



AUTHORIZED BY AUTHORITY OF
Water Quality Rules and
Regulations, Chapter III
Director

Department of Environmental Quality

PERMIT NO. 14-451

DATE 12/3/15

BY *Seto Donaghy*

WYOMING PUBLIC WORKS STANDARD SPECIFICATIONS

2015 EDITION

The 2015 Edition of the Wyoming Public Works Standard
Specifications was prepared by the

WYOMING PUBLIC WORKS COUNCIL



Wyoming Association
of Municipalities
Building Strong Communities



Wyoming County Commissioners Association



AMERICAN COUNCIL OF ENGINEERING COMPANIES
of Wyoming



I, Joseph C. Lord, hereby certify that I am the registered agent of the Wyoming Public Works Council that led a collaborative effort to prepare the 2015 Edition of the Wyoming Public Works Standard Specifications. My seal is placed on these standard specifications recognizing the following disclaimer.

Disclaimer: Users of the 2015 Edition of the Wyoming Public Works Standard Specifications hereby certify that they: 1) are duly licensed as a professional engineer in the State of Wyoming in

accordance with Wyoming Statutes §33-29-201 through §33-29-801; 2) place their seal on the project manual wherein the standard specifications are incorporated by reference; 3) accept any and all liability resulting from their use of the standard specifications; and, 4) have made no alterations to the standard specifications except through Special Provisions included in the project manual.

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DATED 12/8/2015**

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WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER QUALITY DIVISION
PERMIT TO CONSTRUCT

PERMIT NO. 14-451

WYOMING PUBLIC WORKS STANDARD SPECIFICATIONS - 2015 EDITION

This permit hereby authorizes the applicant:

Wyoming Public Works Council
1007 East Curtis Street
Laramie, WY 82072-2217

To utilize these standard specifications for drinking water and wastewater capital improvements according to the procedures and conditions of the application number 14-451.

The issuance of this permit confirms that the Wyoming Department of Environmental Quality (DEQ) has evaluated the application submitted by the permittee and determined that it meets minimum applicable construction and design standards. The compliance with construction standards and the operation and maintenance of the facility to meet the engineer's design are the responsibility of the permittee, owner, and operator.

Granting this permit does not imply that DEQ guarantees or ensures that the permitted facility, when constructed, will meet applicable discharge permit conditions or other effluent or operational requirements. Compliance with discharge standards remains the responsibility of the permittee.

Nothing in this permit constitutes an endorsement by DEQ of the construction or the design of the facility described herein. This permit verifies only that the submitted application meets the design and construction standards imposed by Wyoming statutes, rules and regulations. The DEQ assumes no liability for, and does not in any way guarantee or warrant the performance or operation of the permitted facility. The permittee, owner and operator are solely responsible for any liability arising from the construction or operation of the permitted facility. By issuing this permit, the State of Wyoming does not waive its sovereign immunity.

The permittee shall allow authorized representatives from DEQ to enter and inspect any property, premise or place on or at which the facility is located or is being constructed or installed for the purpose of investigating actual or potential sources of water pollution, and for determining compliance or non-compliance with any rules, regulations, standards, permits or orders.

Nothing in this permit shall be construed to preclude the institution of any legal action or other proceeding to enforce any applicable provision of law or rules and regulations. It is the duty of the permittee, owner and operator to comply with all applicable federal, state and local laws or regulations in the exercise of its activities authorized by this permit.

The issuance of this permit does not convey any property rights in either real or personal property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

The permittee shall construct and operate the permitted facility in accordance with the statements, representations, procedures, terms and conditions of the permit application, supporting documents and permit. This permit does not relieve the permittee from any duty to obtain any other permit or authorization that may be required by any provision of federal, state or local laws.

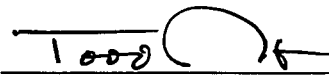
In carrying out its activities authorized by this permit, the permittee, owner and operator shall comply with all of the following permit conditions:

1. The applicant will provide immediate oral or written notice to the Southeast District, Water Quality Division, Herschler Building 4 West, Cheyenne, WY, 82002, Phone 307-777-7088, FAX 307-777-7610, in accordance with the provisions of Section 11, Chapter 3, Wyoming Water Quality Rules and Regulations of any changes or modifications which are not consistent with the terms and conditions of this permit.
2. To use these specifications, additional permits to construct must be obtained from the Department of Environmental Quality / Water Quality Division to meet the engineering design report, construction plans, and further site specific technical specifications requirements for specific projects.
3. Within sixty days of completion of construction of the authorized facility, the applicant will submit to the Southeast District, Water Quality Division, Herschler Building 4 West, Cheyenne, WY, 82002 a certification of completion signed by the Engineer of Record or the owner. A form titled "Certificate of Completion" has been provided and must be completely filled out.
4. The review and approval of this permit is based upon the items identified in the attached "Statement of Basis".

AUTHORIZED BY:



Kevin Frederick
Administrator
Water Quality Division



Todd Parfitt
Director
Department of Environmental Quality

Date of Issuance 12-8-15

SWT/rm/15-1100

Cc: (PDF to Reviewer) Seth Tourney, <seth.tourney@wyo.gov>

STATEMENT OF BASIS

1. Permit Number: 14-451
2. This application was reviewed for compliance with the applicable regulations ;
Chapters 3, 11, 12
3. Does the permit comply with all applicable regulations identified above?
Yes
4. A review to determine groundwater impacts in accordance with Section 17, Chapter 3 was not required.
Public water supplies and sewerage systems are exempted from review by Chapter 3, Section 17.
5. Documentation of Statement of Basis: The archive file for this permit includes adequate documentation of all sections of this Statement of Basis.

CERTIFICATION

The issuance of this permit is based upon a review of the application package submitted in accordance with the requirements of Chapter 3, Section 6, Wyoming Water Quality Rules and Regulations. This review was performed by Seth Tournay, Southeast District Engineer, Water and Wastewater Section, Wyoming Department of Environmental Quality /Water Quality Division, and completed on December 3, 2015. Permit issuance is recommended based upon statements, representations, and procedures presented in the permit application and supporting documents, permit conditions, and the items identified in this "Statement of Basis."

A GUIDE TO USING THE 2015 WYOMING PUBLIC WORKS STANDARD SPECIFICATIONS

GENERAL

In 1979, the Wyoming Association of Consulting Engineers and Surveyors (WACES) undertook a project to standardize the technical specifications and bidding documents for public works projects in the State of Wyoming. The set of specifications produced became known as the Wyoming Public Works Standard Specifications (WPWSS). The 2015 edition of the WPWSS represents the fifth edition of this important document. Authors of this edition include representatives of the American Council of Engineering Companies of Wyoming (ACEC of Wyoming), formerly known as WACES, the Wyoming County Commissioners Association (WCCA) through the Wyoming Association of County Engineers and Road Supervisors (WACERS), the Wyoming Association of Municipalities (WAM), and the Wyoming Contractors Association (WCA). Advisory support was provided by the Wyoming Department of Environmental Quality (WDEQ) and the Wyoming Department of Transportation (WYDOT).

This work was compiled and edited by the Wyoming Public Works Council, comprised of representatives of the organizations and agencies previously noted. This fifth edition incorporates the narrative format used by the Construction Specifications Institute (CSI). The CSI format uses an outline style to describe scope of work, materials, execution of work, method of measurement and basis of payment. The CSI format provides a 16-division framework for the development of project specifications. Each division consists of a number of related sections. Division titles are fixed while section titles are assigned at the discretion of the author of the project manual.

The WPWSS represent the technical portion of the project manual. In addition to the WPWSS, the project manual generally contains the bidding requirements, contract forms, conditions of the contract, descriptions of modifications to both the standard conditions and specifications for the individual project, and references to the portions of the contract documents not bound into the project manual.

