection shall be 6 inches, standard flange, Class 125 drilling conforming to ANSI B 16.1.

9-30.5(3) HYDRANT DIMENSIONS

The dimensions and details of hydrant and nozzles shall be as follows:

Hydrant connection pipe size inside diameter: 6 inches.
Standpipe, minimum inside diameter: 7 inches.
(flange): 3-1/2 feet.
Valve opening, minimum diameter: 5 inches.
Size of auxiliary gate valve: 6 inches.
Hose nozzles, number and size: 2 - 2-1/2 inches.
Thread (National Board of Fire Underwriters): 7-1/2 per inch.
Total length of threaded male nipple: 1 inch.
Streamer nozzle, number and size:

Hydrants shall be furnished with one streamer nozzle with size and threads conforming to dimensions as identified on the latest City of Seattle Standard Plans for Fire Hydrants.

Drain Valve: Drain valve shall be automatic with outlet tapped or plumbed to 3/4-inch female iron pipe threads.

Sidewalk flange (ring) to center of pumper nozzle: 14 inches or more.

Face: Pumper port toward the street.

All nozzles shall be fitted with cast iron threaded caps with operating nut of the same design and proportions as the hydrant stem nut. Caps shall be threaded to fit the corresponding nozzles and shall be fitted with suitable neoprene gaskets for positive water tightness under test pressures.

9-30.5(4) OPERATING NUTS

The operating nuts on hydrant stem and nozzle caps shall be as follows:

Pattern of nut	Tapered pentagonal
Height	1-1/6 inch
Size of pentagon	1.35-inch at bottom of nut 1.23-inch at top of nut (measured from point to flat)

The direction of opening shall be clearly marked on the operaing nut or hydrant and shall be counterclockwise.

9-30.5(5) HYDRANT RESTRAINT

Shackling rods shall be 3/4 inch diameter with threaded ends, and shall meet ASTM A 36. "All-thread" rod is not acceptable. If a tie bolt restraint system is used, they shall be "COR-TEN Steel Star National Products Super Star Tie Bolt #SST7" or approved equal. If a mechanical joint- gland-with-lugs restraint system is used, it shall conform dimensionally as shown on the hydrant detail, and shall be ductile iron conforming to ASTM A 536 Class 80-55-06. Coating for shackling rods shall be in accordance with Section 9-30.15.

9-30.5(6) SIDEWALK FLANGE CONSTRUCTION

Hydrants shall be provided with a sidewalk flange and be equipped with breaking devices at the sidewalk flange which will allow the hydrant barrel to separate at this point with a minimum breakage of hydrant parts in case of damage. There shall also be provided at this point a safety stem coupling on the operating stem that will shear at the time of impact. Unless otherwise specified, all hydrants shall be equipped with 0-ring stem seals.

9-30.5(7) VACANT

9-30.5(8) HYDRANT FACTORY HYDROSTATIC TEST

All hydrants shall be tested by the manufacturer, as required in AWWA C502. The Contractors shall furnish to the Owner an affidavit of compliance from the manufacturer for all tests.

9-30.5(9) HYDRANT CONNECTION PIPE

Pipe connections from the hydrant to the water main shall be 6-inch Ductile Iron Pipe, Class 52, in accordance with Section 9-30.1(1).

9-30.5(10) HYDRANT VERTICAL EXTENSIONS

Hydrant barrel extensions shall have a 7-inch minimum inside diameter and shall be gray cast iron or Ductile Iron and shall conform to the AWWA Standards for such castings. The drillings of the connecting flanges on the extensions shall match the drillings of the flanges on the hydrant.

Hydrant vertical extensions shall also include the necessary hydrant operating stem extension, complete with safety stem couplings.

Extensions with threaded flanges shall be ductile iron and shall conform to AWWA C115. The exterior flange lip overlapping the barrel pipe shall be sealed with a bituministic mastic.

9-30.5(11) HYDRANT BLEEDER

When approved by SWD, the hydrant bleeder assembly, as shown on the hydrant detail, shall be constructed of 3/4-inch polyethylene or polybutylene tubing or 3/4-inch copper tubing Type K, conforming to Sections 9-30.6(4)A, 9-30.6(4)B, or 9-30.6(4)C, as approved.

9-30.5(12) POLYETHYLENE ENCASEMENT, MULTI-LAYERED POLYETHYLENE TAPE COATING, AND SPECIAL TAPE COATING FOR HYDRANTS AND CONNECTIONS

Refer to Section 9-30.3(15).

9-30.6 SERVICE CONNECTIONS AND SERVICE PIPE OR TUBING

9-30.6(1) GENERAL

These standards shall be used unless modified by the Drawings and/or the Project Manual.

Service Piping standards shall also be used, as modified on the Drawings for 2 inches blow off assembly; hydrant bleeder assembly.

9-30.6(2) SADDLES

Saddles shall be ductile iron, or bronze, double straps with F.I.P. thread standard outlet tapping. Saddles shall be of a size designed by the manufacturer to fit the pipe called for on the Drawings and/or in the Project Manual.

9-30.6(3) CORPORATION STOPS

Corporation stops for use with saddle shall be of bronze alloy with inlet F.I.P. standard thread and outlet thread compatible with connection piping, with no special adapters. Corporation stops for direct tapping shall be bronze alloy with AWWA tapered thread inlet and outlet thread compatible with connecting pipe without special adapters.

9-30.6(4) SERVICE PIPE

9-30.6(4)A COPPER TUBING

Copper tubing shall conform to the requirements of ASTM B 88, Type K, annealed. The tubing shall be coupled using flare-type compression fittings, conforming to the requirements of AWWA C800, minimum 150 psi working pressure.

9-30.6(4)B POLYETHYLENE PIPE

Polyethylene pipe, (tubing) when approved by the Seattle Water Department, to be used for water service lines 2 inches in size and smaller, shall conform to the requirements of AWWA C901. The pipe shall bear the seal of the National Sanitation Foundation for potable water pipe. Pipe joints shall be made in accordance with the manufacturer's recommendations. Solvent welded pipe joints will not be permitted. Minimum working pressure rating shall be 160 psi.

9-30.6(4)C POLYBUTYLENE PIPE

Refer to Section 9-30.6(4)B except that the requirements of AWWA C902 shall apply.

9-30.6(5) COMPRESSION COUPLINGS

Compression couplings for use in connecting plain end water service pipes shall be applicable for the type of pipe being coupled. Compression couplings shall have armored gaskets when similar metal pipes are being joined.

9-30.6(6) INSULATING COUPLINGS

Insulating couplings shall be required at any point of connection of two dissimilar metallic pipes (i.e., copper to galvanized iron or steel).

9-30.6(7) METER STOPS AND SETTERS

Meter stops and setters shall be in accordance with the Seattle Water Department Standard Plans.

9-30.6(8) METER BOX AND LID

Meter Box and Lid shall be in accordance with the latest Seattle Water Department Standards. The Meter Box casting shall conform to ASTM A-48 Class 30 for gray cast iron. The Lid casting shall conform to ASTM A-536 Grade 80-55-06 for ductile iron, or ASTM A-47 for malleable cast iron. Castings shall be brushed or dipped with a bituminous coating. Meter Box and Lid shall be Olympic Foundry (1984) Inc. #5111-17 Box and #5111-19 Lid or approved equals.

9-30.6(9) VALVES

Valves shall conform to Section 9-30.3.

9-30.7 BEDDING, FOUNDATION MATERIAL AND GRAVEL

When the mineral aggregate is specified by a "Type" designation, it shall conform to the requirements shown on the table in Section 9-03.

9-30.8 PLASTIC FILM WRAP

Plastic film wrap for polyethylene encasement shall be 8-mil polyethylene conforming to AWWA C105.

9-30.9 VACANT

9-30.10 LOCATING WIRE

Locating wire for use with PVC pipe shall be 14 gauge solid copper with neoprene coating. Connections and splices shall be made with Penn Wilson split Bolt Wire Connectors, catalog No. 5-8-5, or approved equal.

9-30.11 ELECTROLYSIS PROTECTION

9-30.11(1) ZINC REFERENCE ELECTRODES

The electrode material shall be high purity zinc with a minimum content of 99.99% zinc (ASTM B418-73 Type II or equivalent). The zinc electrode shall have a minimum surface area of 50 sq. in. (323 sq. cm.). The active material shall be molded around mild steel core.

The reference electrode shall include a lead cable consisting of a single conductor No. 12 AWG stranded copper type THW with 600 volt yellow insulation or equivalent.

(a) The cable shall be attached to the mild steel core with a copper electical compression crimpet.
(b) The cable attachment shall be thoroughly covered with 2 half lapped layers of electrical tape, or epoxy cap.

9-30.11(2) WATER METER BOX

9-30.11(2)A GENERAL

The water meter box and lid shall conform to Section 9-30.6(8).

9-30.11(2)B TEST BOX

(a) The 4 5/16 inch (11 cm) deep test box shall provide a single piece enclosure 8 inches x 6 inches (20 cm x 15 cm) with a lid. The test box shall be Stahlin No. J806W or approved equal.
(b) The lid shall be manufactured from fiberglass and shall contain a one-piece closed cell neoprene gasket. The lid shall be secured by hold down screws.
(c) The test box shall comply with the NEMA Type 12 standard for an oil, dust and drip-free enclosure. The wire entrance shall be sealed with an epoxy seal kit.
(d) The test box shall include a 1/4 inch (6 mm) thick phenolic back panel with a terminal block assembly (Buchanan No. P625 or equivalent) containing 16 terminals sized to accommodate No. 12 AWG wire. Each terminal shall be specifically identified by laminated phenolic name plates which indicate the origin of the attached wire.
(e) Each wire shall include at least 18 inches slack to allow lifting of the test box out of the meter box during testing. Each wire shall be specifically identified by marking tape.

Approximately 1.5 cu. ft. (0.04 cu. m) of crushed rock or pea gravel shall be provided to create a permeable bed 6 inches (15 cm) deep inside each water meter box.

9-30.11(2)C TEST WIRES

The wires shall be stranded copper with Type THW insulation. AWG size and insulation color shall be as shown on the Drawings.

9-30.12 VACANT

9-30.13 TURBINE METERS (METER, COLD WATER, MAGNETIC DRIVE TURBINE TYPE, 2" THROUGH 12" SIZES)

9-30.13(1) GENERAL

These requirements apply to Magnetic Drive Turbine Type Cold Water Meters 2-inch through 12-inch in size, manufactured for use on customer water services. Turbine Meters shall consist of a cast bronze case containing the measuring mechanism with a strainer housing attached.

Meters shall shall meet the requirements of AWWA C701-78, latest revision, Class II type, except as modified herein.

9-30.13(2) REGISTER AND REGISTER BOX

Registration shall be in cubic feet. Register box and cover shall be of a copper alloy.

9-30.13(3) MAIN CASE AND COVER

The main case and cover shall be constructed of a copper alloy containing not less than 75% copper.

9-30.13(4) MEASURING MECHANISM

The measuring mechanism shall be the inline, horizontal axis, high velocity turbine type, and so designed that it can be readily removed from the main case as a complete unit. The measuring mechanism shall be capable of operating within the accuracy limits specified under "Normal Flow Limits," without recalibration when transferred from one turbine meter case to another.

9-30.13(5) INTERMEDIATE GEAR TRAIN

If an intermediate gear train is utilized, it shall operate in a dry, hermetically sealed compartment, separated from the water passage by a bronze wall.

9-30.13(6) CAPACITY AND ACCURACY

The turbine meter shall register all rates of flow through it with an accuracy of 100% ± 2% at rates of flow within the limits specified under "Normal Flow Limits."

9-30.13(7) NORMAL FLOW LIMITS

Size	Normal Flow Limit
2-Inch	5 - 160 GPM
3-Inch	10 - 350 GPM
4-Inch	15 - 800 GPM
6-Inch	30 - 1800 GPM
8-Inch	50 - 3500 GPM
10-Inch	55 - 5500 GPM
12-Inch	70 - 7000 GPM

Note: Above flow limit shall be for continuous flows, all turbine meters shall have a 25% overspeed capacity for intermittent flows.

9-30.13(8) HEAD LOSS

Maximum loss of head shall not exceed 7 psi at the flow rates listed under "Normal Flow Limits."

9-30.13(9) CONNECTIONS

All main case connections shall be flanged. The flanges for 2-inch meters shall be of the two bolt oval type. Meters shall be furnished without companion flanges.

9-30.13(10) INTERCHANGEABLE PARTS

All parts of turbine meters of the same size, make and model shall be interchangeable.

9-30.13(11) STRAINER

Turbine meters shall be supplied with a strainer attached. Strainers shall be short pattern, 125 lb. ANSI, iron body, with heavy gauge 1/4-inch perforated, stainless steel screen having an effective straining area at least double that of the meter main case inlet.

9-30.13(12) REMOTE READING

Turbine meters shall be compatible with existing Seattle Water Department Demand Recording Hardware and/or switches. Manufacturer, type, and style of switch are to be submitted for approval by the Engineer. (Note: Rockwell Impulse Contractor and Hersey MHR Turbine are compatible with existing Seattle Water Department switches.)

9-30.13(13) GENERAL REQUIREMENTS

Only meters manufactured by a well established firm will be considered. Only those meters of a specific model and manufacture, samples of which have been submitted to the Seatle Water Department for inspection and approval, and carrying a 1 year guarantee will be acceptable.

9-30.13(14) INSPECTION

All turbine meters purchased under this specification will be subject to inspection and testing by the Seattie Water Department upon receipt, and if any meter is found not to conform with these Specifications, the lot or any portion thereof may be rejected.

9-30.13(15) GUARANTEE

All turbine meters shall be guaranteed for a period of 1 year after installation. This guarantee shall be against defect in materials, workmanship, and construction.

9-30.13(16) TEST REPORT

All turbine meters purchased under this specification shall be accompanied by a notarized test report of the factory accuracy test.

9-30.14 BONDING CABLE

Bonding cable shall be stranded No. 2 AWG insulated copper conductor. The cable shall have polyethylene insulation and polyvinyl chloride jacket similar and equal to Anaconda "Type CP" cable with "Densheath" jacket, or General Cable "Gencathene."

Bond straps and connections supplied by the pipe manufacturer shall be the approved equal to the above.

9-30.15 COATING FOR ALL BOLTS AND SHACKLE RODS

All bolts and shackle rods, unless otherwise designated by the Engineer, shall be coated with 2 coats of asphaltic varnish Royston Roskote 612 XM, or approved equal.

On corrosion protected watermains, all shackle rods, concrete blocking anchor rods, and shackle clamps shall have a factory applied protective coating with fusion bonded epoxy in accordance with ASTM A 755. After threading and assembly, the threaded ends, nuts, and washers shall be coated with a liquid epoxy patch kit in accordance with ASTM A 755 and manufacturer's recommendation.