This edition of the WPWSS establishes a formal presentation of specifications which can be used in a variety of projects typical to the State of Wyoming. It is intended to be referenced in its entirety. Changes by individual users are to be made only through Special Provisions. The authors of these WPWSS recommend that the project manual incorporate documents issued by the Engineer's Joint Contract Documents Committee (EJCDC) for the bidding requirements, contract forms, and conditions of contract portions. These portions of the project manual are not considered specifications and should be well coordinated between the owner and the owner's legal and insurance counselors. The EJCDC documents are issued and published jointly by the National Society of Professional Engineers, the American Council of Engineering Companies, the American Society of Civil Engineers, and the Construction Specifications Institute, and are endorsed by the Associated General Contractors of America.

The Wyoming Public Works Council intends that these specifications will be updated on an as-needed basis to reflect changes in engineering and construction practices and to publish errata. Interested parties who wish to present changes of these specifications should send comments to ACEC of Wyoming.

THE PROJECT MANUAL

The project manual should be outlined early in the preliminary design process. The outline should be flexible enough to include or exclude sections of the documents when such change may become necessary. Having the outline will help make some very important decisions. One such decision is the method of payment to the contractor. Another is the clear definition of responsibility for quality control and payment for required testing. Suggestions for dealing with these issues are included in this guide as they appear in their respective sections. The outline should contain the source of each item. A suggested project manual outline is presented in the following table.

ITEM	COMMENT
Cover	Should include the Title, "Project Manual", Project Name, Engineer of Record, and owner.
Table of Contents	Commonly divided into Introductory Pages, Bidding Requirements, Contract Documents, and Specifications.
Advertisement for Bid	The advertisement must be published per State Statute.
Instructions to Bidders	Should include detailed information and requirements for preparing and submitting bids. Include method of preparation of bids, qualification of bids during and after the bid opening and general requirements specified by Wyoming State Statutes.
Bid Form	Should include bid items, statements that the bidder has examined the site and locality where work is to be performed, acceptance of all terms and conditions of the bidding requirement by the bidder, and that the bidder will enter into a contract with owner or forfeit a bid bond. The bid form shall contain places for signature of bidder as an individual, partnership or corporation.
Bid Bond Form	Use form provided by the EJCDC.
Agreement Form	Use form provided by the EJCDC.
Performance Bond Form	Use form provided by the EJCDC.
Payment Bond Form	Use form provided by the EJCDC.
General Conditions	Use form provided by the EJCDC.
Supplementary Conditions	Should provide revisions or additions to the General Conditions.
Specifications	Refer to the WPWSS and list the sections to be used (may reproduce in white the WPWSS sections that apply).
Special Provisions	Written modifications of the WPWSS, inclusion of other standard specifications by reference, or other project-specific specifications.

Dividing the project manual using colored sheets is up to the author of the manual. It does make section identification easier and helps keep specific changes of the standard technical specifications recognizable. Other variations are subject to the author's preference as applicable. Including the WPWSS by reference only is preferred because it greatly reduces printing and handling costs.

STANDARD FORMS

In conjunction with the outline suggested above, it is advisable to bind into the project manual any forms or documents either added to or modified during the bidding process and up to the time an agreement is executed between the owner and the contractor, and any forms which will be used during construction. Forms typically bound into the project manual include: addenda, application for payment, and change order.

The author of the project manual should be aware numerous variations of standard forms and standard general conditions exist. Funding agencies of the federal government (the United States Department of Agriculture – Rural Development (USDA-RD), the Environmental Protection Agency (EPA), and the Housing and Urban Development (HUD), to name a few) all have slightly differing requirements reflected in their accepted construction contracts. In addition, engineering societies have developed standard forms and standard general conditions. The authors of project manuals should carefully compare the forms used with their own writing for cross-compatibility between each document. It is not emphasized enough that the bidding requirements and CSI Division I of the contract documents contain certain legal obligations between the owner, engineer, and contractor. It is imperative that the engineer know and understand the implications of these requirements. It is further emphasized that the owner's legal counsel be required to review these documents prior to both their publication and the execution of an Agreement.

DECISIONS

Users of the WPWSS must understand the contents of the document. They must know which item specifications are applicable and can be used for their project, which item specifications are NOT applicable and may need to be deleted, and which item specifications are not addressed in the WPWSS and therefore need to be written or otherwise included. How the items are included, deleted, or written is decided during the outline stage. At that time, the author should also decide on both the method of measurement and basis of payment to the contractor. A suggested Method of Measurement and Basis of Payment format has been included in the WPWSS. The author may choose other options by writing a paragraph in the Special Provisions covering that section of any item specification. Other decisions of a general nature will be discussed under the item to which they pertain.

Three basic decisions have to be made on any item specification used:

- A. which class of material or manufactured item is acceptable;
- B. decisions to change word(s), sentence(s), or paragraph(s) to new or different meanings; and,
- C. decision(s) to add or delete from a section for supplementary meaning.

CERTIFICATIONS

Project manuals incorporating the WPWSS are to be authored by individuals duly licensed as a professional engineer in the State of Wyoming in accordance with Wyoming Statutes §33-29-201 through §33-29-801, and the engineering seals of the authors are to be placed on the manual. Authors placing their seal on the project manual accept any and all liability resulting from their use of the standard specifications.

SECTION 01010 — SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. Apply for, obtain, and pay for permits required to perform the work.
- B. Comply with applicable codes and regulations of authorities having jurisdiction.
- C. Field-verify dimensions indicated on drawings before fabricating or ordering materials. Do not scale drawings.
- D. Notify OWNER of existing conditions differing from those indicated on the drawings. Verify the existence and location of underground utilities along the route of proposed work. Omission of an existing utility location on the Drawings is not to be considered as its nonexistence. Inclusion of existing utility locations on the Drawings is not to be considered as its definite location. Do not remove or alter existing utilities without prior written approval.
- E. The Contract Documents are intended to provide the basis for proper completion of the work suitable for the intended use of OWNER. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the project shall be included.
- F. Portions of the Contract Documents are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is CONTRACTOR. For example, "Furnish..." means "CONTRACTOR shall furnish...", "Provide..." means "CONTRACTOR shall provide...".

END OF SECTION

SECTION 01041 — PROJECT COORDINATION

PART 1 GENERAL

1.01 SUMMARY

- A. Schedule a preconstruction conference to be held within twenty (20) days of the Notice of Award. Contractor's assigned supervisory personnel shall attend this conference.
- B. Conduct all construction activities between the hours of 7:00 a.m. and 6:00 p.m., Monday through Friday, except for emergencies. No work will be allowed on Saturdays without Owner's permission, and no work, except for emergencies, will be allowed on Sundays.
- C. Water for use during construction will be obtained by Contractor at his expense. If he elects to obtain water from the public water utility, he will make all the arrangements, comply with their regulations, and pay all fees and charges.

1.02 COORDINATION WITH PUBLIC AND PRIVATE AGENCIES

- A. If other utility companies elect to repair or replace their lines in the project area, their crews will be permitted access to the area to accomplish their work.
- B. Contact all utility companies for location of their facilities. Call at least forty-eight (48) hours prior to excavation.
- C. Contractor is responsible for dust control, and shall provide all equipment and personnel necessary to meet the requirements of this responsibility. Contractor shall provide Engineer with the name(s) and telephone number(s) of the person(s) designated to maintain dust control during evenings and weekends. If this person cannot be contacted, Owner may use its equipment to correct a dust problem. In this case, Contractor shall pay all costs incurred by Owner.
- D. Do not park vehicles or equipment on private property without written permission from the property owner.
- E. Permit Coordination:
 - 1) The ENGINEER/OWNER will secure the appropriate DEQ permit(s) required for construction authorization, such as construction of new or modifications to existing Water Treatment Facilities, Water Distribution Systems, Waste Water Collection Systems and Waste Water Treatment Facilities. In many circumstances, this may be prior to advertising the proposed work, but shall be prior to issuing a Notice to Proceed to the Contractor. When a permit is required, Construction shall be per the DEQ permit.

- 2) The Contractor will be required to secure all DEQ/WQD construction-specific related permits regarding his/her pursuing the Work. In general, permit(s) are required for activities that may ultimately discharge water (or pollutants) to Waters of the State. Activities requiring a DEQ permit may include:
- a. Coverage under a Wyoming Pollution Discharge Elimination System (WYPDES) permit for small construction activities. This is required for construction activities disturbing at least one (1) acre, but less than five (5) acres that may potentially discharge storm water runoff or minor amounts of ground water from excavations and depressions on a permitted site. Coverage under the Small Construction General Permit (SCGP) does not (currently) require either a Notice of Intent or a permit fee provided that the General Permit requirements are met and that work is performed in accordance with the site-specific Storm Water Pollution Prevention Plan (SWPPP). The SWPPP may include structural & non-structural Best Management Practices (BMPs) and a copy of the SWPPP shall be maintained at the construction site. Additionally, any requisite BMP maintenance log shall be maintained onsite and available for review should DEQ staff, or DEQ authorized agent, visit the site for inspection.
 - b. Coverage under a Wyoming Pollution Discharge Elimination System (WYPDES) Large Construction General Permit (LCGP). This is required for disturbances of five (5) or more acres or for disturbances of smaller sites that are part of a “Common Plan of Development or Sale” with a total disturbance of five (5) or more acres. The five acre disturbance need not be contiguous. Coverage under the LCGP requires the Contractor complete a Storm Water Pollution Prevention Plan (SWPPP), file a Notice of Intent (NOI) with DEQ, and pay any requisite permit fees. Coverage under the LCGP will begin when the Permit Authorization is posted to the DEQ website. Permit fees are to be paid with the NOI for the entire permit term.
 - c. Coverage under a non-storm water permit, such as for the temporary discharge of ground water generated by trench dewatering operations, discharge of chlorinated water used for system disinfection, or discharge of water produced from hydrostatic pipeline testing. The Contractor shall be responsible for completing and submitting a “Notice of Intent” (NOI) to the Wyoming DEQ. The DEQ will review the NOI and determine if the proposed activity is eligible for coverage under this permit or if the activity must be covered under an individual permit. If the proposed activity is eligible for coverage under the general permit, the DEQ will send the Contractor an authorization letter. The authorization to discharge under a general permit will include effluent limitations and monitoring requirements deemed necessary to protect the surface waters of the State.

****Note that the Temporary Discharge Permit is a single permit that may cover all three (3) activities stated above, but must be indicated as such and one (1) fee (currently \$100) covers all permit activities.**

- 3) For Temporary Discharge Permits, the Contractor shall be solely responsible for performing any effluent water quality tests and all monitoring requirements imposed with the Notice of Authorization.
- 4) The contractor shall be considered the Responsible Party for the Site until they submit a "Notice of Termination" or "Notice of Transfer and Acceptance" to DEQ. If the site has not achieved stabilization prior to Final Acceptance, the Contractor may file a Notice of Transfer and Acceptance with DEQ to transfer all permit requirements to the OWNER, who shall then be responsible for the Site. Terms of responsibility and when a Notice of Transfer and Acceptance shall be as set forth in the Special Provisions, however, responsibility shall generally be the responsibility of the entity in "day-to-day control and supervision" of the Site.
- 5) The Permittee of Record with DEQ (Contractor or OWNER) shall be solely responsible for maintaining all BMPs, conforming to any conditions adopted under his/her SWPPP throughout construction.
- 6) Filing of a Notice of Termination does not relieve the Contractor (or OWNER) of the obligations of the Permit until the permit is closed out by DEQ. DEQ may require verification of BMP removal (if appropriate) and site stabilization prior to ending coverage and permit obligations.
- 7) If the project is a new facility, where construction will create a new discharge point (permanent discharge or intermittent), then the OWNER shall be responsible for securing an appropriate WYPDES permit for ongoing operations at the time of construction completion.
- 8) If the project modifies an existing discharge location, either by changing the physical location or changing the effluent quantity or quality, then the OWNER shall be responsible for coordinating with DEQ WYPDES staff for permit modification. This coordination shall take place prior to effecting the discharge change but should not be considered cause for extension of contract time between the OWNER and CONTRACTOR nor cause for delay in accepting either substantial completion or final completion of the Work.

1.03

COORDINATION WITH OWNER AND ENGINEER

- A. Owner will provide engineering surveys to establish reference points as necessary. Construct all work in accordance with the lines and grades shown on the Drawings, and as designated by Engineer. These lines and grades may be modified by Engineer as provided in the General Conditions. Notify Engineer a minimum of twenty-four

(24) hours in advance to request surveying. All survey work shall be done by or under the direct supervision of a licensed Wyoming professional land surveyor.

- B. Unless otherwise provided for in the Contract, the Owner shall employ and pay for the services of an independent testing laboratory to perform all tests required by the Contract Documents. Notify Engineer a minimum of twenty-four (24) hours in advance to request testing.

END OF SECTION

SECTION 01090 — REFERENCES

PART 1 GENERAL

1.01 COORDINATION OF CONTRACT DOCUMENTS

- A. The various portions of the Contract Documents, of which these specifications are a part, are essential parts of the Agreement, and a requirement occurring in any portion or part is as binding as though occurring in all. All portions are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, the following hierarchy shall be observed:
1. Special Provisions will govern over
 2. Supplementary Specifications, which will govern over
 3. Project Drawings, which will govern over
 4. These specifications and Standard Drawings.
- B. Contractor shall not take advantage of any apparent error or omission in the Contract Documents. If Contractor discovers an error or omission, Contractor shall immediately notify Engineer. Engineer will pursue such corrections and interpretations as may be necessary for fulfilling the intent of the Contract Documents.

1.02 DEFINITIONS

- A. These specifications use “Article 1 - Definitions” of the Standard General Conditions of the Construction Contract, C-700, prepared and issued by the Engineers Joint Contract Documents Committee (EJCDC, 2013), as the basis for the definition of terms herein. Changes in these definitions shall be made either by substitution for that article or as Supplementary Conditions.
- B. Additional definitions and clarification of terms:
1. Provide: Furnish and install, complete with all necessary ancillary items, ready for intended use. Pay for all related costs.
 2. Approved: Acceptance of an item submitted for approval. Not a limitation or release for compliance with the Contract Documents or any regulatory requirements.
 3. Match Existing: Construct new work to conform to the existing lines and grades of the site and facilities as acceptable to Owner.

4. Supplementary Specifications: Permanent additions to and revisions of these specifications, covering conditions, which are not unique to any one project. Supplementary Specifications will govern over these specifications, including the Standard Drawings, when in conflict therewith.
5. Special Provisions: Additions and revisions to these specifications covering special conditions on an individual project. Special Provisions will govern over project Drawings and supplementary documents, Supplementary Specifications, standard Drawings, and these specifications when in conflict therewith.

END OF SECTION

SECTION 01340 — SUBMITTALS

PART 1 GENERAL

1.01 SUMMARY

- A. Comply with Submittal format requirements as specified in the Contract Documents.
- B. Provide the numbers and types of submittals listed in individual sections of the Contract Documents. If not specified elsewhere, provide the following as a minimum:
 - 1. Shop drawings: One reproducible and two blueline or photocopy prints. Reviewed and annotated by Contractor.
 - 2. Product data: Four copies.
 - 3. Samples: Two each plus extra samples as required to indicate range of color, finish, and texture.
 - 4. Mock-ups: Number as required in the individual sections.
 - 5. Warranties: Four copies.
 - 6. Closeout submittals: Four copies.
- C. Provide required resubmittals in the appropriate distribution if original submittals are not approved.
- D. Samples and shop drawings shall be prepared specifically for this project. Shop drawings shall include dimensions and details, including adjacent construction and related work. Note any special coordination required. Note any deviations from requirements of the Contract Documents.
- E. Provide warranties as specified. Warranties shall not limit length of time for remedy of damages Owner may have by legal statute. Warranties shall be signed by Contractor, Supplier or Installer responsible for performance of warranty.