SECTION 9-31 ILLUMINATION AND ELECTRICAL MATERIALS

9-31.1 LUMINAIRES

9-31.1(1) GENERAL

Luminiares shall be "cobrahead" style and shall consist of a luminaire housing, lamp, ballast, and photoelectric cell. Luminaires shall be in accordance with Material Standard 5723.1, except as modified herein.

Luminaires shall have attached to the housing, an ANSI approval decal (3 inches square) which will be readily visible from the ground, indicating lamp type by color code (i.e., blue for Mercury Vapor, gold for High Pressure Sodium, red for Metal Halide); and lamp voltage by numerical code, i.e.:

7 for 70 Watt
10 for 100 Watt
15 for 150 Watt
20 for 200 Watt
25 for 250 Watt
31 for 310 Watt
40 for 400 Watt

Legends shall be a minimum of 2 inches in height and weather resistant.

Luminaire light distribution patterns shall conform to the IES classification system for Type III medium cutoff for less than 200 watts and Type II short cutoff for 200 watts and more.

Glare control shall be accomplished by use of a flat lens. Minimum streetside utilization shall be 39 percent at 1.5 transverse mounting height. Distribution shall be free from striations and hotspots.

Photometric performance will be subject to testing by the Washington State Material Testing Laboratory to insure conformance with these specifications and the photometric data submitted. A sample luminaire shall be submitted for testing when designated by the Engineer.

9-31.1(2) HOUSING

The luminaire housing shall be aluminum provided with slipfitter end mounting for 2-inch nominal diameter pipe. The housing shall have means for leveling which shall consist of 2 sets of clamps equipped with lock washers on all 4 bolts.

The housing, complete with ballast, shall be weather tight. Gaskets and filters shall be composed of material capable of withstanding temperatures involved and shall be securely held in place. Air entering the optical assembly shall pass through a filtering medium capable of removing particulate matter and harmful gases.

The housing shall be equipped with a NEMA type twist lock receptacle for photoelectric cell, which shall be adjustable to allow facing the photoelectric cell north.

Luminaires shall have their components secured to the luminaire frame with stainless steel mounting hardware (nuts, bolts, washers, hinges, etc.). The stainless steel shall be ANSI 300 series, chrome-nickel grade.

The housing exterior shall have an acrylic electrocast finish. The color shall be grey ASA 70.

The refractor shall be flat, clear, heat and impact-resistant glass. Refractors shall be mounted in the door frame assembly which shall be hinged to the luminaire and secured in the closed position by means of an automatic-type latch. "Bird Guards" shall be provided at the slipfitter to prevent the entry of small birds into the ballast area (refer to Section 9-31.12).

The reflector shall be securely mounted such that the normal operation of the door does not affect the photometrics.

The lamp socket shall be porcelain enclosed mogul with integral lamp grips to assure electrical contact under conditions of normal vibration. The socket shall be rated to exceed the lamp starting voltage. All components shall be pre-wired to a terminal board with clearly identified contacts.

9-31.1(3) LAMPS

Clear lamps suitable for operation in any position shall be used (unless noted otherwise on the Drawings).

High pressure sodium lamps shall meet the following minimum ratings:

WATTAGE	MINIMUM LIFE (HOURS)	INITIAL LUMEN OUTPUT
70	24,000	5,800
100	24,000	9,500
150	24,000	16,000
200	24,000	22,000
250	24,000	30,000
310	24,000	37,000
400	24,000	50,000

9-31.1(4) BALLAST

The ballast shall be designed to properly operate the type of lamp at the specified operating voltage. The ballast shall be designed to start lamps at temperatures as low as -20 degrees Fahrenheit. Ballasts shall be the regulator type, high power factor. Ballasts shall be capable of operation with plus or minus 10 percent input voltage variation. All ballasts shall be multi-tap to allow field adjustment of voltage.

Ballast core laminations shall be of high quality electrical grade steel welded together to minimize noise and assure trouble free operation over the life of the luminaire.

Ballast coils shall be precision wound on formed insulating bobbins and terminals shall be of a push on type connectioN.

Components to provide the high starting voltage required by the high pressure sodium lamp shall be mounted on a printed circuit board which shall be easily accessible without disturbing other components of the total ballast assembly.

The ballast shall be capable of starting and operating high pressure sodium lamps from a nominal 60 hz. power source within the limits specified by the lamp manufacturer. The ballast, including starting aid, must protect itself against normal lamp failure modes. The ballast shall be capable of operation with the lamp in an open or short circuit condition for 6 months without significant loss of ballast life.

For nominal line voltage and nominal lamp voltage, the ballast design center shall not vary more than 5 percent from rated lamp watts.

At any lamp voltage, from nominal through life, lamp wattage regulation spread at that lamp voltage shall not exceed 18 percent for + 10 percent line voltage variation.

For 70 watt, 100 watt and 150 watt lamps, socket voltage shall be rated at 55 volts. For 200 watts and above, socket voltage shall be rated at 100 volts.

Each ballast shall have a name plate attached permanently to the case listing all electrical data.

All ballasts shall be multi-tap.

9-31.1(5) PHOTOELECTRIC CELLS

Photoelectric controls shall be used with all luminaires and shall meet the requirements of Material Standard 5693.0 and 5693.2. Photoelectric controls shall be NEMA-type twist plug-in device in accordance with TDJ-146 & 148 rated to operate at the voltage indicated on the Drawings. The unit shall consist of a light sensitive element connected to necessary control relays. The light sensitive element shall have a spectral response that is especially sensitive to north sky illumination.

The unit shall be so designed that a failure of any electronic component will energize the lighting circuit.

Minimum inrush current ratings shall be 100 amps for 120 volt and 55 amps for 240 volt service. Photoelectric cells shall be provided with an integral lightning arrester.

Photoelectric cells shall be rated to switch 1000 watts incandescent "on."

9-31.1(6) UNDERDECK MOUNTED UNDERCROSSING LUMINAIRE

Underdeck luminaires shall be pendant-mounted as called for on the Drawings. The ballast shall be integral with the luminaire. Ballast housing and structrual parts shall be of cast aluminum. Mounting devices must provide positive, vibration-proof locking. Luminaires shall be UL listed as "Enclosed and Gasketed" and shall be suitable for wet locations. All exposed screws and/or rivets shall be of stainless-steel material.

All exposed cast aluminum parts are to be furnished with a baked-enamel paint.

The ballast housing and optical assembly shall be provided with easy-to-read moisture-proof nameplates that can be read without disturbing the luminaire when installed.

Ballast and optical assemblies shall include provision for field mounting of safety chains.

Luminaires shall have wiring compartment with a single fuse holder.

Mounting of the optical assembly to the ballast assembly or pendant cap shall be secured by positive vibration-proof means. The optical and ballast or pendant cap assemblies shall include a positive aligning electrical disconnect allowing the socket to be shipped factory assembled in the optical assembly.

The luminaire shall be enclosed and gasketed and shall include an activated charcoal filter to permit passage of air.

Heat-resistant polycarbonate plastic shall be used for the refractor. The optical assembly shall be hinged and latched for lamp access. An automatic disconnect shall ensure that optical assembly is electrically cold when servicing. The optical assembly shall be removable from the ballast without tools.

The filter assembly shall be factory installed, but easily removable and shall be located to prevent accidental dislodgement when the luminaire is installed.

The unit will provide at least 3% uplight dispersed widely across the surrounding area.

Luminaire shall be suitable for continuous service in an ambient temperature of 40°C. The unit shall be weatherproof and dustproof.

Ballasts shall conform to the requirements of Section 9-31.1(4).

9-31.1(7) WALL-PACK LUMINAIRE

The luminaire shall consist of rear die-cast back housing which encloses the ballast, lamp socket and reflector, and a refractor frame assembly. The back casting assembly shall mount against the wall (or pole) and the refractor housing assembly shall fasten to it by means of concelaed hinges and a single point, positive acting latch. There shall be plated steel retaining chain attached between the main housing and refractor frame. Overall dimensions shall be approximately 16 inches square by 10-3/8 inches deep.

Units shall be prewired and equipped to be wall mounted directly on conduit for surface wiring without bending the conduit or to a recessed outlet box, and shall require no tools for lamp replacement.

The optical train shall consist of the lamp, fluted specular aluminum reflector, and molded prismatic borosilicate thermal shock-resistant glass refractor. The dimensions of the refractor shall be approximately 16 inches square by 4 inches deep and shall have internal splitting prisms and external dispersing prisms. The refractor frame color shall be anodized aluminum.

The integral ballast shall operate the wattage shown on the Drawings, high-pressure sodium 55-volt lamp and provide reliable starting at temperatures as low as -20°F. The ballast shall be multi-tap to allow field adjustments of voltage.

All insulation shall be U.L. listed Class H; core, coil, and capacitors shall be positioned for maximum heat dissipation. Supply wires to the unit are to be of proper temperature rating for the type of entry used. The housing shall be finished with a black polyester powder paint coating. The complete unit shall be U.L. listed as "Suitabel for Wet Locations." The unit shall be Moldcast catalog No. PCL-1, or approved equal, to be furnished with photocontrol, wireway conduit adapter, and Polycarbonate shield.

The wall-pack luminaires shall be furnished with photocontrol, wireway conduit adapter, and polycarbonate shield.

9-31.2 BRACKET ARMS

Luminaire bracket arms shall be manufactured as indicated on the Standard Plans and in accordance with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", to support a luminaire of 50 pounds, a 1.2 square foot Effective Projected Area for an 80 mph wind and a coefficient of height of 1.10. Brackets shall include the bolts, nuts and washers (galvanized for wood and steel pole mounting and stainless steel for aluminum pole types). Bracket arms shall be the same style as depicted on the Drawings. Small differences in dimensions may be acceptable when structural calculations accompany the shop drawings.

Luminaire bracket arms shall accommodate a slipfitter luminaire attachment. The terminal end of the arm shall be a straight, tubular section with external dimensions of 2 inches NPS by 6-1/2 inches long.

Bracket arms mounted on metal poles shall be constructed of the same material as the poles. If the bracket arm and metal pole are of dissimilar metals, they shall be separated by an approved plastic dielectric pad of 5 mils minimum thickness.

The longitudinal axis of the luminaire end of the luminaire support arm shall be not less than 1 degree nor more than 4 degrees above the horizontal with the luminaire installed.

All tubing used for aluminum arm members shall be seamless, Alloy 6063 - heat treated to T-6 after fabrication. Aluminum arms shall meet the requirements of EEI-TDJ 135 & 139. Steel luminaire arms shall meet the requirements of EEI-TDJ 137 & 139.

9-31.3 WIRE

Street light wire in conduits shall be stranded copper single conductor, with 600 volt type THWN color-coded insulation, size as indicated on the Drawings, and in accordance with Material Standard 6122.3.

Wire used inside of poles and bracket arms (including wood pole mounted bracket arms) or bonded to signal spanwires shall be No. 10 stranded copper "Pole and Bracket" cable with an insulation thickness of 45 mils and a belt thickness of 95 mils. Where the proper combination of colored conductors is unavailable in "Pole and Bracket" cable, No. 12 20-10 cable in accordance with Material Standard 6404.4 may be substituted when approved on a submitted Shop Drawing.

Duplex wire shall consist of one black conductor and one white conductor for circuits with one "hot" conductor and one neutral conductor; and one black conductor and one red conductor for circuits with 2 hot conductors. Multiple conductors shall be color coded in accordance with the NEC. Neutral wire shall always be white. Ground wires shall be green and insulated. The first hot conductor shall be black, the second hot conductor shall be red, and the third hot conductor shall be blue. Triplex wire shall be used for overhead applications, and shall conform with Material Standard 6007.3

except shall be sized as indicated on the Drawings. Color coding will not be required for triplex wire.

Wire shall be continuously color coded. (Color coding not required for triplex wire).

Color code taping at terminations is not acceptable.

Plastic molding for covering wire attached to the side of wood poles shall be in accordance with Material Standard 5820.5.

9-31.4 MINERAL INSULATED (MI) CABLE

Conductors shall be solid copper, 600 volt rated, of the size noted on the Drawings.

The Contractor may choose cable with 2 or more conductors. All the conductors serving a device shall be in the same sheath. This shall not prevent normal practices such as the power conductors to a switch being in one sheath and the load conductors being in a second sheath.

The sheath shall be copper, and unless noted otherwise on the Drawings or in the Project Manual, shall be covered with a factory provided polyethylene jacket. The sheath shall be considered the grounding conductor.

The sheath shall be terminated at junction boxes or condulets as shown on the Drawings, using glands and nuts provided by the cable manufacturer. The glands shall be sized for the cable used and U.L. Listed.

The conductors exposed beyond the end of the sheath shall be covered by insulation provided with the gland. The normal length of the insulation is 10 inches. Power circuits shall be color coded in accordance with Section 9-31.3.

The sheath shall be sealed against moisture at the glands with seal provided by the cable manufacturer. The seal shall be suitable for prolonged submersion in water.

9-31.5 WIRE SPLICES

This standard applies to wire connections other than MI cable made in above grade or below grade installations except where the wires are attached directly to the terminal board. All connectors shall be U.L. or equivalent, labeled approved for the intended use.

(a) **Above Grade Installations**: (Including connections in pole hand holes)

(1) Copper to Copper Connector - The connector shall be a high strength bronze alloy of the split bolt type specified in Material Standard 6688.7

(2) Copper to Aluminum Connector - The connector shall be of the one or two bolt type labeled CO/ALR and include an approved spacer bar.

(3) Aluminum to Aluminum Connector - The connector shall be of the 1 or 2 bolt type and meet the requirements of Material Standard 6693.5

(4) Split bolt connections shall be insulated in accordance with Section 8-30.3(5).

(b) **Below Grade Installations:** (Including on structures)

(1) Below grade splices shall be made in a 2 piece rigid body transparent moisture proof spliced enclosure. The body shall be webbed to ensure centering of the splice and even distribution of the encapsulant. The body and encapsulant shall be composed of material that will not support fungi or mold. The encapsulant shall be a reenterable (gel like), transparent type. (Non-reenterable encapsulant may be approved if each splice is approved by the Engineer prior to installing encapsulant.)

(2) Connectors shall be as described in "A" above or a copper mechanical crimp type may be used when approved by the Engineer and/or an approved Shop Drawing. Mechanical crimp splices shall be made with an approved crimping tool.

(c) **Inside Cabinets and Panels:**

Wire nuts may be used only inside cabinets and panels. Copper or silver plated terminals shall be used at terminals blocks.

9-31.6 FUSES AND FUSE HOLDERS

The in-line fuse holder shall consist of a fuse, a two-section fuseholder body and two insulating boots, all rated at 600 volts: The fuse shall be of the voltage and amperage specified. Fuses rated at 30 amps and less shall be 13/32 inches by 1-1/2 inches in a 30 amp rated boot. Fuses rated 30 to 60 amps shall be 13/32 inches by 2-1/4 inches in a 60 amp rated boot.