END OF SECTION

SECTION 01442 — PARTNERING

PART 1 GENERAL

1.01 SUMMARY

- A. This section presents an alternate project delivery system whereby the Owner, Contractor and Engineer formally agree to work as a team to achieve the project goals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FACILITATOR

- A. A professional Facilitator is employed to oversee and guide a meeting of decision-making personnel from every entity involved in the project. The Facilitator explains the process and paves the way to collective understanding.

3.02 PROCESS

- A. Executive (decision-making) people from involved entities, generally the Owner, Contractor, Engineer/Architect meet to, by mutual agreement, explore each other's concepts of their roles in the project as well as their own. The Facilitator guides the discussion and aids in establishing project goals such as avenues to avoiding disputes, quick resolution of problems. Establishment of communication with agreed upon paths to success for everyone involved is the goal. The strength of the process is the mutual commitment. Actually, everyone signs onto the pact.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Various methods are used at this point to pay for the Facilitator and the meeting facility. Payment can be a bid item or it can be paid by the Owner directly. Usually officers of each entity volunteer their time for the initial meeting.

END OF SECTION

SECTION 01505 — TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish temporary services and utilities, including use fees and operation costs:
 - 1. Potable and non-potable water
 - 2. Lighting and power
 - 3. Materials storage
- B. Furnish construction facilities, including utility costs:
 - 1. Construction equipment
 - 2. Dewatering and pumping
- C. Furnish security and protection requirements;
 - 1. Fire extinguishers
 - 2. Site enclosure fence, barricades, warning signs, and lights
 - 3. Snow and ice removal, if applicable
- D. Furnish personnel support facilities:
 - 1. Sanitary facilities
 - 2. Drinking water
 - 3. First aid facilities
 - 4. Coordinate emergency medical services
 - 5. Trash removal

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. No separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

4.02 BASIS OF PAYMENT

- A. No separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

DIVISION 2 SITE WORK

SECTION 02050 — REMOVAL AND DISPOSAL OF STRUCTURES AND OBSTRUCTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. The work involved in this category shall consist of removing and satisfactorily disposing of existing asphalt pavement, Portland cement pavement, concrete curb, combined curb and gutter, sidewalk, private driveways, crosswalks, fences, abandoned pipelines, buildings and any other structure or obstruction designated for removal on the plans.
- B. Removed items shall be properly disposed of as required by Federal, State, and Local Government regulations. The Engineer shall receive written notification of disposal procedures and may require the Contractor to certify that proper disposal methods were used.
- C. It shall also include the salvaging of designated material, as shown on the plans, and backfilling the resulting trenches, holes, and pits.
- D. Materials removed and not designated to be salvaged or incorporated into the work shall become the property of the Contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Demolition of asphalt and Portland cement concrete. Section 02075
- B. Clearing and grubbing. Section 02110
- C. Selective clearing. Section 02115

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

- A. Demolition and disposal.
 - 1. All existing pavement, curb, gutter, sidewalks, driveways, crosswalks, fences, abandoned pipelines, buildings or any other structure or obstruction specified

for removal on the plans or as directed by the Engineer, shall be removed and disposed of by the Contractor.

2. Care shall be exercised in such removal to assure that adjacent facilities or structures which are to remain shall not be disturbed.
3. Any damage to such existing facilities or structures resulting from carelessness or negligence on the Contractor's part shall be satisfactorily restored to its original condition at the Contractor's expense.
4. Existing pavement shall be cut and removed to the lines indicated on the plans, or as directed by the Engineer.
5. Existing private concrete driveways or sidewalks which interfere with construction of street improvements or which do not match for grade shall be removed as shown on the plans or as directed by the Engineer. Removal shall be on a neat line produced by a concrete saw cut.

3.02 REMOVAL OF PIPE

- A. Pipe designated for salvage shall be removed and cleaned. Every precaution shall be taken to avoid breaking or damaging the pipe. Pipes to be re-laid shall be removed and stored so that there will be no loss or damage before relaying. The Contractor shall replace at his expense, sections lost from storage or damaged by negligence or by use of improper methods.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. When the contract stipulates, payment will be made for removal of obstructions on a lump sum basis. No measurement of individual items will be required.
- B. When the contract stipulates, payment will be made for each item removed at unit prices. Each item removed will be measured at the bid schedule unit of measurement.

4.02 BASIS OF PAYMENT

- A. Lump Sum – Payment shall be made at the lump sum quote for this item in the "Bid Schedule" and shall be for the removal of all obstructions including pipe, and structures encountered within the right-of-way. Payment will include required excavation and backfill.

- B. Unit Price – Payment for specific obstruction items including pipe shall be paid for at the measured quantities removed multiplied by the unit price per each as called out in the “Bid Schedule”.
- C. When the “Bid Schedule” does not contain pay items for removal of structures and obstructions including pipe removal, the work will not be paid for directly, but will be considered as a subsidiary obligation of the Contractor under other contract items.

END OF SECTION

SECTION 02075 — DEMOLITION OF ASPHALT AND PORTLAND CEMENT CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of removal of all surfacing material encountered.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Clearing and grubbing. Section 02110
- B. Selective clearing. Section 02115

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PAVEMENT REMOVAL

- A. Where trench excavation or structure excavation requires the removal of curb and gutter, concrete sidewalks, or asphaltic or concrete pavement, the pavement or concrete shall be cut in a straight line parallel to the edge of the excavation by use of a spade-bitted air hammer, concrete saw or similar approved equipment to obtain a straight, square clean break. Pavement cuts shall be two (2) feet wider than the actual trench opening and centered over such trench.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT (THIS WORK WILL NOT BE MEASURED FOR PAYMENT)

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 02110 — CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of the construction area. Vegetation and objects designated to remain shall be preserved from injury or defacement.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Unless otherwise established by the Engineer, all areas between lines two (2) feet outside the back of sidewalk, curb and/or curb and gutter, or within the neat lines of cut or fill areas shall constitute the clearing and grubbing limits. Where sidewalk, curb and/or curb and gutter is not required, the clearing limits shall be two (2) feet outside the edge of pavement or within the neat lines of cut or fill areas.
- B. All stumps, roots, logs or other timber more than three (3) inches in diameter, and all brush, matted roots and other debris within the grubbing limits not suitable for street foundation shall be pulled or otherwise removed to a depth of not less than 6 inches below the original ground or twelve (12) inches below street subgrade.
- C. The refuse resulting from the clearing and grubbing operation may be hauled to an available waste site approved by the OWNER and shall be disposed of in such a manner as to meet all requirements of State, county and municipal regulations regarding health, safety, and public welfare. When authorized by the proper fire authorities, the Contractor may dispose of such refuse by burning on the site of the project provided all requirements set forth by the authorities are met.
- D. On easements through private property, the Contractor shall not burn on the site unless specifically permitted by the Property Owner in which case he shall obtain permission as previously stated.
- E. In all cases, the authority to burn shall not relieve the Contractor in any way from damages which may result from his operations. In no case shall any material be left on the project, shoved onto abutting private properties, or be buried in embankments or trenches on the project.

- F. The Contractor shall avoid, as far as practicable, injury to shrubbery, vines, plants, grasses and other vegetation growing on areas outside of the grading area, or on parking strips or adjacent lots.