The fuseholder body shall be made of waterproof molded plastic, in two sections, the line-side section and the load-side section. Their purpose is to provide a visible means of disconnect for circuit repairs or maintenance. The fuse shall be held in the load-side section only. Each section shall be totally enclosed at the wire entrance end and the sections shall be joined by a threaded, gasketed joint. The fuseholder body shall be designed to confine any electric arc, should the fuseholder be closed on a live circuit.

Fuse holder terminals shall be compression type, sized for the actual wire utilized. Only one wire shall be installed in any terminal.

Where the fuse is in the base of a metal pole, it shall have a breakaway receptacle used as a mechanical weak link to physically interrupt the circuit under impact in addition to the requirements for the fuseholder body.

Insulating boots shall be used to waterproof the wire connections. The type of insulating boot shall be a single conductor boot for the load-side and a single conductor boot for the line-side.

The fuse shall be a current limiting type with a high speed opening and an interrupting rating of 100,000 rms symmetrical amperes. The fuse shall have a minimum time delay of 25 seconds at 200 percent load, but not great enough to result in a safety loss during overload or short-circuit conditions.

The fuse shall be designed so that the carrying capacity or opening time is little affected by ambient temperature and will operate with low watt loss to reduce heating.

Individual luminaires fuses shall be rated at 10 amps except for 400 watt luminaires at 120 volts which shall be rated at 15 amps.

Festoon outlets shall be fused at 15 amps.

9-31.7 GROUND RODS AND CLAMPS

Ground rods shall be fabricated from cold-finished carbon steel shafting in accordance with ASTM Designation A 108 as it applies to Grade 1018. Galvanized ground rods shall not be used.

The covering of the steel core shall be a sheath of electrolytic-grade copper having a minimum thickness of 0.010 inches. The rods shall have rolled threads at each end for joining together with couplings. Rods shall be 10 feet in length and 5/8 inch diameter. Rods shall conform to Material Standard 5642.1, except for length.

Couplings for sectional rods shall be made of high-strength, corrosion-resistant bronze, internally threaded to fit standard rods.

Driving studs shall be made of high-strength, hardened steel of SAE 1045 or equal quality.

Ground rod clamps shall meet the requirements of Material Standard 5640.3.

Ground plates shall be a minimum of 2 square feet surface area copper plate.

9-31.8 ENCLOSURES

Enclosures located outside shall be weather-proof type, NEMA Type 3R. All doors and covers shall be gasketed. All enclosure metal shall be formed of Code gauge galvanized steel or aluminum as noted on the Drawings, and shall be constructed to the dimensions shown on the Drawings. All doors shall be provided with a heavy duty hasp suitable for padlocking.

All joints shall be seam welded. Enclosures shall be fabricated to allow for anchor bolt mounting.

A permanent sign shall be attached to the exterior of the enclosure cover or door. The sign shall be engraved into a 2-inch x 6-inch stainless steel plate with a minimum thickness of 18 gauge. The lettering shall be in 3 lines:

DANGER
HIGH VOLTAGE
KEEP OUT

The letters shall be 1/2-inch high with a stroke width of 3/32-inch, and will be filled with a red paint.

The completed sign shall be coated with a clear polyurethane enamel with exterior catalyst and attached to the enclosure cover with a minimum of 6 stainless steel drive rivets.

Circuit breakers shall conform to Federal Specifications W-C-375B. All 100 ampere frame breakers shall be Class 12a for single pole breakers, and shall be Class 12b for multiple pole breakers; 225 ampere frame breakers shall be Class 12b.

Circuit breakers shall be of the rating shown on the Drawings or as called for in the Project Manual. Circuit breakers shall be of the unenclosed molded case bolt-on type with end conductor terminals, suitable for surface mounting in the cabinet on a false back or bracket.

Circuit breakers shall be labeled to indicate the circuit controlled.

Overcurrent protection and relay equipment, as called for on the Drawings or in the Project Manual, shall be installed according to the best common practice, with materials and installation meeting all applicable requirements of the National Electric Code (NEC) and the Seattle Electrical Code.

Contactors shall be "lighting" type specifically rated for tungsten, fluorescent and mercury lamp loads, electrically held.

9-31.9 SWITCHES AND RECEPTACLES

All toggle switches shall be 20 amp, 120 volt, AC type, grounded, specification grade, conforming to Federal Specification W-S-896 and shall be UL listed. Switches shall be Hubbell 122-G single pole, or approved equal.

All duplex receptacles shall be 20 amp, 125 volt, AC, GFCI, Hospital Grade receptacles, to be UL listed "Hospital Grade" under UL No. 498. Receptacles shall be Hubbell GF-8300, or approved equal.

Cover plates for switches and receptacles shall be stainless steel.

Device boxes shall be standard surface mount hot-dip galvanized steel type at least 1-1/2 inches deep, single or ganged of size to accomodate devices shown. All boxes shall be equipped with cover plates.

9-31.10 PULL CORD

Pull cord shall be 1/4 inch polypropolene in accordance with Material Standard 7272.2.

9-31.11 FUSED SWITCH

9-31.11(1) GENERAL

Fused switch shall be rated heavy duty with dead front construction. All factory wiring shall be copper. The switch shall be a 3 pole single throw fused disconnect with a grounded neutral bus. Fuses shall be a dual element time dealy current limiting type with 200,000 A.I.C. rating.

Fused switch shall be Furnas Cat. No. 73HA323NCB for 100 amp, 240 volt, single phase with S/N, or equal, mounted in NEMA I enclosure; or shall be Furnas Cat. No. 73HA423NCB for 100 amp, 240 volt, three phase with S/N, or equal, mounted in NEMA I enclosure. Switches for other voltages shall be similar to the above. The enclosure shall prevent cover opening unless the switch is "OFF." Operation shall be "Quick-Make, Quick-Break" type. Knock outs and mounting holes shall be provided in the enclosure. Door latch shall permit padlocking door in closed position.

9-31.11(2) SWITCHBOARD MATTING

Switchboard matting shall conform to Occupational Safety and Health Administration (OSHA) Regulation Reference 29CRF 1910.137 and 29CRF 1910.309(b).

Matting shall be neoprene rubber with a diamond plate surface design and cloth impression back. Design shall conform to MIL SPEC MIL-M-15562F Type III dated December 7, 1977 as amended.

Matting shall have a minimum dialectric strength of 30,000 volts.

9-31.11(3) ELECTRIC PANELS AND BREAKERS

Panels shall be of dead front construction. All factory wiring shall be copper. Circuit breakers shall conform to Federal Specifications WC375.

9-31.12 BIRD GUARDS

Bird guards shall be stainless steel as manufactured by Nixolite of America, or approved equal. Installation shall be as recommended by the manufacturer.

Bird guards shall be installed on all fused switches, panel boards, enclosures, and where directed by the Engineer, on equipment which is more than 8 feet aboved grade.

SECTION 9-32 TRAFFIC SIGNALS SYSTEM

9-32.1 CONTROLLER ASSEMBLY

9-32.1(1) GENERAL

The controller assembly shall consist of the controller, associated equipment and specified auxilliary equipment all in the specified cabinet, as indicated in the Controller Assembly Table and other Exhibits as found in the appendix of the Project Manual, and on the Drawings.

Controllers shall be pre-timed or actuated as indicated on the Controller Assembly Table.

The controller assembly for each location shall be capable of controlling traffic flow in conformance with the respective Initial Controller Timing Exhibit and the Phase Sequence Diagram or Signal Sequence Diagram, or both, for each intersection as specified in the Controller Assembly Table.

The controller shall be micro-processor based, modularly constructed and shall be completely enclosed in a sheet metal case, with a protective finish, which shall serve as a mounting frame. No active or passive electronic components, other than the power supply, shall be attached to a part of the case.

Controller inputs and outputs shall be made at the front panel through a NEMA type (MIL-C-26482) connector. The connector shall be metal or plastic.

All circuits and their associated components shall be grouped in plug-in printed circuit assemblies. Printed circuits shall conform to the "printed circuit assemblies" standard, NEMA Standard TS1-1983. Contacts shall be gold-plated. The circuit reference symbol for each component part shall be clearly marked thereon. Circuit boards shall be mechanically keyed to prevent insertion in the wrong plug. Circuit boards shall be plug connected and systematically arranged so that they may be readily removed without unsoldering or handling individual connections.

External logic circuits shall be installed as required to provide special functions (e.g., pre- emption, special phasing, etc.) and shall conform to the external logic specifications as detailed on the Drawings and/or the Controller Assembly Table. External logic shall use digital methods and solid state construction. Logic units shall be modularly constructed, enclosed in a sheet metal case and all inputs and outputs shall be through NEMA Type (MIL-C-26482) connector. The connector shall be metal or plastic.

Automatic changes via time clocks or interconnect from flashing to normal operation shall be made at the beginning of the major street green interval. Automatic changes from normal operation to flashing shall be made at the end of the major street red interval. The change from flashing to normal or normal to flashing by any manual switch may be made at any time, except changes from flashing to normal through the "EMERGENCY FLASH" switch shall be made at the beginning of the major street green interval.

The controllers shall power up in the major street yellow.

All necessary programming equipment shall be provided with each controller to change the timing of the controller.

All timing shall be set with push buttons from the front panel.

All timing shall be set in decimal numbers.

It shall be possible to change the timing without removing any part of the controller and without using any special tools and to change timing without placing the intersection into the flashing mode.

All timing functions except offsets shall be in seconds (decimal numbers) and not in percentages. It shall be possible to program any interval to zero timing to allow that interval to be skipped.

All illuminated displays and manual input timing shall be clearly visible in bright sunlight.

Any power volatile memories such as random access memory (RAM) which contain input timing not stored in non-volatile memory shall be battery-supported for non-volatility for a period of not less than 5 days. The battery shall be a rechargeable type with automatic charging circuitry or lithium type with a 10 year shelf life and an accumulating running time of one 1 year minimum.

Each controller model shall be provided with an internal or external unit to program all programmable read-only memories used in each type of controller, unless one unit is capable of programming all models provided.

To prevent the conflict monitor from tripping during relamping of a green or yellow in a single head per phase location, a 10 watt wire wound 1000 ohm resistor on the yellow and green outputs to neutral shall be wired into the cabinet for the appropriate circuits.

The following exhibits included herein shall apply to the controller:

Exhibit	Title
A	Controller Assembly Table
B	Police Panel
C	Auxiliary Panel
D	Computer Interface
E	Field Wiring Terminals
F	Phase Sequence Diagram, Signal Sequence Diagram, and Initial Controller Timing
G	Functional Test Procedure for Controller Assemblies

9-32.1(2) PRE-TIMED CONTROLLER

9-32.1(2)A GENERAL

The following table defines the minimum timing patterns which shall be provided:

Timing Element	Min. #	Min. Range	Max. Increment
Pre-empt	1	N.A.	N.A.
Signal Sequence	2	N.A.	N.A.
Intervals	24	N.A.	N.A.
Cycle	4	30-120 sec.	5 sec.
Split	3 per Cycle	1 to 99.9 sec.	1 sec.
Offset	3 per Cycle	0 to 119 sec.	1 sec.

It shall be possible to program the start-up interval, to select the interval in which the controller will change a timing pattern, and to select the interval and amount of maximum change that can occur during one cycle for the dwell interrupter function

Each controller shall accept the following inputs:

(a) Chassis Ground
(b) 120 VAC+
(c) 120 VAC Neutral
(d) Stop Time
(e) Interval Advanc
(f) Offset 1
(g) Offset 2
(h) Offset 3
(i) Cycle 2
(j) Cycle 3
(k) Interval Advance Enable
(l) On Line (computer control)
(m) Line Advance (computer advance-change intervals
(n) Logic Ground
(o) Restart
(p) Split 2
(q) Split 3
(r) Signal Plan 2
(s) Actuation
(t) Pre-empt

Terminals or support logic, or both, shall be provided to allow the controller to rest in any designated walk phase position until a push button actuation, contact closure or remote signal permits the controller to cycle with a momentary push button actuation. The controller shall complete one cycle and return to rest in the designated walk phase lowercase. This operation shall be suitable for school crosswalk locations.

9-32.1(2)B SIGNAL CIRCUITS

The controller unit shall provide a minimum of 30 load switch control-circuits, at NEMA logic level.

Signal circuits shown on the wiring diagram shall be complete in each controller including flash transfer relay, conflict monitor capacity and signal load switch units to provide 120 VAC, 10 Ampere signal circuits controlled by the output of the fixed time controller.

A minimum of 12 signal circuits shall be programmable to flash.

9-32.1(2)C 120 VAC INTERCONNECTION INTERFACES

Pre-timed controller assemblies shall be wired to operate on a standard 120 VAC 3-cycle, 3-offset interconnect system:

Circuit	Function
1	120 VAC Commmon
2	Cycle 2 Transfer (120 VAC)
3	Cycle 3 Transfer (120 VAC)
4	Offset 1 (5 percent/cycle ground at zero)
5	Offset 2 (5 percent/cycle ground at zero)
6	Offset 3 (5 percent/cycle ground at zero)

9-32.1(2)D MASTER CONTROLLER OPTION

It shall be possible to program the controller to function as a master controller. In this mode the controller shall output a logic ground synch signal providing a grounded output for five percent of cycle in effect for each cycle length selected. The controller shall be furnished as a master controller if specified.

9-32.1(3) ACTUATED CONTROLLER

9-32.1(3)A NEMA STANDARDS

The controller shall conform to NEMA Standard TS 1-1983 and shall provide all functions (except that volume density can be, but need not be provided) which are provided for in the standard. Controller modules which are modified and are not interchangeable with the same module in a NEMA standard controller shall be marked, in a permanent manner, as a non-NEMA standard module. All overlap functions shall be programmable.

9-32.1(3)B MANUAL INPUTS

The following manual inputs shall be provided:

(a) Minimum Green
(b) Passage
(c) Yellow Orange
(d) Red Clearance
(e) Max I
(f) Max II
(g) Walk
(h) Don't Walk
(i) Minimum Recall
(j) Maximum Recall
(k) Pedestrian Recall
(l) Locking non-locking detection

9-32.1(3)C VISUAL OUTPUTS

The following visual outputs shall be available by observing switch positions or illuminated displays on the front panel:

(a) Per Phase:
  (1) Phase on
  (2) Phase next
  (3) Vehicle call
  (4) Vehicle actuation
  (5) Pedestrian actuation
  (6) All interval time settings listed in Section 9-32.1(3)B for manual inputs.
(b) Per Ring:
  (1) Initial
  (2) Passage
  (3) Walk
  (4) Pedestrian clearance
  (5) Yellow
  (6) Red clearance

9-32.1(3)D CONSTRUCTION STANDARDS - WIRING

Inputs and outputs of the controller and accessories shall be brought out through the wiring harness and connector(s) and terminated on terminal strips in the cabinet.

9-32.1(3)E CONTROLLER PEDESTRIAN SEQUENCE

The basic operation of the controller will be to rest in the GREEN/DON'T WALK position so that it may advance to the next phase immediately after the vehicle clearance intervals (yellow/all red).

The controller shall also have the ability to rest in the GREEN/WALK position in any phase.

When the controller is in the GREEN/DON'T WALK rest position, it shall be capable of returning directly to the GREEN/WALK position upon actuation of the major street push buttons providing no demand is registered on the other phases.

When yield is provided by a co-ordination, the variable yield shall determine when the control may return to the walk position even if no calls are present on the opposing phases.

9-32.1(4) ASSOCIATED EQUIPMENT

9-32.1(4)A GENERAL

Both pretimed and actuated controller assemblies shall be equipped with associated equipment as specified in Section 9-32.1(4).

9-32.1(4)B TERMINAL STRIP/WIRING IDENTIFICATION

Only terminal strips with screw-type terminals shall be used to secure signal and service wires to the terminal strips.

Each conductor termination and each terminal strip shall be permanently tagged with an identifying circuit number as indicated on the Drawings. Wire markers shall be stretch slip over/type printed with the circuit numbers for each circuit available. Wire markers shall be applied within 6 inches of the termination. Wire marker requirements apply only to field wiring.

All field wire terminal strips shall be located a minimum distance of 6 inches and a maximum distance of 8 inches above the bottom of the cabinet.

9-32.1(4)C POLICE PANEL

The police panel shall have two toggle switches, each with two positions. Switch No. 1 shall be on the left side and its upper position shall be labeled "EMERGENCY OFF." In this position, the signals shall be off and the controller shall run. The lower position shall be labeled "ON" and in this position, the signals shall be on and the controller shall operate normally. Switch No. 2 shall be on the right side and its upper position shall be labeled "EMERGENCY FLASH." In this position, the signals shall flash with the pedestrian signals dark, and the controller shall run. The lower position shall be labeled "AUTO" and in this position, the signals and controller shall operate normally. Switch No. 1 shall override Switch No. 2. The controller shall start up in major street green when being returned from flashing operation through Switch No. 2.

9-32.1(4)D AUXILIARY PANEL

A panel shall be mounted inside the cabinet door and shall include the following items, as specified in Exhibit C (included in the appendix of the Project Manual).

Switches and lights shall be oriented and labeled. The door switch shall cause all display lights to be turned on when the door is open and off when the door is closed. Switches shall be toggle type except for "OFFSET CONTROL" switch.

(a) A "NORMAL FLASH" switch which shall cause the signals to flash and shall allow the controller to run.
(b) A "MANUAL CONTROL" switch which shall cause the controller to stop time in each non-guaranteed interval until manually advanced by actuation of the manual push

button. Actuated type controllers shall time guaranteed intervals normally without halting when in the manual mode.

(c) A "PRE-EMPT TEST" switch which shall cause a pre-empt signal to activate the pre-emption sequence. If more than one pre-empt sequence is available there shall be a switch for each sequence.

(d) A "DETECTOR INHIBIT" switch which shall inhibit all detector inputs to the controller, except the manual call buttons on the map display board or auxiliary panel.

(e) A "COORD/FREE" switch which shall, when in the FREE position, free the local controller from coordination input but leave the coordinator energized.

(f) A "CONTROLLER POWER" switch which shall de-energize the controller.

(g) A "SIGNAL LIGHTS" switch which shall turn the signal lights off and allow the controller to run.

(h) A "STOP TIME" switch which shall stop time the controller in the interval it is in when the switch is activated.

9-32.1(4)E LOAD SWITCHES AND BASES

Each cabinet shall be furnished with the number of load switch bases specified in the Controller Assembly Table. Each base shall be fully wired for control circuits, flash transfer relay, and conflict monitor.

Load switches shall be furnished in the quantities specified in the Controller Assembly Table. Load switches shall be solid state, plug in, triple, according to NEMA Standards, TS 1-Part 5. Indicator lights for each circuit shall be provided on each load switch.

9-32.1(4)F OTHER EQUIPMENT

An internally mounted thermostat which will activate the fan at temperatures above 70 degrees Fahrenheit and the light at temperatures below 55 degrees Fahrenheit. The thermostat shall have a minimum cycle of 5 degrees Fahrenheit between turn-on and turn-off of either the fan or the light.

An internally mounted electric exhaust fan mounted near the top of the cabinet with ball or roller bearings and a capacity of 100 cubic feet per minute as installed. The fan exhaust shall be vented to the outside and be weathertight. The fan shall be thermostatically controlled. The fan circuit shall be fused.

Weatherproof vents with a glass fiber air filter, (1 inch x 10 inch x 20 inch for Type II and III cabinets) or of sufficient size to allow the fan to pump 100 CFM.

An incandescent light socket door switch controlled and thermostatically controlled (thermostat switch in parallel with door switch) with 67 watt light bulb. The light shall be located near the bottom of the cabinet.

A radio interference suppressor shall be rated at 30 amps or more.

A 30 amp circuit breaker for the controller, accessories and signal lights and a 15 amp circuit breaker for illuminated signs and convenience outlet. Wherever 5 or more vehicle phases are provided, the primary circuit breaker shall be 45 amps.

A 15 amp NEMA standard convenience outlet with a ground contact and a ground fault interrupter.

Electrical interface shall be provided in the control cabinet wiring to provide the electrical logic and voltage levels required by the interconnect interface and the computer interface (See Exhibit D in the appendix of the Project Manual).

Computer Interface: A computer interface panel will be required in each controller assembly and a connecting harness. Space shall be provided adjacent to the computer interface panel for a communications amplifier (Eagle Signal Model DGS 352 - approx. 8 inch x 8 inch x 11 inch) which shall be installed and connected when required in all cabinets. The on-line command of the computer shall have circuitry that will remove control of the back-up system. Absence of the on-line command will automatically allow control to return to the back-up system. The computer on line command shall inhibit any control of the back-up system. The communications unit for interfacing the controller assembly with the computer located in the Municipal Building shall be an Eagle Signal Company Model DGS 352 either pre-timed or actuated as required whenever specified in the Controller Assembly Table.

Interconnection Cable Interface: An interface panel shall be provided to convert the 120 volt A.C. direct wire interconnect incoming commands to NEMA logic for the controller coordinator.

The flasher and flash relay shall be in accordance with the current NEMA Standard for flashers. The flasher shall have two circuits rated at 10 amps each.

The flash transfer relay shall be electromechanical, enclosed in a dust cover and plug mounted. The relay shall be rated at 120 VAC coil and 120 VAC 15 amp contacts. The relay shall apply power to the flash sequence and allow the controller to run when in the energized state.

A manual push button with a 4 foot flexible cord shall be installed on the inside of the door with a box or hook to keep the cord from dangling more than 6 inches.

9-32.1(5) AUXILIARY EQUIPMENT

9-32.1(5)A GENERAL

Controller assemblies shall be furnished with auxiliary equipment as specified in the Controller Assembly Table.

9-32.1(5)B INDUCTIVE LOOP DETECTOR AMPLIFIER

Loop vehicle detector amplifier units shall be configured in 2 channel and/or 4 channel digital, sequential, "scanning" type, adaptable for either shelf or rack mounting which will provide the minimum number of amplifier units, as indicated in Exhibit A included in the appendix of the Project Manual. The unit shall employ a single mating connector with adequate number of pins to accommodate input and output for the specified channels, AC power input and equipment ground.

Amplifier units shall be self-tuning. Tuning controls of any kind shall not be acceptable. Tuning shall employ a digital system which is completely automatic and is accomplished within 2 minutes after turn-on. Operation of the detector shall automatically compensate for changes in loop parameters caused by moisture and temperature variations.

Amplifier unit dimensions shall not exceed 2, inches wide, 6 inches high, and 9 inches deep, including connector.

All controls, cable connectors, and indicators shall be located on the front panel. Each channel shall have an associated "write-on" I.D. pad to indicate traffic phase or other relevant information.

An indicator (incandescent or LED) shall be provided for each channel to indicate output state.

Amplifier units shall operate on the "scanning" principle - only 1 channel exciting a loop/lead-in system at any one point in time - and shall provide for channel-to-channel automatic digital processing of loop inductance data over two-channels and/or four-channels as specified.

"Cross-talk" between channels of the same amplifier unit shall be eliminated within the unit by sequential scanning of the channels.

"Cross-talk" between amplifier units shall be minimized by a front panel mounted control switch.

Sensitivity, pulse or presence mode and "OFF" position for each channel shall be selectable by a multi-position switch. A wide range of sensitivity levels shall be provided to allow

detection of small vehicles (motorcycles) at the higher levels and elimination of vehicle detection on adjoining lanes at lower levels.

In the pulse mode, each new vehicle shall provide an output pulse of 100 + 25 milliseconds. A vehicle stopped over the loop shall generate a pulse upon entering the loop and shall be "tuned-out" within 2 seconds at which time the detector channel shall return to full performance, so that additional vehicles shall register calls over the loop or other loops connected to the same channel.

In the presence mode, the minimum hold time for detectable vehicles shall be 4 minutes, and no more than 120 minutes. In the presence mode the detector channel shall recover to normal sensitivity within 1 second after termination of vehicle presence in the zone of detection regardless of the duration of the presence.

Each of the channels of the amplifier unit shall automatically self-tune to any standard loop or combination of loops, from 0 to 2000 microhenry, within 10 seconds after application or interruption of power.

Each channel of the amplifier unit shall provide continued operation on a loop, or loops, which are shorted or leaking to ground.

A broken loop or lead-in cable on any channel shall cause that channel to place a continuous call (fail call).

Each channel shall provide unlimited detection of continuous traffic without loss of detection in long, peak-hour traffic queues. Vehicle movement over loop shall restart presence hold time.

The output circuit for each channel shall be compatible for interfacing with solid-state digital equipment.

Lightning protection shall be installed inside the loop detector:

(a) The protection shall enable the detector to withstand the connection of a 2 microfarad capacitor charge to + 1000 volts directly across the detector input inductance pins with no loop load present.

(b) The protection shall enable the detector to withstand the connection of a 2 microfarad capacitor charge to + 1000 volts directly across either the detector input inductance pins or from either side of the detector input inductance pins to earth ground. The detector chasis shall be grounded and the detector input inductance pins shall have a dummy resistive load attached equal to 5 ohms.

(c) Varistors between the power line leads shall be included to limit power line peak transient voltage to not more than 280 Volts DC.

9-32.1(5)C COORDINATING UNIT

The coordinating units shall provide the following minimum functions:

(a) 4 Cycles
(b) 3 Split/Cycle
(c) 3 Offsets per cycle
(d) 3 Force-off circuits
(e) 3 Permissive periods
(f) 3 Hold circuits
(g) Free mode
(h) Flash operation
(i) Pedestrian Lock-out

The unit shall be a digital, solid state device constructed as an integral part of the controller. All timing shall be done through the front panel by push button keyboard. Input shall be directly from the 120 VAC interconnecting cable; output shall be NEMA Logic.

9-32.1(5)D TIME BASE COORDINATOR

The term "Time Base Coordinator" shall describe a unit that is capable of providing mastering functions for any standard traffic signal controller on a "Stand Alone" basis without any external input. The unit shall be capable of maintaining all timing functions such as time of day, cycle, offset and synchronization through a power failure of up to 40 hours and resuming operation with all outputs including synchronization identical to any other units in a system which have not had a power interruption.

The unit shall be programmable on a weekly basis with the capability of programming on a yearly basis events such as daylight savings time changes, holidays and special events. The unit shall be micro-computer based, modular in design using circuits consistent with the latest solid state digital technology.

All programming shall be done on a front panel keyboard or by downloading.

The unit shall have an illuminated display on the front panel which will show all output functions currently in effect and also all programming that is placed in memory.

Time Base Coordinators shall be housed in one of the following ways:

(a) A single fully enclosed metal housing with easy accessibility for internal maintenance.

(b) A separate module of the controller front panel.

The unit shall provide negative true outputs (nominal 0 volts) for each programmed function. Each output shall be an NPN open collector capable of sinking 100 MA and shall be capable of interfacing directly with solid-state control equipment using true logic inputs per NEMA standards TS-1-1976 TS-1-3.02C. The units shall provide 120 VAC output via sensitive mechanical relays (mini relays) for all functions for operating electro-mechanical controls, interconnecting cable systems or sign feature.

For traffic-actuated controls, the unit shall provide a hold-force off program for 4 phases of an actuated control with the following minimum functions:

(a) Phase 1 hold
(b) 3 force-off circuits (output adjustable in length)
(c) Programmable free operation
(d) 2 unassigned outputs
(e) 4 cycle lengths
(f) 3 Splits
(g) 3 offsets per cycle

For pretimed controls, the unit shall provide a dial-reset program with the following minimum functions:

(a) 4 cycle length
(b) 3 Splits
(c) 3 offsets per cycle
(d) 2 unassigned outputs

The zero point for each cycle shall be set by a push button on the front of the case or shall be based on an automatic reset of all cycles which occurs at midnight every 24 hours.

The unit shall execute up to 99 programs over a 7-day period with a 1 minute resolution between programs. Additional programming shall be available to provide daylight savings time resetting and to provide omitting of normal programming for 10 holidays on a yearly basis.

Each unit shall have a standby battery that will retain in memory all timing functions and all "zero" points for at least 40 consecutive hours with an accuracy of .015 percent over that period. During normal operation the battery shall be maintained by a trickle charge. The battery shall be a sealed lead acid type.

Each unit shall have the capability, when fully programmed, of programming (downloading) another unit by means of a connecting cable.

9-32.1(5)E TIME CLOCKS

Time clocks shall be solid state design with all programming through a push button keyboard. The clock shall be capable of driving all functions specified for a controller or a co-ordinator based on NEMA logic.

The clock shall provide a minimum of 8 output functions with an additional output for a synchronizing pulse for each cycle in effect. Timing functions shall be in seconds and decimals, not in percentages.

The clock shall provide a minimum of 100 on-off functions for a weekly program. The weekly program shall have the capability of omitting any day.

An illuminated display shall be provided to indicate time setting and program outputs.

The clock shall provide 4 discrete timing cycles from 30 to 256 seconds. The resynchronizing circuit shall provide a 5 percent synch pulse for any selected cycle. The start of each cycle (i.e. zero) shall be individually set and shall be retained through programmed cycle changes or battery back up operation as though that cycle had remained in continuous operation.