PART 4 METHODS OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

A. Measurement will be by one or more of the following alternate methods:

1. Area Basis. The work to be paid for will be the number of acres and fractions thereof acceptably cleared or grubbed, or both, within the limits shown on the plans or staked for clearing and grubbing by the Engineer. Areas not shown on the plans, or not staked for clearing and grubbing, will not be measured for payment.
2. Lump Sum Basis. When the bid schedule contains a clearing and grubbing lump sum item, no measurement of area will be made.
3. Individual Unit Basis.
 - a. The diameter of trees will be measured at a height of twenty-four (24) inches above the ground. Trees less than four (4) inches in diameter will be classed as brush.
 - b. When the bid schedule indicates measurement by individual unit basis, the units will be designated and measured in accordance with the following schedule of size:

DIAMETER OF A TREE AT HEIGHT OF 24 INCHES	PAY ITEMS DESIGNATION
INCHES	
4 to 8	6-inch size each
Over 8 to 12	10-inch size each
Over 12 to 24	18-inch size each
Over 24 to 36	30-inch size each
Over 36 to 60	48-inch size each
Over 60	60-inch size each

- c. Stumps will be measured by taking the average diameter at the cutoff.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of clearing and grubbing will be paid for at the contract unit prices as follows:

1. Area Basis. The quantities determined will be paid for at the contract unit bid price per acre for each of the particular pay items listed on an area basis under this Subsection.
2. Lump Sum Basis. When the bid schedule contains a lump sum item, the lump sum price shall be full compensation for all clearing, grubbing, or clearing and grubbing required.
3. Individual Unit Basis. When individual unit quantities are shown on the bid schedule, the accepted quantities will be paid for at the contract unit price for the respective items.
4. Exclusions. When the bid schedule does not contain an estimated quantity or lump sum item for clearing and grubbing, the work will not be paid for directly, but will be considered as a subsidiary obligation of the Contractor under other contract items.

PAYMENT WILL BE MADE UNDER:

PAY ITEM	PAY UNIT
Clearing	Acre, LS
Grubbing	Acre, LS
Clearing and Grubbing	Acre, LS
Clearing Trees Diameter	Each
Range from Table, page 2 of 3	

END OF SECTION

SECTION 02115 — SELECTIVE CLEARING

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of all necessary clearing, grubbing and site preparation; removal of all material of whatever description that may be encountered; and removal and disposal of debris.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 STRIPPING

- A. When crossing existing or prospective cultivated areas, gravel streets or other developed surfaces, the CONTRACTOR shall strip the cover material to full depth at the existing surfacing. This surfacing shall be stockpiled and placed back over the trench after backfilling to the extent that it is acceptable and usable for that purpose. Topsoil shall be removed to full depth of the topsoil, or to a maximum depth of twelve (12) inches, whichever is less.
- B. All established lawn areas cut by the trench or damaged during the course of the work shall be restored to a condition comparable to its surrounding area and to the complete satisfaction of the ENGINEER.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 02150 — SHORING AND UNDERPINNING

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of all necessary bracing, shoring and protection, required for open excavations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. All excavation, trenching and shoring, and the like, under this contract shall be performed in a manner that meets with the latest edition of the OSHA Department of Labor, Safety and Health Regulations for Construction.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement or payment will be made for items under this section, full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 02190 — AGGREGATES

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes the preparation and stockpiling of aggregates for Portland cement concrete, bases, bituminous pavements and surface treatments, cover coats, bed courses, drains, pervious backfill and riprap.
- B. This section is a material specification only and is subsidiary to other sections which address placement of the materials prepared under same.

1.02 RELATED WORK

- A. Section 02231, Aggregate Sub-base and Base Courses.
- B. Section 02273, Riprap.
- C. Section 03304, Portland Cement Concrete.
- D. Section 02511, Road Mix Bituminous Pavements.
- E. Section 02512, Plant Mix Pavements
- F. Section 02550, Prime Coat.
- G. Section 02552, Seal Coat.
- H. Section 02553, Bituminous Surface Treatment.

1.03 QUALITY ASSURANCE

- A. AASHTO M 6: Fine Aggregate for Portland Cement Concrete.
- B. AASHTO M 80: Coarse Aggregate for Portland Cement Concrete.
- C. AASHTO M 92: Wire-cloth Sieve for Testing Purposes.
- D. AASHTO T 2: Sampling Aggregates.
- E. AASHTO T 27: Wyoming Modified Sieve Analysis of Fine and Coarse Aggregates.
- F. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine.
- G. AASHTO T 104: Soundness of Aggregate by use of Sodium Sulfate or Magnesium Sulfate.

- H. ASTM C 33: Concrete Aggregates.
- I. ASTM C 127: Specific Gravity and Moisture Absorption of Coarse Aggregate.
- J. ASTM C 136: Sieve or Screen Analysis of Fine and Coarse Aggregate.

1.04

SUBMITTAL

- A. Sampling and testing of aggregates for flexible pavements shall be in accordance with the following standard methods of the American Association of State Highway Transportation Officials (AASHTO):
 - 1. Sampling T 2
 - 2. Percentage of Wear T 96
 - 3. Soundness T 104
 - 4. Sieve Analysis T 27, Wyoming Modified
 - 5. Sieve Analysis ASTM C 136
- B. Sampling and testing of aggregates for Portland cement concrete shall be in accordance with the following standard methods of the American Association of State Highway Transportation Officials (AASHTO):
 - 1. Fine Aggregate M 6
 - 2. Coarse Aggregate M 80
 - 3. Sieve Analysis T 27, Wyoming Modified
 - 4. Percentage of Wear T 96
 - 5. Soundness T 104

1.05

DEFINITIONS

- A. Coarse aggregate shall mean materials retained on a #4 sieve.
- B. Fine aggregate shall mean materials passing a #4 sieve.
- C. Sub-base shall be crushed sub-base unless otherwise specified.
- D. Base shall be crushed base unless otherwise specified.
- E. Gradation requirements, as listed herein, shall be the percentage of material by weight passing laboratory sieves having square openings. Sieve sizes or designations will be in accordance with AASHTO M 92 and ASTM C 33.

PART 2 PRODUCTS

2.01 MATERIALS

- A. When crushed aggregate for sub-base, bases, surfacing or bituminous pavements is specified, all boulders in the pit up to six (6) inches in diameter shall be crushed to meet the required specifications and shall be uniformly distributed in the remainder of the material, unless otherwise specified.
- B. Before production of any of the following materials, all vegetation and stripping material shall be removed from the pit. Only designated portions of the pit will be used. The composite materials shall be free from clay balls, vegetable matter, and other deleterious substances, and shall not contain an excess of thin or elongated pieces.

2.02 AGGREGATE FOR PORTLAND CEMENT CONCRETE

A. FINE AGGREGATE

- 1. Fine aggregate for concrete shall conform to the requirements of AASHTO M 6 with the following exceptions:

- 2. Max. % by Weight

Clay Lumps 0.5

Coal, Lignite, or Shale 0.3

Material Passing No.200 Sieve 4.0

The sum of the above materials and other deleterious substances such as shale, alkali, mica, coated grains, or soft and flaky particles shall not exceed four (4) percent by weight.

- 3. Fine aggregate shall be well graded from coarse to fine and shall conform to the following gradation requirements:

SIEVE DESIGNATION	PERCENTAGE PASSING
3/8"	100
#4	95-100
#16	45-80
#50	10-30
#100	2-10

B. COARSE AGGREGATE

- 1. Coarse aggregates shall consist of crushed stone, gravel, or other approved inert materials of similar characteristics, or combinations thereof, having strong and durable pieces. The aggregate shall be free from vegetable matter, lumps or

balls of clay, adherent films of clay, or other matter that would prevent thorough bonding in accordance with Paragraph 2.