Battery back up power shall be provided to allow operation of the timing, memory, program, and resynch operations. The transfer to battery power and return to AC power shall be automatic and without interruption. The recharging of the battery shall be automatic. Battery operation shall not accumulate an error greater than .005 percent over 100 hours. The battery shall be a sealed lead acid type.

Timing shall be crystal controlled and synchronized to the 60 Hz AC line frequency. Timing error shall not exceed plus or minus 1 second per month on 60 cycle AC power.

The unit shall be enclosed in a metal cabinet suitable for shelf mounting or may be an integral part of the controller. Displays and connections shall be on the front panel.

9-32.1(5)F CONFLICT MONITOR

The conflict monitor shall meet NEMA Standards and shall monitor all 120 volt AC outputs of greens, yellows and walks, for conflicting indications as well as the absence of red indications. It shall also monitor controller power. Conflict monitors shall provide indicators for each channel.

Conflicting indications shall stop time the controller and cause the signals to flash all phases red and turn all pedestrian signals dark. Removal of the conflict monitor shall allow the controller to continue to operate.

Conflict monitors shall be capable of monitoring the number of circuits specified in Exhibit A, included in the appendix of the Project Manual.

The monitor shall only detect conflicts after a minimum duration of approximately 0.3 seconds and not more than 0.4 seconds before transferring the timer to flashing operation.

The design of the sensing unit of the monitor shall be completely solid state with NEMA program board to program overlaps and NEMA plugs and harness.

The sensing unit shall detect both positive and negative alternations of the sine wave or full wave voltage conflicts.

The sensing unit shall detect a minimum of 25 volts.

An indicating light and reset button shall be provided on each channel.

Conflict monitors shall be modularly constructed, and shall be completely enclosed in a sheet metal case.

Conflict monitors shall be constructed as a separate unit, not integral to the controller. It shall have its own integral power supply and a separate connector for all inputs and outputs.

9-32.1(5)G MAP DISPLAY BOARD

The map display board shall include a momentary contact switch to simulate detectors and push button for each phase.

The detector call buttons and colored signal indicator lights, with phases indicated and labeled, shall be mounted in the appropriate positions on the map display board of the intersection. North shall be at top of display panel.

The map display board shall graphically represent the intersection and shall be no smaller than 14 inches square and shall be mounted on the cabinet door.

White indicator lights shall show pedestrian and vehicular detector actuations and any special functions (e.g., pre-empt, etc.) for each phase. Indications shall be visible in bright sunlight.

9-32.1(5)H CONTROLLER ASSEMBLY CABINET

The controller shall be housed in a cabinet type as shown in the Controller Assembly Table. If the cabinet size specified does not, in the estimation of the Contractor, provide adequate space, a larger size cabinet may be substituted, but only with the approval of the Engineer. The Engineer shall be given written justification and a proposed cabinet layout with the manufacturer request to use larger cabinets. Each cabinet and the arrangement of components therein shall be to accommodate the largest load switch allowed according to NEMA Standard, TSI-Part 5.

Cabinets shall be weatherproof meeting NEMA 3R specifications and constructed of aluminum. The maximum overall height of the complete assembly shall be 66 inches. There shall be a police door in the main cabinet door. Door hinge pins shall be stainless steel. Doors shall be sealed with gaskets. The main door shall be fitted with a door stop having at least two positions with an extreme position of not less than 120 degrees and an intermediate position of 90 degrees. The door shall be provided with an opening mechanism which will accept a 3/8 inch allen wrench for opening instead of a permanent door handle. A sliding keyhole cover shall be provided to cover the allen wrench opening.

The main cabinet door shall have a Best Lock or equal with a construction core and the police panel door shall have a standard police lock. The City will exchange the construction core for a Seattle "A" master core at the time of turn on. One key for the construction core and one key for the police lock shall be furnished with each assembly. A sliding keyhole cover shall be provided to prevent ice and snow build-up in the key hole.

Controller cabinets shall be painted with 2 coats meeting or exceeding Federal Specification TT-C-542D "Poly Urethane Coating, Moisture Curing" Type I, Class II 29. Exterior color shall be Federal Specification ASA 61 Gray. Interior shall be flat black.

Cabinets shall be clearly labeled on the inside of the door with a minimum of 3/8 inch lettering, indicating the intersection location including the main and minor cross streets.

The cabinets shall be of the following sizes:

Dimension	Type I	Type II	Type III
Width	18 to 24"	28 to 34"	36 to 46"
Depth	12 to 18"	16 to 20"	20 to 28"
Height	26 to 40"	38 to 52"	50 to 58"

Type I cabinet shall be pedestal mounted and Type II and III cabinets shall be base mounted. The bottom of Type I cabinets shall be of sufficient thickness and reinforced to provide a rigid assembly.

Cabinets shall be of sufficient size to house all required equipment and provide adequate space for maintenance and cooling. Shelves shall be provided for all equipment.

Type I cabinets shall be furnished with 4 inch pipe pedestal (4-1/2 inches O.D.). Type II & III cabinets shall fit concrete foundations as detailed on Standard Plan No. 500.

Internal and external attachments to the cabinet shall be constructed such that no exposed screw heads or protruding screw threads are accessible from the outside of the cabinet.

Electrical interface shall be provided in the control cabinet wiring to provide the electrical logic and voltage levels required by the interconnect interface and the computer interface (Exhibit D in the appendix of the Project Manual).

9-32.2 TRAINING

9-32.2(1) GENERAL

Within 30 days after approval of controller assembly shop drawings, the Contractor shall submit a proposed plan and a course outline for the training of City engineering and maintenance personnel (3 days each) in the operation and maintenance of the complete intersection controller assembly.

The course shall be conducted for a minimum period of 6 hours each working day until the conclusion of the course, unless otherwise approved by the Engineer. A factory trained instructor for each element of the course shall be assigned to it full time and shall not perform other duties which would interrupt instruction during this period. A classroom will be provided by the Owner for the course.

As an alternate to the above training course, the Contractor may, with advance approval of the Engineer, furnish a video cassette tape which meets the following requirements:

(a) VHS format
(b) Standard speed T-120
(c) 2 hours of operation instructions
(d) 4 hours of maintenance and repair
(e) Indexed by footage to identify course elements
(f) Tape shall become the property of the owner

This may be a copy of an approved tape previously supplied to other agencies. The tape shall include the latest revisions to this equipment.

9-32.2(2) COURSE CONTENT AND MANUALS

The course shall include, but not necessarily be limited to:

(a) Operation of the local controllers and coordination units.
(b) Operation of the local master units.
(c) Routine maintenance and repair of local controllers and auxiliary equipment including diagnostic and trouble shooting procedures.
(d) Routine maintenance and repair of communications system including diagnostic and trouble shooting procedures.
(e) Routine maintenance of system master units including diagnostic and trouble shooting procedures.

The Contractor shall provide 8 sets of instructional material including trainee's workbooks, instructor's guides, training aids, equipment and systems technical manuals wiring diagrams, block diagrams, and all other necessary documentation and material sufficient to perform routine maintenance and trouble shooting.

9-32.3 SIGNAL HEADS, VEHICLE

9-32.3(1) GENERAL

9-32.3(1)A SIGNAL HEAD COMPONENTS

Signal heads shall be in accordance with the "Institute of Transportation Engineers" publication, latest edition of "ADJUSTABLE FACE VEHICLE TRAFFIC CONTROL SIGNAL HEAD STANDARD" and the following additional requirements.

The equipment shall be designed for operation under temperature and humidity conditions encountered in the Pacific Northwestern United States.

Materials and workmanship shall conform to the best commercial standards of the industry.

A terminal block of an approved type shall be mounted inside at the back of each signal head. All sockets shall be so wired that a white wire will be connected to the shell of the socket and a wire, the color of the lens, to the end terminal of the socket. These wires shall in turn be connected to the terminal block mounted in the housing. The terminal block shall have sufficient studs to terminate 6 field wires and lamp wires independently to the block with separate screws. The terminals to which field wires are attached shall be permanently identified to facilitate field work.

All signal heads shall be installed as indicated on the Drawings and as designated by the Engineer.

The housing, door, visor exterior and mounting hardware/framework shall be dark green in color. The visor interior and both sides of the back plate shall be optical black or flat black in color. The paint shall be of the best quality synthetic resin enamel.

Adjustable signal heads shall consist of separate signal sections, expandable type, for vertical or horizontal mounting, rigidly and securely fastened together into one weather-tight signal assembly. The signal sections shall be 8 inches or 12 inches as indicated on the Drawings.

Each section shall consist of a housing, door assembly and optical unit and backplate and shall be so constructed as to provide complete inter-changeability of parts.

Weather-resistant mildew-proof gasketing shall be provided between the housing and door assembly and between the lens and reflector, which shall exclude dust and moisture.

9-32.3(1)B HOUSING

The housing shall be cast from aluminum alloy free from flaws, cracks, blowholes and other imperfections.

Each vehicular signal head shall have a 1/4 inch drain hole in the bottom of the head.

Each section shall house 1 individual optical unit complete with 1-piece hinged square door, mounting for the lens and other parts of the optical system and a simple noncorrodible door-locking device.

Sections shall be interchangeable and so constructed that sections can be added or removed. The top and bottom shall be drilled for 1-1/2 inch supporting pipe fittings. Hexagonal heavy plumbers lock nuts 2-1/2 inches across flats for 1-1/2 inch pipe shall be provided for top and bottom.

The 4 backplate mounting holes (2 in the top of the backplate and 2 in the bottom of the backplate) shall be a maximum distance of 1-1/4 inches on 8 inch signal and 2-1/2 inches on 12 inch signals from the top or bottom edge of the signal housing.

9-32.3(1)C DOOR ASSEMBLY

The door assembly shall consist of the door, lens and visor.

The door of each section shall be made of aluminum alloy and shall be hinged to the housing so as to permit access or removal. The door shall be secured to the housing by a finger type locking device. The door-locking device shall be easily removable to allow door removal.

Each section shall have a visor made from aluminum alloy sheet of a tunnel design attached to the door by means of 4 panhead screws. The mounting holes shall be slotted. Visor length shall be 8 inches for 8 inch signals and 12 inches for 12 inch signals.

The lens shall be glass, circular in shape of the color, type and size specified. The lens shall be designed to give an outward distribution of light with a minimum above the

horizontal. Each lens shall be true to color and shall conform to the latest ITE Standard. The lenses shall have a minimum visible diameter of 7-3/4 inches (eight inches nominal) or 11-1/2 inches (12 inches nominal).

9-32.3(1)D OPTICAL UNIT

The optical unit consists of the reflector and lamp receptacle and shall be so mounted to the housing that it can be swung open for ready access or removal without the use of tools. The optical unit lens and visor shall be designed as a whole to reduce sun-phantom. Lamp re-placement shall be through the parabolic side of the reflector, and shall not require removal of the lamp holder from the reflector unit.

The reflectors shall be constructed of silvered glass or specular alzak aluminum in a parabolic design. An opening in the back of the reflector for a lamp holder shall be constructed to elimininate dark spots on the lens.

Relamping and cleaning of reflectors shall be easily accomplished upon opening of the door without removal of screws or mounting framework inside the housing.

The lamp receptacle shall be of weather-proof molded construction immune to the operating temperatures in the unit and shall be provided with 2 wires of sufficient length to be connected to the terminal block.

Traffic signal lamps shall be of the following requirements and meet current institute of Transportation Engineers' specifications:

Lens Size	Voltage	Rated Life	Initial Lumen Output
8 inch	120 V	8000 Hr.	665
12 inch	120 V	8000 Hr.	1950

9-32.3(1)E BACKPLATE

The signal, with backplate, shall be designed to meet or exceed the load requirements in accordance with Section 2 of "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals," AASHTO 1975. Back plates shall be furnished and attached to each signal head assembly. Back plates shall be constructed of anodized, 3-S half-hard aluminum sheet, 0.058 inches minimum thickness. The back plates shall be riveted together with a minimum of 8 5/16-inch pop rivets. No bolts or screws will be permitted. Back plates shall not interfere with either the operation of the door or the mounting of the signal. Mounting hole pattern shall match pattern on signal head housing. The front and back of the back plates shall be finished with 2 coats of flat black enamel.

Back plates shall be permanently attached so as to provide a 5 inch border for either 8 inch or 12 inch signal heads. On combination heads (i.e., 12-inch and 8-inch sections) the back plate shall have a 5-inch border relative to the 8-inch head. Therefore, the border on the 12-inch shall be approximately 3 inches.

Back plates shall be provided with a minimum of 2 mounting holes per signal section, one on each side. The 2 top and 2 bottom backplate mounting holes shall be a maximum distance of 1 1/4-inch from the corners of a 8 inch signal housing, and 2 1/2-inch from the corners of a 12-inch signal housing.

9-32.3(2) BI-MODAL VEHICLE SIGNALS SECTION

The signal section shall display both yellow and green arrow indications from the same face and shall use a fail-safe 2-lamp system to direct either color light into a fiberoptic display. The section shall be adaptable to conventional 12-inch vehicle signal heads.

9-32.3(3) OPTICALLY PROGRAMMED VEHICLE SIGNAL SECTION

The signal shall permit the visibility zone of the indication to be determined optically and require no hoods or louvers. The projected indication may be selectively visible or veiled anywhere within 15 degrees of the optical axis. No indication shall result from external illumination nor shall one light unit illuminate a second.

The components of the optical system shall comprise: lamps; lamp collar; optical limiter - diffuser; and objective lens.

The lamp shall be nominal 150 watt (75 watt for distance-limiting applications), 120 volt AC, three-prong, sealed beam having an integral reflector with stippled cover and an average rated life of at least 6,000 hours. The lamp shall be coupled to the diffusing element with a collar including a specular inner surface. The diffusing element may be discrete or integral with the convex surface of the optical limiter.

The optical limiter shall provide an imaging surface at focus on the optical axis for objects 900 to 1200 feet distance, and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be provided with positive indexing means and composed of heat resistant glass.

The objective lens shall be a high resolution planar incremental lens hermetically sealed with a flat laminate of weather resistant acrylic or approved equal. The lens shall be symmetrical in outline and may be rotated to any 90 degree orientation about the optical axis without displacing the primary image.

The optical system shall accommodate projection of diverse, selected indicia to separate portions of the roadway such that only one indication will be simultaneously apparent to any viewer after optically limiting procedures have been accomplished. The projected indication shall conform to ITE transmittance and chromaticity standards.

9-32.3(4) DIRECTIONAL LOUVERS

Where so indicated on the Drawings, louvers shall be furnished and installed in signal visors. Directional louvers shall be so constructed as to have a snug fit in the signal visor. The outside cylinder shall be constructed of No. 22 U.S. gauge sheet steel, and the vanes shall be constructed of No. 27 U.S. gauge sheet steel. Dimensions and arrangement of vanes shall be as indicated on the Drawings.