2. Coarse aggregate shall conform to the requirements of AASHTO M 80 with the following exceptions:

- a. The amount of deleterious substances shall not exceed the following limits:

Max. % by Weight

Clay Lumps 0.5

Coal, Lignite, or Shale 0.31.0

Material Passing #200 Sieve 4.0

Other deleterious substances such as friable, thin, elongated or laminated pieces 3.0

The sum of the above material and other deleterious substances shall not exceed five (5) percent by weight.

- b. Coarse aggregates shall have a percentage of wear of not more than forty (40) when tested in accordance with AASHTO T 96 or show a sodium sulfate loss not to exceed twelve (12) percent when tested in accordance with AASHTO T 104. The wear and soundness requirements may be waived, or modified, by ENGINEER provided that the coarse aggregate has a proven service record for similar conditions.
- c. Coarse aggregate shall meet the following gradation limits for the concrete class specified. Other sizes or combinations of sizes may be used when otherwise specified. If not specified, Type No. 57 shall be the gradation used.

SIEVE DESIGNATION	TYPE NO. 57	TYPE NO. 67
1 1/2"	100	-
1"	95-100	100
3/4"	-	-
1/2"	25-60	-
3/8"	-	20-55
*#4	0-10	0-10

* Not more than 5% shall pass the #8.

2.03

AGGREGATE FOR UNTREATED SUB-BASE AND BASE

- A. The composite materials shall be free from clay balls, vegetable matter, and other deleterious substances, and shall not contain an excess of thin or elongated pieces.

B. Crushed sub-base and crushed base shall be crushed stone or crushed gravel and an approved soil binder or natural filler, where required, conforming to the following requirements, unless otherwise designated in the Contract Documents.

1. Coarse aggregate shall consist of hard, durable particles or fragments of stone or gravel. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used. Unless otherwise specified, the coarse aggregate shall have a percentage of wear of not more than fifty (50).
2. Fine aggregate shall consist of crushed stone, crushed gravel, or natural sand. The fraction passing the #200 sieve shall not be greater than two-thirds of the fraction passing the #40 sieve. The fraction passing the #40 sieve shall have a liquid limit not greater than twenty-five (25) and a plasticity index not greater than six (6) except that, when the plasticity index is non-plastic (NP), the liquid limit shall not be more than thirty (30).
3. Crushed base and crushed sub-base shall meet one of the following gradation requirements as specified in the Contract Documents:

SIEVE DESIGNATION	GRADING D	GRADING G	GRADING H	GRADING J	GRADING K	GRADING W
2"	100	100	-	100	-	-
1 1/2"	90-100	90-100	-	90-100	100	100
1"	-	-	100	-	90-100	90-100
3/4"	-	-	90-100	-	-	-
#4	50-85	-	45-65	35-75	40-65	45-65
#8	40-70	-	33-53	-	30-55	33-53
#200	2-5	0-15	3-12	0-15	3-15	3-12

- C. Crusher run sub-base and crusher run base shall be crusher run material of the maximum size as called for in the Contract Documents, not to exceed three (3) inches.
- D. Pit run or screened sub-base and base shall be pit run or screened material of the maximum size called for in the Contract Documents, not to exceed three (3) inches.
- E. Placement of sub-base materials with aggregates greater than three (3) inches shall not be allowed unless otherwise specified by ENGINEER in the Special Provisions.

2.04

AGGREGATE FOR PLANT MIX BITUMINOUS BASE

- A. GENERAL - Aggregate shall be composed of coarse and fine aggregates combined in the proper proportions to meet the grading requirements for Grading W of Subsection 2.03 herein, AGGREGATE FOR UNTREATED SUB-BASE AND BASE, unless otherwise noted in the Contract Documents. Aggregates shall be composed of clean, tough, durable fragments free from an excess of flat, elongated, soft, or disintegrated pieces and free from fragments coated with dirt or other objectionable matter.

- B. COARSE AGGREGATE - Coarse aggregate shall be crushed stone, crushed gravel, or natural gravel. Unless otherwise shown noted in the Contract Documents, the material shall have a percentage of wear of not more than fifty (50) when tested in accordance with AASHTO T 96. The sodium sulfate soundness loss shall not exceed 12% in accordance with AASHTO T 104.
- C. FINE AGGREGATE - Fine aggregate shall consist of crushed stone, crushed gravel, or natural sand. The fraction passing the #200 sieve shall not be greater than two-thirds of the fraction passing the #40 sieve. The fraction passing the #40 sieve shall have a liquid limit not greater than twenty-five (25) and a plasticity index not greater than three (3), except that when the plasticity index is non-plastic (NP), the liquid limit shall be not more than thirty (30).

2.05 AGGREGATE FOR ROAD MIX BITUMINOUS BASE

- A. Aggregates for road mix bituminous base shall meet the requirements for Crushed Base of Subsection 2.03 herein, AGGREGATE FOR UNTREATED SUB-BASE AND BASE and unless otherwise specified by ENGINEER in the Special Provisions, the combined aggregate and natural filler, where required, shall meet the gradation requirements for Grading W.

2.06 AGGREGATE FOR FLEXIBLE PAYMENTS

- A. GENERAL - Aggregates shall be of uniform quality, crushed to size as necessary, and shall be composed of sound, tough, durable pebbles or fragments with or without natural or mineral fillers, as required. The aggregate shall be free from vegetable matter, lumps or balls of clay, adherent films of clay or other matter that would prevent thorough coating with bituminous material and shall be free of an excess of flat or elongated pieces. The crushed aggregate shall have a percentage of wear of not more than forty (40), show a sodium sulfate loss of not more than twelve (12) percent, and a plasticity index shall not exceed three (3) unless otherwise provided for in the Contract Documents or as approved by ENGINEER.
- B. COARSE AGGREGATE - Coarse aggregate shall be crushed stone or crushed gravel of such gradation that when combined with other required aggregate fractions and fillers in proper proportion, the resultant mixture shall meet the gradation requirements under the composition of mixture for the specific material type. Only one kind shall be used on the Project except as approved by ENGINEER.
- C. FINE AGGREGATE - Fine aggregate shall consist of crushed stone, crushed gravel, or natural sand. Fine aggregate shall be of such gradation that when combined with other required aggregate fractions in proper proportion, the resultant mixture shall meet the gradation requirements under the composition of mixture for the specific

material type. Only one kind shall be used on the Project except as approved by ENGINEER.

2.07 AGGREGATE FOR HOT PLANT MIX BITUMINOUS PAVEMENT

- A. Type I Pavement aggregate shall be composed of coarse and fine aggregates combined as shown and in conformance with Subsection 2.04 herein, AGGREGATE FOR PLANT MIX BITUMINOUS BASE.
- B. Type 11 Pavement aggregate material, prior to crushing, shall be of such size that not less than ninety-five (95) percent shall be retained on a sieve with square openings 1/4 inch larger than the maximum size mineral aggregate being produced, unless otherwise specified by ENGINEER in the Special Provisions.
- C. Type III Pavement aggregate shall have not less than fifty (50) percent of the materials by weight retained on the #4 sieve with at least one fractured face, unless a different percentage of fractured faces is otherwise specified in the Contract Documents.
- D. The several aggregate fractions for the mixture shall be sized, graded, and combined in such proportions that the resulting composite blend meets one of the grading requirements in the following table as specified in the Contract Documents. If not specified, CONTRACTOR shall use the 3/4-inch maximum material grading specification.