Louvers shall be galvanized after fabrication by the hot dipped process in conformance with ASTM Designation A 153 and painted flat black.

9-32.4 SIGNAL HEADS, PEDESTRIAN

9-32.4(1) GENERAL

The pedestrian signal head shall consist of a message module, case, eggcrate visor, transformer, and directional louvers.

The entire pedestrian signal including neon tubing, transformers, and all ABS or polycarbonate plastic parts shall be warranted for 2 years from the date of shipment against defects in workmanship, or materials, or both.

The case, sun shield and mounting hardware shall be painted dark green in color. The eggcrate visor interior and directional louvers shall be painted flat black in color.

The maximum overall dimension of the signal shall be 19+ inches wide, 19 inches high and 9 inches deep, not including eggcrate visor and hinges. In order to facilitate installation and maintenance, the signal shall be designed so that all components are readily accessible from the front by merely opening the signal door.

Pedestrian signals shall display international symbols (Portland orange "Hand" and the lunar white "Walking Person") illuminated by multiple configuration neon tubes encased in a molded plug-in plastic message Module. The Hand-Person symbols shall be a minimum of 12 inches in height and 7 inches in width.

9-32.4(2) MESSAGE MODULE

The message module shall consist of 2 neon gas tubes enclosed and thus protected by a housing made of white acrylonitrile butadiene styrene or polycarbonate plastic and a screened message lens made of polycarbonate plastic.

The tube used for the Portland orange hand symbol shall be coated on the inside with fluorescent material producing the desired Portland orange output. Tubing for the lunar white person symbol shall be coated on the inside with fluorescent material producing the desired lunar white output. It shall be formed to the approximate shape of the person and shall be positioned for maximum lunar white intensity.

The 2 neon tubes shall be enclosed in a single plug-in plastic module via resilient rubber adhesive to prevent transfer of mechanical strain to the glass tubing and to provide effective shock mounting. The plastic housing shall be molded in a manner to provide positive location of the neon tubing in relation to the screened message lens.

The message lens shall consist of 1/8 inch minimum thickness clear, U.V. stabilized refractor type, polycarbonate plastic with outer prisms and shall be weather, craze and heat resistant. The prism pattern shall face the outside of the module with the screened message enclosed within the module.

The inside face of the message lens shall be painted in all areas except where the desired symbols are formed. The first coating of paint shall be black to form a contrasting background when viewed from the outside. The second coating of paint shall be white to reflect internal light.

The message module shall be sealed into an integral assembly with a 1 piece sponge neoprene gasket fitted around the perimeter to provide positive protection of the enclosed neon tubing from handling, weather, and moisture.

The message module shall be provided with electrical contacts which will plug directly into recessed contacts in the transformer enclosure when the module is in proper position and shall not require the use of tools for insertion or removal.

9-32.4(3) CASE

The case shall consist of a housing and door each made from 1 piece, aluminum alloy die casting. It shall be dustproof, weatherproof and corrosion resistant and shall provide for easy access to and replacement of all components. The housing shall have an integral cast top, bottom, sides, and back. 4 integrally cast hinge lug pairs shall be provided for operation of a swing down door.

The housing shall be suitable for left or right hand (with pre-drilled holes and rubber plugs) clamshell mounting hardware, post-top mounting, or bracket mounting.

The top and bottom of the housing shall have an opening to accommodate 1-1/2 inch pipe brackets. The bottom opening of the signal housing shall have a standard 72 tooth locking boss integrally cast into the case. The teeth shall be clean and sharp and provide full engagement. The radial angular grooves of the boss shall provide positive positioning of the entire signal to eliminate rotation or misalignment of the signal.

The door shall be attached to the case by means of 2 stainless steel spring pins. 2 stainless steel hinged bolts with captive stainless steel wingnuts and washers shall be attached to the case with the use of stainless steel spring pins. Hence, latching or unlatching of the door shall require no tools.

9-32.4(4) EGGCRATE VISOR

Each signal shall be provided with an eggcrate type visor designed to eliminate sun phantom.

The eggcrate type visor shall be installed parallel to the face of the Hand - Person message lens and shall be held in place by stainless steel screws. The eggcrate assembly shall consist of vertical members and horizontal members. The completed assembly shall be approximately 1-1/2 inches deep.

The basic material used in construction of the eggcrate shall be nominally 0.030 inches thick and shall be polycarbonate plastic. Additional members may be employed outside the two legend areas but are not required unless dictated by structural strength of the particular assembly technique employed.

The assembly shall be enclosed in a mounting frame constructed of 0.040 inches minimum thickness aluminum or polycarbonite plastic. This frame shall be approximately 1-1/2 inches deep and may contain alternate mounting holes for use on alternate types of pedestrian signals.

9-32.4(5) TRANSFORMERS

Two transformers shall be provided with recessed secondary contacts. Both transformers shall have as a minimum 4000 volt, 30 milliampere secondary.

Each transformer shall have 120 volt (nominal) primary windings and a power factor of 90 percent minimum.

A fused switch consisting of 2 cartridge fuses and a lever for disconnecting the fuses shall be provided inside the case on a terminal block for de-energizing the transformer primary circuit. The terminal blocks shall accommodate no less than 5 terminals.

9-32.4(6) OPTICALLY PROGRAMMED PEDESTRIAN SIGNAL (2-SECTIONS)

Each signal head shall permit the visibility zone of the indication to be determined optically and require no hoods or louvers. The projected indication may be selectively visible or veiled anywhere within 15 degrees of the optical axis. No indication shall result from external illumination nor shall one light unit illuminate a second.

The components of the optical system shall comprise: (a) lamp; (b) lamp collar; (c) optical limiter-diffuser; and (d) objective lens.

The lamp shall be nominal 75 watt PAR, 120 volt AC, three-prong, sealed beam having an integral reflector with stippled cover and an average rated life of at least 6,000 hours. The lamp shall be coupled to the diffusing element with a collar including a specular inner surface. The diffusing element may be discrete or integral with the convex surface of the optical limiter.

The optical limiter shall provide an imaging surface at focus on the optical axis for objects 900 to 1200 feet distance, and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be provided with positive indexing means and composed of heat resistant glass.

The objective lens shall be a high resolution planar incremental lens hermetically sealed with a flat laminated weather resistant acrylic or approved equal. The lens shall be symmetrical in outline and may be rotated to any 90 degree orientation about the optical axis without displacing the primary image.

The optical system shall accommodate projection of diverse, selected indicia to separate portions of the crosswalk such that only one indication will be simultaneously apparent to any viewer after optically limiting procedures have been accomplished. The projected indication shall conform to ITE transmittance and chromaticity standards.

The signal head shall display international symbols. The top section lens shall provide a Portland Orange "RAISED HAND" symbol and the bottom section lens shall provide a Lunar White "WALKING MAN" symbol.

9-32.5 PEDESTRIAN PUSHBUTTON ASSEMBLY

Pedestrian pushbuttons shall be tamperproof construction. The pushbutton shall be constructed of a single, round, chrome plated metal plunger approximately 2-1/4 inches in diameter, of direct push type, and a single momentary silver contact switch rated 125 volts, 10 amperes, all in a metal enclosure.

The assembly shall be made weatherproof and shockproof by means of synthetic rubber gaskets between the cover and the enclosure and between the plunger and the cover so that it will be impossible to receive an electrical shock under any weather conditions.

The pushbutton assembly and sign shall be located on the pole shaft such that they are generally parallel to the crosswalk they are intended to serve and on the same side of the pole as the crosswalk. The pushbutton shall be mounted directly beneath the sign unless otherwise indicated on the Drawings.

9-32.6 DETECTOR LOOPS

Detectors shall be used for actuating traffic-actuated controllers and sample stations. A complete detector loop installation shall consist of loop wire and lead-in cable from the loop to the amplifier.

Loop wire shall be #14 AWG Class B (104 X 34) stranded tinned copper, high density polyethylene insulated with a .032 inch minimum thickness.

The lead-in from the detector junction box to the controller cabinet or remote detector amplifier cabinet shall be single pair #16 AWG 19 X 29 stranded tinned copper, polyethylene insulated, PVC jacketed, twisted pair cable with copper foil or aluminum-polyester shield, and a No. 18 AWG stranded tinned-copper drain wire. The conductors shall be twisted together approximately 3 turns per foot. Connections of the loop wire to the lead-in wire shall be made only in a hand hole with a waterproof splice as indicated on the Drawings.

9-32.7 INTERIOR ILLUMINATED SIGNS

The equipment shall be designed and manufactured for operation under temperature and humidity conditions encountered in the Pacific Northwestern United States.

The sign, when mounted, shall be designed to meet or exceed the load requirements in accordance with Section 2 of "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," AASHTO 1975.

The sign size shall be as indicated on the Drawings. The housing shall be a double faced design made of extruded aluminum alloy or polyvinyl, color shall be dark green or brushed aluminum finish. The interior shall be painted white.

Standard signal mounting hardware shall be used to mount illuminated signs to all street furniture. The sign shall be fitted with a 1-1/2 inch iron pipe (IP) tapped straight thread hub on top, for mast arm and span wire mount, and on top and bottom for bracket mount.

The front message panel shall be transluscent white Rohm and Haas Plexiglass, or Tuflite white fiberglass, or equal. The back message panel shall be constructed of aluminum alloy or polyvinyl, colored dark green or brushed aluminum finish to match the housing, unless the sign is double faced in which case it shall be the same as the front message panel. Sign message shall be as indicated on the Drawings.

A terminal block for power input hookup shall be accessible by opening either message panel.

Signs shall be completely wired and assembled.

The sign shall be equipped with, unless otherwise indicated on the Drawings, 4 24-inch T12-CW fluorescent tubes with weatherproof tube type sockets and ballast transformer. The ballast transformer shall be non-flashing 425 mil-amp type, 0 degree Farenheit starting, 120 VAC, 60 Hz.

Hardware (i.e., rivets, screws, bolts, nuts, etc.) and parts not aluminum shall be stainless steel.

9-32.8 INTERIOR ILLUMINATED CROSSWALK SIGN

The equipment shall be designed and manufactured for operation under temperature and humidity conditions encountered in the Pacific Northwest United States.

The sign, when mounted, shall be designed to meet or exceed the load requirements in accordance with Section 2 of "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," AASHTO 1975.

The size shall be as indicated on the Drawings. The housing shall be a double faced design made of extruded aluminum alloy or polyvinyl colored dark green or brushed aluminum finish.

Standard signal mounting hardware shall be used to mount illuminated signs to all street furniture. The sign shall be fitted with a 1-1/2 inch I.P.S. tapped straight thread hub on top for mast arm and span wire mounting, and on top and bottom for bracket mount.

The message panels shall be transluscent yellow Rohm and Haas Plexiglass, or Tuflite yellow fiberglass, or approved equal.

Lettering shall be 10 inch high letters by 1-3/4 inch stroke formed with No. 900 fascal tape.

The sign shall be equipped with two 48-inch T48-HO fluorescent tubes with weatherproof tube type sockets and ballast transformer. The ballast transformer shall be high power factor type, 0 degree Farenheit starting, 120 VAC, 60 Hz.

Hardware (i.e., rivets, screws, bolts, nuts, etc.) and parts not aluminum shall be stainless steel.

A terminal block for power input hookup shall be accessible by opening either message panel. Signs shall be delivered completely wired and assembled.

9-32.9 INTERCONNECT CABLE

9-32.9(1) UNDERGROUND

Multiple pair communication cable for underground installation shall meet REA Specification PE-39 for filled cable with #22AWG solid copper conductors and coated aluminum shield. The number of pairs shall be as indicated on the Drawings.

9-32.9(2) AERIAL ("FIGURE 8")

Multiple pair communication cable for aerial installation shall meet REA Specification PE-38 for aerial cable with #22AWG solid copper conductors and coated aluminum shield. The number of pairs shall be as indicated on the Drawings. Aerial communication cable shall be supported throughout the run by Stanley Flagg cable hanger PA296X, or Joslyn Cable Hanger J2235 or equal. Termination and horizontal angle turns shall be supported by automatic dead-end devices.

9-32.9(3) INDOOR

Multiple pair communications cable installation shall meet REA Specification PE-22 for cable with #22AWG solid copper conductors and coated aluminum shield. The number of pairs shall be as indicated on the Drawings.

9-32.9(4) TELEPHONE LINE INTERCONNECT

Where shown on the Drawings, communications cable shall be used to interconnect traffic signal controllers within the traffic signal interconnect system. The telephone company will furnish and install the cable from their facilities to a junction box at each of the intersections. The Contractor shall furnish and install the junction box, which shall contain a fuseless station protector, together with all conduit and mounting hardware. The Contractor shall furnish and install a 2-pair, #16 AWG 19x29 stranded copper polyethylene insulated, PVC jacketed, twisted pair with copper foil or aluminum-polyester shield, and a No. 18 AWG stranded tinned-copper drain wire between the traffic signal controller cabinet and the fuseless station protector. The conductors shall be twisted together approximately 3 turns per foot.

9-32.9(5) TELEPHONE PROTECTOR UNIT

The interface unit shall be "Fuseless Station Protector" Western Electric 564G or equivalent. The Contractor shall install all conduit connections to the protector and shall install the cable from the protector into the controller cabinet and from the protector to the weatherhead.

The City will make arrangements with the telephone company immediately after award for 3002 data grade service drop to the protector at the designated locations.

9-32.10 AERIAL TERMINAL COMPARTMENT

The compartment shall be capable of encasing the sheath of "R" type and "T" type non-pressurized electrical cable and shall accommodate "Branch Type" splices of interconnect cables.

Compartment openings shall accommodate the various cable sizes indicated on the Drawings.

Compartments shall be watertight.

Compartment shall be supportable on span wire or messenger cable.

The terminal block shall have sufficient studs to terminate a minimum of 36 field circuits independently to the terminal block with separate screws.

The compartment shall be either cast aluminum or polyethylene.

All external hardware shall be stainless steel.

9-32.11 SIGNAL WIRING

9-32.11(1) TRAFFIC SIGNAL CABLE

Color Code (Base/Tracer)	1co	2co	3co	5co	7co	10co	13co
Black	#12	#14	#14	#14	#14	#14	#14
White	#12	#14	#14	#14	#14	#14	#14
Red			#14	#14	#14	#14	#14
Green				#14	#14	#14	#14
Orange				#14	#14	#14	#14
Blue					#14	#14	#14
White/Black					#14	#14	#14
Red/Black						#14	#14
Green/Black						#14	#14
Orange/Black						#14	#14
Blue/Black							#14
Black/White							#14
Red/White							#14

Signal Cable shall have solid copper conductors and shall conform to I.M.S.A. Specification No. 20-1 (polyethylene insulated, polyethylene jacketed signal cable).