SIEVE DESIGNATION	% BY WEIGHT PASSING	
	3/4" Max.	1/2" Max.
Inches		
1"	100	-
3/4"	97-100	100
1/2"	-	97-100
3/8"	60-85	-
#4	40-65	45-70
#8	25-55	25-55
#30	10-35	15-40
#200	2-10	2-11

2.08 AGGREGATE FOR PLANT MIX WEARING COURSE

- A. The aggregate for plant mix wearing course shall be crushed stone or gravel composed of hard, durable pebbles or fragments and a filler of finely crushed stone, gravel, or sand, where required, to provide a composition of aggregates meeting the following requirements for the type specified:

SIEVE DESIGNATION	% BY WEIGHT PASSING	
	Type A	Type B
Inches		
1/2"	100	100
3/8"	97-100	97-100
#4	25-45	20-40
#8	60-85	10-20
#200	40-65	2-7

- B. The aggregate shall be free from vegetable matter, lumps or balls of clay adherent films of clay, or other matter that would prevent thorough coating with bituminous material. Unless otherwise shown on the plans, at least seventy-five (75) percent of the material by weight retained on the #4 sieve shall be particles having at least one fractured face and shall have a percentage of wear of not more than thirty-five (35).
- C. When either Type A or Type B wearing course is specified, the aggregate material, prior to crushing, shall be of such size that not less than ninety-five (95) percent shall be retained on a sieve with square openings of 3/8 inch.

2.09 AGGREGATE FOR ROAD MIX BITUMINOUS PAVEMENT

- A. Aggregates shall be composed of clean, tough, durable fragments of crushed stone, or crushed or natural gravel free from an excess of flat, elongated, soft, or disintegrated pieces. The aggregate shall be free from vegetable matter, lumps or balls of clay, adherent films or other matter that would prevent thorough coating with bituminous material.
- B. Unless otherwise specified, the coarse aggregate shall have a percentage of wear of not more than fifty (50). The sodium sulfate soundness loss shall not exceed twelve (12) percent and the plasticity index shall not exceed three (3). The combined coarse and fine aggregate shall meet the following gradation requirements:

SIEVE DESIGNATION	% BY WEIGHT PASSING
1"	100
3/4"	95-100
#4	45-65
#8	33-53
#200	3-12

2.10 AGGREGATE FOR COVER COAT

- A. Only one type of aggregate shall be used on the project unless alternate types are approved.
- B. Cover aggregate for seal coats shall be crushed stone, crushed ledge rock, crushed or natural gravel, or sand.
- C. Cover aggregate material for bituminous surface treatment shall consist of clean, tough, durable fragments free from an excess of flat, elongated, soft or disintegrated pieces and free from coatings of dirt or other objectionable matter. The aggregate shall have neither a percentage of wear of more than forty (40) nor a plasticity index in excess of three (3). The aggregate material shall be well graded from coarse to fine within the following limits:

SIEVE DESIGNATION	% BY WEIGHT PASSING
3/4"	100
1/2"	95-100
#4	50-70
#8	33-63
#200	3-10

- D. Type A, B, C, D, E and S aggregate material produced shall be well graded from coarse to fine within the following limits:

SIEVE DESIGNATION	% BY WEIGHT PASSING					
Inches	Type A	Type B	Type C	Type D	Type E	Type S
1"	100	-	-	-	-	-
3/4"	95-100	100	-	100	100	-
1/2"	30-60	95-100	100	95-100	95-100	100
3/8"	-	-	95-100	-	-	95-100
#4	0-15	0-15	0-20	0-15	35-70	85-100
#8	0-7	0-7	0-12	0-7	-	-
#200	0-2	0-2	0-2	0-2	0-10	0-5

- E. Material used for the production of Type A, B, or C cover aggregate shall be stone, ledge rock, or boulders of such size that prior to crushing not more than five (5) percent will pass a 3/4-inch screen for Type A or a 1/2-inch screen for Type B and Type C.
- F. Type D cover aggregate shall be crushed stone, crushed gravel, or clean pea gravel.
- G. Types A, B, C, or D shall have a percentage of wear of not more than thirty-five (35), unless a different percentage of wear is specified by ENGINEER in the Special Provisions.
- H. Type E cover aggregate shall be crushed sand-gravel. Type S cover aggregate shall be screened or pit-run sand. The plasticity index of either Type E or Type S shall not exceed three (3).

2.11 AGGREGATE FOR BLOTTER

- A. Blotter material shall be either sand or screenings, free from vegetable matter, or other deleterious matter. The material shall be of such size that 100 percent of the material will pass through a 3/8-inch sieve, the fraction passing the #4 sieve shall be from eighty-five (85) percent to one hundred (100) percent and the fraction passing the #200 sieve shall not be greater than twenty (20) percent. The plastic index shall not exceed six (6).

2.12 AGGREGATE FOR FILLER

- A. Filler shall consist of clean, hard, durable grains of naturally occurring granular material taken either from locations shown on the Drawings or from approved sources as otherwise specified in the Contract Documents.

2.13 AGGREGATE FOR BED COURSE MATERIAL

- A. Bed course material for sidewalks and curbing shall consist of graded gravel, crushed stone, or other approved material of such that all particles will pass through a sieve having 1/2-inch-square openings.

2.14 AGGREGATE FOR DRAINS

- A. Gravel for drains shall be crushed or natural sand and gravel or other approved free-draining material. The material shall be uniformly graded from coarse to fine within the following gradation requirements for the material type indicated in the Contract Documents. When the grading is not indicated in the Contract Documents, Grading B shall be used.

SIEVE DESIGNATION	% BY WEIGHT PASSING		
	Grading A	Grading B	Grading C
Inches			
2"	100	-	-
1 1/2"	95-100	100	-
1"	-	95-100	-
3/4"	35-70	-	100
3/8"	10-30	-	95-100
#4	0-5	0-10	-
#8	-	-	65-95
#16	-	-	5-30
#100	-	-	0-10

2.15 AGGREGATE FOR MAINTENANCE STOCKPILES

- A. Type A aggregate shall consist of clean, hard, durable particles of crushed gravel or stone free from soft, thin, elongated, or laminated pieces or organic material, and shall show a percentage of wear of not more than fifty (50). The fraction passing the #40 sieve shall have a liquid limit not greater than twenty-five (25) and a plasticity index not greater than three (3), except that, when the plasticity index is non-plastic (NP), the liquid limit shall not be more than thirty (30). The material placed in the stockpile shall meet the following gradation requirements for the maximum size specified:

SIEVE DESIGNATION	% BY WEIGHT PASSING	
Inches	½" Max.	3/8" Max.
3/4"	100	-
1/2"	95-100	100
3/8"	-	95-100
#4	45-65	50-70
#8	37-57	33-63
#200	3-12	3-12

- B. Type B aggregate shall consist of clean, hard, durable particles of crusher-run gravel or stone free from soft, thin, elongated, or laminated pieces or organic material. Material shall be obtained from designated portions of the pit. The plasticity index

shall not be greater than 6. The material placed in the stockpile shall meet the following gradation requirements for the maximum size specified:

SIEVE DESIGNATION	% BY WEIGHT PASSING
Maximum Designated	95-100
#4	0-75
#200	0-15

- C. Type C aggregate shall consist of crusher-run scoria. Not less than ninety-five (95) percent of the material placed in the stockpile shall pass a 1/2-inch sieve.
- D. Type D aggregate shall consist of clean, hard, durable particles of screened sand free from soft, thin, elongated or laminated pieces, or organic material. The plasticity index shall not be greater than six (6). The material placed in the stockpile shall meet the following gradation requirements:

SIEVE DESIGNATION	% BY WEIGHT PASSING
1/2"	100
3/8"	95-100
#4	85-100
#200	0-15

2.16

AGGREGATE FOR PERVIOUS BACKFILL MATERIAL

- A. Pervious Backfill Material shall consist of gravel, crushed gravel, crushed rock, natural sands, manufactured sands, or combinations thereof, and shall meet the following gradation requirements:

SIEVE DESIGNATION	% BY WEIGHT PASSING
2"	100
#4	0-50
#40	0-30
#100	0-10
#200	0-4

- B. In addition, the fraction passing the #40 sieve shall be non-plastic (NP) and shall have a liquid limit not greater than thirty (30).