9-32.11(2) PEDESTRIAN PUSH BUTTON CABLE

Pedestrian push button cable shall be single pair #16 AWG 19x29 stranded copper, polyethylene insulated, PVC jacketed, twisted pair cable with copper or aluminum-polyester shield and a No. 18 AWG stranded tinned-copper drain wire. The conductors shall be twisted together approximately 3 turns per foot.

9-32.11(3) ELECTRICAL SERVICE CONNECTIONS

All traffic signal services shall be 2 parallel 120 volt, 60 HZ AC electrical services with accompanying equipment.

Individual service conductors shall be color or number coded type XHHW or THWN No. 6 AWG stranded copper. The outer jacket of cable shall be flame retardant, moisture, heat and sun light resistant thermoplastic or cross linked synthetic polymer suitable for underground conduit or aerial installation with suitable non-hygroscopic fillers.

All final connections and energizing of signal systems (overhead secondary or secondary in vaults or handholes) shall be performed by City Light.

9-32.11(4) FUSES AND FUSE BLOCKS

The In-Line fuse shall consist of a 2-section fuseholder body, 2 insulating boots and a fuse. The fuse shall be of the voltage and amperage specified with the fuseholder body, and insulating boots rated at 60 amperes, 300 volts.

The fuse shall be a current limiting type with a high interrupting rating, high speed opening, and sufficient time delay to prevent needless opening due to harmless short lived overloads without any loss of safety on either overload or short circuit condition. The fuse shall have a capacity of 35 to 60 amps as required at 300 volts, be 13/32 inches in diameter x 2-1/4 inches long, with an interrupting rating of 100,000 rms symmetrical amperes and minimum time delay of 25 seconds at 200 percent load.

The fuseholder body shall be made of molded plastic, in two sections - the line-side section and the load-side section - to provide a visible means of disconnect for circuit repairs or maintenance. Each section shall be totally enclosed at the wire entrance end, and the sections shall be joined by means of a threaded and gasketed joint. The fuse shall be held in the load-side section only. The fuseholder body shall be such that should the fuseholder be closed on a live circuit, any arc is confined within the fuseholder body.

Each section of the fuseholder shall have a crimp type connector to take 1 #12 to #2 solid or stranded coppper wire.

Insulating boots shall be used to seal the wire connections and eliminate taping. 2 types of insulating boots may be used. A single conductor boot for the load-side and either a 1- or 2-conductor boot for the line-side (two conductor boot when required for tap-off).

The design of the fuse shall be such that the carrying capacity or opening time is little affected by ambient temperature and will operate with low watt loss to reduce heating.

9-32.11(5) POLE JUNCTION BOXES AND TERMINAL BOXES

Junction and terminal boxes shall be watertight (NEMA 4) rated, cast iron box and cover. Finish shall be hot dipped galvanized. Cover shall mount with a neoprene gasket and brass cover screws. Top and bottom conduit holes shall be bossed, drilled and tapped. Conduit holes in rear of terminal boxes shall be drilled and tapped. The threads in poles and junction boxes shall be sealed to prevent water entry and rusting. Cabinet size shall be as indicated on the Drawings.

9-32.11(6) GROUND RODS, CLAMPS AND BONDING

Ground rods shall be 5/8 inch diameter by 10 feet long copper clad steel rods. A ground rod shall be driven in each new handhole.

Bonding jumpers and equipment grounding conductors shall be green and insulated THWN stranded or solid, bare copper wire of the same cross-sectional area as No. 8 AWG unless a larger equipment grounding conductor is required by Code. Where parallel circuits are enclosed in a common conduit, the equipment grounding conductor shall be sized by the rating of the largest overcurrent device serving any circuit contained in the conduit.

Ground rods shall be fabricated from cold-finished carbon steel shafting in accordance with ASTM Specification A 108 as it applies to grade 1018.

The covering of the steel core shall be a molecularly-bonded sheath of electrolytic-grade copper having a minimum thickness of 0.010 inches. The rods shall have rolled threads at each end for joining together with couplings.

Couplings for sectional rods shall be made of high-strength, corrosion-resistant bronze, internally threaded to fit standard rods.

Driving studs shall be made of high-strength, hardened steel of SAE 1045 or equal quality.

Plate electrodes shall conform to Article 250-83-NEC.

The body of the ground clamp shall be manufactured of forged, cast or high-conductivity drawn copper alloy. Clamps shall provide high pressure contact directly between wire and rod by means of a set screw. The screw shall be of silicon bronze and shall have a square or hexagonal head.

Drawn copper shall be a 220 Alloy (nominal 90 percent Cu. 10 percent zinc) and have a minimum Rockwell hardness of 95 on the F scale. Clamps shall conform to Material Std. 5640.3.

9-32.11(7) SQUEEZE CABLE FITTINGS

Cable fittings for entry of cable through metal walls of poles, signs and signals shall be squeeze-type cable fittings with water-tight neoprene bushings. Size shall be carefully chosen to match the cable diameter to assure a water-tight fitting without damaging the cable.

9-32.12 SPAN WIRE

Span wire shall be 5/16 inch, 7-strand aluminum covered steel span wire conforming to ASTM B415 with rated breaking strength of 10,270 lbs. in accordance with Department of Lighting Material Standard No. 5664.1.

Catenary span wire will be 7/16-inch, 7-strand aluminum covered steel span wire conforming to ASTM B415 with rated breaking strength of 20,800 lbs. in accordance with Department of Lighting Material Standard No. 5664.1.

9-32.13 POLE LINE HARDWARE

Strain insulators shall be wet process, porcelain, conforming to EEI-NEMA TDJ-54 as follows:

5/16 inch wire	Class 54-2
7/16 inch wire	Class 54-3

Tether wire shall be 1/8 inch galvanized steel stranded wire conforming to ASTM A475, extra high strength grade (rated at 1500 pounds minimum), Class A galvanized unless otherwise noted.

Bull rings (purse seine rings) shall be low carbon steel C1008 or better with an ultimate strength of 25,000 pounds. The ring shall be closed with a weld equal to or greater than 90 percent of the unwelded steel. The ring shall be galvanized with at least 2 ounces of zinc per square foot, which is equivalent to 3 mils of thickness. The steel shall be 3/4 inches in diameter and shall form a ring with a 3-inch ID. Higher strength steel shall be used when more than 4 signal heads are being supported.

All pole hardware, bolts, plate rods, hangers, clamps, wire guards and pole bands shall be hot-dipped galvanized in conformance with the requirements of ASTM Designation A-153, or shall be stainless steel.

All miscellaneous pole line hardware required to complete the project as planned shall be standard material manufactured for pole line construction.

9-32.14 GALVANIZING REPAIR PAINT

Field repair of galvanized surfaces shall be a coating of heated zinc alloy solder to a minimum thickness of 2 mils in accordance with ASTM A 780.

9-32.15 PULL CORD

Pull cord shall be 1/4-inch polypropolene in accordance with Material Standard 7272.2.

SECTION 9-33 POLES, PEDESTALS AND FOUNDATIONS

9-33.1 GENERAL

9-33.1(1) POLES, MAST ARMS AND LUMINAIRE EXTENSIONS

All metal poles, mast arms and luminaire extensions shall be designed and fabricated to conform with the requirements of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" (Hereinafter referred to as "AASHTO"), and EEI-TDJ 135 and 139. All load requirements shall be accommodated as indicated in the Drawings.

Poles shall be galvanized steel, timber or aluminum in accordance with the Drawings. Only one type of pole shall be used throughout the project, unless specifically called out otherwise on the Drawings.

Poles shall be of sufficient length to support span wires, mast arms, bracket arms, luminaires or other loads as indicated on the Drawings.

Poles not meeting the requirements of the Drawings and Specifications will be rejected. Steel or aluminum poles received damaged or broken shall be repaired or replaced at the option of the Engineer. Wood poles received damaged or broken shall, at the option of the Engineer, be replaced or cut back.

9-33.1(2) ANCHOR BOLTS

Steel anchor bolts and nuts as specified on the Drawings shall be provided with each metal pole. Anchor bolts shall conform to ASTM A307 or A576 unless stated otherwise on the Drawings, and shall be capable of resisting, at yield strength stress, the bending moment of the shaft at its yield strength stress. Each anchor bolt shall have a hexagonal leveling nut with a washer for leveling and a hexagonal nut with a flat washer and a lock washer for the top of the anchor base plate. All anchor bolts (full length), nuts and washers shall be galvanized in accordance with ASTM A153. No field cutting of threads will be allowed.

Anchor bolt extenders (sleeve nuts), where required, shall be of a strength greater than the existing anchor bolts. The bolt extenders shall have a hexagonal tightening nut, and shall be galvanized in accordance with ASTM A 153.

9-33.1(3) GALVANIZING

Before galvanizing, all visible welds on the pole shaft, mast arm and luminaire extension shall be ground flush to base metal, and all sharp edges shall be removed on the interior to prevent damage to the wires in the pole.

Structural material shall be zinc-coated by hot-dip process in accordance with ASTM A 123 and the final coating shall measure 0.003 inches or more in thickness as determined by a magnetic thickness gauge. Hardware and appurtenances shall be coated in accordance with ASTM A 153. Threads shall be re-cut after galvanizing without exposing base metal. Galvanizing certification of compliance with the applicable ASTM Standards signed by an independent testing laboratory shall be submitted to the Engineer before shipment.

The finished pole shall be straight and free from injurious defects. Poles distorted by the galvanizing process shall be straightened without damage to the galvanizing coating. The finish coating shall be smooth and free of dross. After galvanizing, the interior of the pole and arms shall be free from sharp edges to prevent damage to wiring.

9-33.1(4) GROUND LUGS

Metal poles shall have a 3/8 inch tapped hole in the bottom edge of the handhole inside the pole. A 3/8 inch stainless steel bolt with stainless steel lock washer suitable for grounding shall be provided.

9-33.1(5) NUT COVERS

On metal poles the Contractor shall furnish and install separate nut covers to cover anchor bolts and nuts only (not the base flange). Nut covers shall fit snugly to the bolt. Nut covers shall be made of the same materials as the pole and shall be provided by the pole manufacturer.

9-33.1(6) CONCENTRICITY

Unless otherwise noted on the Drawings, poles, mast arms, and luminaire extensions shall be within plus or minus 1/16 inch of perfect round with a constant taper of approximately 0.14 inches per foot and of uniform thickness.

9-33.2 STEEL POLES, MAST ARMS, AND LUMINAIRE EXTENSIONS

9-33.2(1) GENERAL

The term "steel strain pole" as used herein refers to any steel pole subjected to a span wire load (including METRO trolley loads) or mast arm load. Luminaires or other street lighting appurtenances may be mounted on a "steel strain pole". The term "steel lighting pole" refers to any steel pole which carries a luminaire but does not carry a span wire or mast arm load.

The length of the mast arm, height of pole, and size and type of luminaire extension shall be as indicated on the Drawings. An aluminum or stainless steel pole identification plate shall be securely attached immediately above the handhole, and shall indicate gauge, manufacturer, bolt circle, design principle moment in kip-feet, length, and date of manufacture.

Outside diameter of pole shafts shall be not more than 11 inches for supporting mast arm lengths 30 feet and under, and shall be not more than 13 inches for supporting mast arm lengths of 35 and 40 feet.

Outside diameter at the base of steel strain poles shall as noted on the Drawings.

9-33.2(2) STRENGTH AND DEFLECTION REQUIREMENTS

The pole shaft shall have strength sufficient to support all indicated loads.

The following design loads shall be used: Dead load shall consist of the weight of the signals, luminaires and bracket arms, signs and supporting structure, and associated appurtenances; wind and ice loads shall be as indicated by AASHTO. The signal head mast arm shall be of such size and gauge as to resist the bending moment.

The design of steel strain poles that support overhead trolley loads shall be governed by METRO Transit design standards as detailed on the Drawings.

Structural steel having a yield point of 33,000 p.s.i. or more shall be used for all structural parts. Silicon content of the steel shall be no more than 0.06 percent to prevent discoloration during galvanizing.

The total deflection at the top of metal poles resulting from all dead loads applied shall not exceed 2.5 percent of pole height.

The deflection of the mast arm after loading shall not cause the end of the mast arm to extend below a horizontal line from the center of the arm flange. The maximum rise of the mast arm after loading from a horizontal line shall be 2 degrees.

The tenon for the luminaire shall be between 1 and 4 degrees above horizontal with the luminaire installed and all other loads applied to the pole.

9-33.2(3) BOLT CIRCLE

Mast arm flange and pole base bolt circles shall be as indicated on Standard Plan No's. 561, 562, and 563.

9-33.2(4) WELDS

Circumferential butt welds shall have permanent back-up rings and full penetration for 100 percent of the circumference. All exposed butt welds shall be ground flush. All welds shall conform to the requirements of Section 6-03.3(25).

9-33.2(5) HANDHOLES, FESTOONS AND WIRE INLETS

Poles shall have one oval 4 inch x 6-1/2 inch handhole, and a 3 inch X 5 inch festoon outlet, reinforced so as to result in no loss of shaft strength. The handhole shall have matching cover attached with stainless steel bolts. The cover shall be raintight and removable. The handhole shall be fabricated into the pole in a position 90x clockwise from the side on which the bracket arm or mast arm is attached.

Cable outlets (on poles) as shown on the Drawings shall be Schedule 40 steel pipe extending perpendicular from the pole. Both ends of the pipe shall be rounded for wire protection. The cable outlet shall be installed, drilled and edges rounded before galvanizing.

9-33.2(6) MAST ARM COUPLINGS

Couplings for signals shall be 2 inch, Schedule 80 steel pipe extending perpendicularly out 4-1/8 inches from the mast arm with a 7/16 inch diameter hole for mounting plumb in accordance with the detail shown on the Drawings or in the appendix of the Project Manual. Both ends of the pipe shall be rounded for wire protection. The coupling shall be installed, drilled and edge rounded before galvanizing.

9-33.2(7) ANCHOR BASE PLATES

A one-piece steel anchor base plate shall be secured to the lower end of the shaft by two continuous electric arc welds. The base plate shall be fabricated with a hole sized such that the shaft will slip approximately halfway through the plate,

leaving a fillet between the end of the shaft and the inside of the hole, which shall be welded around the full circumference. A second weld shall be made around the full periphery where the shaft exterior meets the top of the base plate. The welded connection shall develop the full strength of the adjacent shaft section.

9-33.2(8) POLE AND MAST ARM CAPS

All metal poles (except davit poles) and mast arms shall be equipped with a rain-tight pole cap constructed of the same material as the pole, and attached with stainless steel bolts.

9-33.3 ALUMINUM POLES

Aluminum street light poles shall meet the requirements of Material Standard 5739.8, except as modified herein and on the Drawings.

The shaft shall be round with a continuous taper of approximately 1/8 inch per foot, and shall be made of a high-strength, corrosion-resistant aluminum alloy. The shaft shall have a satin finish, and shall be protected with a wrapping during shipping and installation. A rip cord shall be provided for easy removal of wrapping. An aluminum pole cap shall be attached with stainless steel bolts. Bracket arm flange shall be as indicated on the Drawings. The diameter at the top of the pole shall be 4-1/2 inches plus or minus 1/8 inch.

Poles shall have an oval 4-inch x 6-inch minimum handhole fabricated into the pole in a position 90x clockwise from the side on which the bracket arm is located and reinforced so as to result in no loss of shaft strength. The handhole shall have a matching aluminum cover attached with stainless steel bolts and shall be located 18 inches above the base plate.

Cast aluminum anchor and transformer base shall be made of high-strength, corrosion-resistant aluminum alloy of sound and uniform quality.

Anchor base poles shall have a 3/8 inch tapped hole in the bottom edge of the handhole and 3/8 inch stainless steel bolt and lock washer for grounding. Transformer bases shall have the ground lug inside the base adjacent to the access door. The lug shall be equipped with a stainless steel bolt (1/4 inch minimum), nut and lockwasher.

Anchor bolts for aluminum poles shall be the same as required for steel poles. See Section 9-33.1(1).

9-33.4 WOOD POLES

9-33.4(1) GENERAL

Strain poles shall be either Douglas Fir, class 1, or Western Red Cedar, class 1.

Street light poles shall be Western Red Cedar, class 4.

Poles shall be framed before treatment with a 1/2 inch deep by 2 inch high setting gain on the pole face, 12 feet from the pole butt.

Poles shall be branded by burning the pole face, as specified by ANSI 05.1, 12 feet 6 inches above the pole butt. Metal marking tags will not be accepted.

Poles shall be butt-treated in accordance with AWPA C7, and the entire butt section of the pole shall be incised. After framing and roofing, the cuts shall be well brushed with the hot preservative.

9-33.4(2) DOUGLAS FIR

Poles shall conform to the latest ANSI Specifications and Dimensions for Wood Poles.

Poles shall be round, sound, well proportioned from butt to top, without short kinks or crooks, and shall be one of the class and length noted on the Drawings or Specifications.

Poles shall be machine shaved full length, and shall be free from "barber pole" and "wheel gouging" depressions.

Poles shall be incised full length after shaving but before seasoning. Minimum incising depth shall be 1/2 inch.

No check exceeding 3/8 inch is permitted. Adjacent maximum acceptable checks closer than 3/4 inch are not permitted.

Poles shall be roof sawed.

Poles shall be full length pressure treated in accordance with AWPA C1 and AWPA C4. Net retention of preservative in poles after treatment shall be not less than 0.4 pounds of pentachlorophenol per cubic foot of wood (equivalent to 8 pounds of 5 percent solution).

The depth of wood preservative penetration shall be not less than 3/4 inches as determined by boring.

Preservative shall be pentachlorophenol conforming to the requirements of AWPA P8.

Solvent for pentachlorophenol shall be a heavy petroleum conforming to the requirements of AWPA P9.

9-33.4(3) WESTERN RED CEDAR

Poles shall be cut from live timber, and shall meet the requirements of ANSI 05.1, with the following additional requirements.

Poles shall have an average of at least 8 annular rings per inch, counted radially on the butt's surface between a point 3 inches from the center of the pole heart and the periphery of the pole.

The maximum top circumference for any class pole shall not exceed the minimum for that class by more than 8 inches.

Poles shall be machine shaved smooth above the groundline. Shaved areas shall be free from "barber pole" and "wheel gouging" depressions.

Poles shall be flat-roofed at an angle of approximately 15 degrees, with the roof sloped from the face of the pole to the back of the pole.

The tops of full-length treated poles shall not be cut, except upon approval of the Engineer. If cutting is deemed necessary, the top of the pole shall be painted with creosote compound and covered completely with a copper or aluminum cap plate. Under no circumstances shall the butt of the pole be cut.

Preservative shall be pentachlorophenol conforming to AWPA P8.

9-33.5 STEEL PEDESTALS

Shafts shall be constructed of welded structural steel, open-hearth lap welded steel or standard steel pipe conforming to the requirements of ASTM A53. Shafts shall be 4-1/2 inches (O.D.) Schedule 40 galvanized steel pipe with threaded end for mounting to the base. The overall height of the shaft and base shall be as indicated on the Drawings.

Pedestal base shall be of cast iron conforming the requirements of ASTM A 48, Class 40 and made in accordance to the configuration on the Standard Plans. Bases for pedestals shall be threaded, octagonal cast iron equipped with an access door for wiring. A 13-1/2 inch diameter bolt circle size shall be used. The base shall have a grounding lug inside which is accessible from the handhole. The base shall be silver in color.

9-33.6 PEDESTRIAN PUSHBUTTON POSTS

Pedestrian pushbutton posts shall be constructed of 2 inch I.D. Schedule 40 galvanized steel pipe with length as indicated on the Drawings. The meter post collar, pipe flange, bolts, nuts and washers shall conform to the details of the Drawings.

9-33.7 BACK GUY ASSEMBLIES

Unless otherwise indicated in the Project Manual, guy wire shall be 7/16 inch, aluminum covered steel strand wire conforming with Department of Lighting Material Standard 5664.1.

Guy assembly components including the deadend grips, the porcelain strain insulator, and the automatic feed-thru deadend shall be sized so as to meet or exceed the rated breaking strength of guy wire.

Guy assembly components shall conform with the requirements of Department of Lighting Material Standards as follows:

Component	Material Standard
Guy Hook with Intergral Spurs	5651.15
Deadend Grip	5651.4
Porcelain Strain Insulator	6901.1
Plastic Wire Guard	5651.8
Automatic Feed-thru Deadend	5650.3

Anchors for back guys shall consist of one of the following types:

(a) A 4-way or 8-way steel expanding anchor, having a minimun of 300 square inches, made of pressed steel, coated with asphalt or similar preservative and fitted with 3/4 inch minimum guy eye anchor rod 8 feet long.

(b) Plate anchor meeting the requirements of Material Standard 5620.7 fitted with 3/4 inch minimum guy eye anchor rod 8 feet long.

(c) An approved steel screw, such as a power installed steel helix anchor with extension rods, extension rod coupling, and strand eye nut. The single strand eye nut shall be in accordance with Material Standard No. 5652.1 The steel screw will be sized based upon its load and soil conditions by the Engineer.

The pipe brace shall be galvanized extra strong steel pipe.

SECTION 9-34 ELECTRICAL AND SIGNAL CONDUITS

9-34.1 GENERAL

Conduit shall be PVC coated galvanized rigid metal, galvanized rigid metal, or Schedule 80 PVC conforming to Articles 330, 346 or 347 respectively of the NEC as indicated on the Drawings. All conduit and junction boxes shall be UL labelled.

Conduit installed totally within the metering and disconnect enclosure shall be rigid metal and may be without the PVC coating.

Where galvanized coating on any material has been damaged it shall be thoroughly painted with galvanized repair paint per Federal Spec MIL-P-21035 in accordance with the manufacturer's written instructions.

Conduit cable runs shall be parallel to building lines and grouped together where possible.

Factory bends and elbows shall be utilized in all cases where they provide the required deflection.

Field bends, when required, shall be performed so as to result in no flattening of conduit or damage to the galvanizing or PVC coating.

It shall be the option of the Contractor to use larger size conduit when approved by the Engineer. Where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. Reducing couplings will not be permitted. Conduit shall not change size between handholes, or condulet access point.

Conduit terminating in enclosures (poles, cabinets, pedestals, etc.) shall extend vertically above the foundation a minimum of 1 inch, unless indicated otherwise on the Drawings.

Conduit entering through the bottom of a handhole shall be located near the end walls to leave the major portion of the box clear. Conduit shall enter from the direction of the run, terminating 6 to 8 inches below the handhole lid and near the box wall.

9-34.2 RIGID STEEL CONDUIT

9-34.2(1) GENERAL

Exterior and interior surfaces of all steel conduit, including threads, except field cut threads, shall be uniformly and adequately zinc coated by a hot dip galvanizing process. The average weight of zinc coating shall not be less than 0.80 ounces of zinc per square foot of single surface area as determined by tests on 12-inch samples taken from a standard length of conduit of each size. The weight of zinc coating on any individual test specimen shall be not less than 0.7 ounces of zinc per square foot of single surface area. The weight of zinc coating will be determined in accordance with AASHTO T-65. Determinations and nominal weights shall conform to the requirements of the Underwriters Laboratory Publication No. 6 (latest edition). In addition, the exterior as well as the interior conduit samples shall withstand 4 dips in the PREECE test in accordance with ASTM A 239.

Every length of rigid metal conduit shall bear the label of Underwriters Laboratories, Inc., or the label of the Canadian Standards Association, if affected items of Canadian manufacture are approved for use on the project. Installation shall conform to appropriate articles of the NEC.

Rigid steel conduit may be substituted where PVC is indicated on the Drawings at the Contractor's option when approved by the Engineer, except on pole risers.

Fittings for field and factory bends shall be identical and interchangeable.

9-34.2(2) THREADS

The exposed thread ends of rigid steel conduit shall be hot dipped galvanized in accordance with the foregoing. Field cut threads shall be painted with galvanized repair paint.

9-34.2(3) COUPLINGS AND FITTINGS

Couplings and fittings for rigid steel type conduits shall be hot-dip galvanized, with the same quantities of zinc noted above. Couplings shall withstand 4 dips in the PREECE test as specified above.

9-34.2(4) PVC COATING

All conduit shall be polyvinyl chloride (PVC) coated where indicated on the Drawings, dark grey, and U.V. Resistant Type.

The zinc surface prior to plastic coating shall be conditioned with chromic acid to provide an anchor for the plastic coating.

The exterior will be coated with an epoxy acrylic primer not to exceed 0.0005 inches thick prior to the application of the PVC coating.

A PVC coating shall be bonded to the outside of the pipe (excluding the threads) with a thickness between 0.035 inch and 0.045 inch. The PVC coating shall be applied by the plastisol dip method and shall contain ultraviolet inhibitors.

A coupling with the same PVC coating shall be furnished loose with each length of conduit and shall have a plastic sleeve extending 1 pipe diameter or 2 inches (whichever is less) beyond the end of the coupling. The inside diameter of the plastic sleeve shall be the same as the outside diameter of uncoated pipe of the same nominal size. The wall thickness of

the plastic sleeve shall be the same as the plastic coating on the pipe. The bond between the metal and the PVC coating shall be equal to or greater than the tensile strength of the PVC coating.

A phenolic coating shall be fusion bonded to the inside of the pipe with a nominal 0.003-inch thickness.

All conduit fittings which are hollow and serve as part of the raceway shall be coated with the same PVC coating on the outside and phenolic coating on the inside as described above. The fittings shall have PVC sleeves at all female openings similar to the sleeves on the couplings.

All plastic coatings shall be applied by the same manufacturer who produces the hot-dip galvanized conduit.

The coated conduit shall conform to NEMA Standard No. RNI-1974 (Type A).

All coated conduit brackets, supports, clamps, NEMA 4 junction boxes, drains, breathers, expansion/deflection fittings, seals, etc., shall be PVC coated by the producer of the conduit. Field repair and touch-up shall be made with materials approved by the Engineer.

9-34.2(5) EXPANSION FITTINGS IN CLASS 1 GROUP D AREAS

Conduit expansion fittings shall be PVC coated and installed as shown on Drawings.

Expansion fittings shall be explosion proof rated for Class I group "D" use.

9-34.2(6) EXPANSION/DEFLECTION FITTINGS IN NON-HAZARD AREAS

Expansion/deflection fittings shall be installed in all structure expansion joints. The expansion portion of the set shall provide for 4 inches of movement, 2 inches in each direction, unless specified greater on the Drawings. The deflection portion of the set shall provide for a movement of 3/4 inch from normal in all directions, and an angular movement of 30 degrees from normal in any direction. Fittings shall be O.Z. Gedney Type AXDX or approved equal.

9-34.2(7) CONDUIT SEALS AND BREATHERS IN CLASS 1 GROUP D

Conduit seals and breathers shall be rated for Class I Group "D" use and PVC coated.

9-34.3 PVC CONDUIT

Plastic conduit and fittings shall be rigid PVC Type EPC Schedule 80.

PVC rigid non-metallic conduit may be used for all installations except the first 10 feet above ground on a pole riser and the adjacent bend, or where specifically called out otherwise on the Drawings or Specifications.

Rigid PVC shall meet the requirements of ASTM D1785 and ASTM D 2466. The conduit shall be suitable for use above ground, for direct burial, and for corrosive atmosphere areas.

9-34.4 CONDUIT RISER

Refer to Section 8-33.3(3).

9-34.5 PULL CORD

Pull cords shall be 1/4-inch polyproplene meeting the requirements of the Department of Lighting Material Standard 7272.2.

9-34.6 HANDHOLES

Handholes shall be precast concrete, and reinforced as indicated on Standard Plan No. 550. Handholes shall have covers with a slide-lock device. Covers shall be 5/16 inch thick steel having a 3-way raised pattern, and shall be hot-dip galvanized in accordance with ASTM A123. Covers shall be identified with 3 inch high letters "TC" clearly visible on the top wherever traffic control cables occupy the handhole or "SL" where the handhole is used by street lighting only. The marking shall be accomplished by welding or shall be cast onto the cover.

Handholes shall be identified as follows unless otherwise noted on the Drawings:

HH TYPE	INSIDE DIMENSIONS (INCHES)		
	Length	Width	Depth
1	19	14	12
2	28	17	12
3	36	24	30
4	24 inch round		
GRHH	8 inch round		10-12

Type 4 handholes shall use a Type 230 frame and cover in accordance with Section 9-05.15 except that the word "ELECTRIC" shall be cast on the cover in lieu of "SEWER."

SECTION 9-35 ELASTOMERIC BEARING PADS

Elastomeric bearing pads shall conform to the requirements of AASHTO M 251 and be constructed of virgin crystallization resistant polychloroprene (neoprene).

All bearing pads shall be individually cast with fully molded edges. Corners and edges of molded pads may be rounded at the option of the Contractor. Radius at corners shall not exceed 3/8 inch and radius of edges shall not exceed 1/8 inch.

Shims contained in laminated bearing pads shall be mill rolled steel sheets not less than 20 gage in thickness with a minimum cover of 1/16 inch of elastomer on all edges and shall be spaced to divide the pad thickness into equal laminations. The bond between the elastomer and metal shims shall be such that, when a sample is tested for separation, failure shall occur within the elastomer and not between the elastomer and the metal shim.

The grade or durometer hardness of the bearing pads shall be as noted in the plans.

INDEX TO SPECIFICATIONS

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X, Y, Z (none)