2.17

AGGREGATE FOR RIPRAP

- A. Aggregate for riprap shall be hard, durable, crushed, quarried, or natural stone, or broken concrete having an apparent specific gravity of 2.4 or greater. The absorption shall not exceed four (4) percent unless otherwise approved by ENGINEER in the Special Provisions. The stone shall be free of weak laminations and cleavages, and shall be of a quality that will not disintegrate on exposure to water or weathering. The aggregate for the various types of riprap shall meet the following additional requirements:

1. Class I Riprap aggregate shall consist of two sizes of stone.

- a. Primary stones shall be not less than 3-inch thick and shall weigh not less than fifty (50) pounds. At least sixty (60) percent of the stones shall weigh more than eighty (80) pounds each.
 - b. Choke stones shall be fragments or spalls of the proper size to satisfactorily wedge between the primary stones as placed.
2. Class 2 Riprap aggregate shall be graded with a sufficient amount of smaller stones uniformly distributed throughout. At least sixty (60) percent of the stones shall weigh more than eighty (80) pounds each.
3. Grouted Riprap aggregate shall conform to the specifications for Class I or Class 2 Riprap. If not specified, Class I Riprap shall be used.
4. Wire Enclosed Riprap aggregate shall be round or angular stones. Not less than ninety-five (95) percent of the stone shall be retained on a screen or wire having 2-inch-square openings.
5. Sacked Concrete Riprap aggregate shall consist of either a sandy or gravelly pit-run material. This material shall be clean and free from roots, vegetable matter, or other deleterious substances. The aggregate shall meet the following gradation requirements:

SIEVE DESIGNATION	% BY WEIGHT PASSING
2"	80 - 100
#200	0 - 4

2.18 AGGREGATE FOR RIPRAP FILTER

- A. Filter aggregates for riprap shall be hard, durable particles or fragments of crushed stone or natural gravel, screened or crushed to meet the following gradation requirements:

SIEVE DESIGNATION	% BY WEIGHT PASSING
3"	100
#4	20 - 50
#200	0 - 10

PART 3 EXECUTION

3.01 STOCKPILED AGGREGATE

- A. This work shall consist of storing aggregate material which will be used in construction projects in accordance with these specifications at locations shown on the Drawings, noted in the Contract Documents, or as otherwise designated by ENGINEER.
- B. The aggregates shall meet applicable parts of this section for the type of material required.

- C. Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the site shall be firm and smooth and well drained. A bed of aggregate suitable to avoid the inclusion of soil or foreign material shall be maintained.
- D. The stockpiles shall be built in layers not exceeding four (4) feet in height, and each layer shall be completely in place before the next layer is started so as to prevent segregation. The material shall be deposited in such manner as to prevent coning, except in the case of fine aggregate composed of material approximately 90 percent finer than a #4 sieve.
- E. Dumping, casting, or pushing over sides of stockpiles is prohibited except in the case of fine aggregate materials.
- F. Stockpiles of different types or sizes of aggregates shall be spaced far enough apart or separated by suitable walls or partitions to prevent the mixing of the aggregates.
- G. Any stockpiling of materials derived by wet pit or dredging operations, other than those stockpiles previously mentioned, are subject to prior approval of ENGINEER and must be specified and submitted in the CONTRACTOR's plan of operations.
- H. When it is necessary to operate trucks or other equipment on the stockpile in the process of building that stockpile, it should be done in a manner approved by ENGINEER. Any method of stockpiling aggregate which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has operated. Failure of such samples to meet all grading requirements for the aggregate shall be considered cause for discontinuance of such stockpiling procedures.
- I. The aggregate shall be transferred from the stockpiles in such a way as to obtain a material having a uniform grading.

3.02

PROTECTION FOR AGGREGATE

- A. The equipment and methods utilized in the production, storage, transportation and final placement of aggregate materials shall be such as to provide in-place materials meeting all requirements as specified.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the Special Provisions, no separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the Special Provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 02210 — EXCAVATION AND EMBANKMENT

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of excavation, disposal, or compaction of all materials not being removed under some other item, which is encountered within the limits of the work necessary for the construction of the roadway in accordance with the specifications and in conformity with the lines, grades, thicknesses, and typical cross sections shown in the plans. All excavation will be denoted as borrow special excavation, rock excavation, muck excavation, or unclassified excavation as hereafter described.

PART 2 PRODUCTS

2.01 BORROW EXCAVATION

- A. Borrow Excavation shall consist of excavation made from borrow areas within the project limits and outside the normal grading limits for the completion of embankments. Borrow areas or areas within the project limits from which the borrow material may be obtained will be designated on the Plans.
- B. Borrow excavation shall be made only at those designated locations and within the horizontal and vertical limits as stated or directed. On completion of borrow operations, the borrow area will be adequately drained and finished to a neat and uniform grade acceptable to the Engineer. Borrow excavation, if required, shall be paid for at the contract unit price bid for "Unclassified Excavation."

2.02 IMPORTED BORROW EXCAVATION

- A. Imported Borrow Excavation shall consist of excavation made from borrow areas outside the project limits and outside the normal grading limits for the completion of the embankments. Borrow areas or areas outside the project pits from which the imported borrow may be obtained will be designated in the contract documents, or selected by the Contractor. However, any source chosen by the Contractor will be subject to the approval of the Engineer.
- B. Imported Borrow Excavation, if required, shall be paid for at the contract unit price bid for "Imported Borrow."

2.03 ROCK EXCAVATION

- A. Rock excavation shall consist of the removal and disposal of igneous, metamorphic, and sedimentary rock which cannot be excavated without blasting or using rippers,

and all boulders or other detached stones each having a volume of one-half (1/2) cubic yard or more.

2.04 MUCK EXCAVATION

- A. Muck excavation shall consist of the removal and disposal of saturated organic mixtures of soils or organic matter from within the roadway, not associated with culvert installations, which requires additional work or equipment which would not normally be required for unclassified excavation. When it is necessary that the muck excavation be stockpiled prior to final placement, classification of the material for the second handling shall be determined by the Engineer.

2.05 UNCLASSIFIED ECAVATION

- A. Unclassified excavation shall consist of the excavation and disposal of all material encountered in the work, including excavation obtained from borrow sources, not classified under other items of the contract.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. All excavation and embankment work shall be constructed to the neat lines and elevations staked by the Engineer or shown on the plans. No materials shall be wasted without permission from the Engineer. All grading and related operations shall be conducted so that the terrain outside of the limits of slopes will not be disturbed. Prior to the commencement of grading operations, all necessary clearing and grubbing in the area shall have been performed in accordance with Section 02110, CLEARING AND GRUBBING.
- B. When embankments are to be placed on a hillside, or where new fill is to be placed against existing embankment, the slope of the original hillside, or old fill respectively, shall be benched or stepped by cutting into it horizontally, for a minimum distance of twelve (12) inches to provide for secure bonding of the embankment while it is being brought up in layers. Each bench shall be cut as close to the one below as the slope of the ground will permit. Material thus cut out of the benches shall be incorporated into the new fill at the Contractor's expense.
- C. If it should become necessary, because of weather or other conditions, to suspend grading operations, the entire area worked upon shall be bladed until smooth, free of depressions and ruts, and crowned so that no water can collect or be impounded.
- D. Embankment placed adjacent to structures shall be brought up in equal layers on all sides to prevent distortion of any of these parts. If is necessary to deposit embankment on only one side of abutments, wing walls, piers, or culvert headwalls,

compaction shall be accomplished without causing overturning of or excessive pressure against the structure. Areas inaccessible to tamping rollers or power rollers shall be compacted by hand or mechanical tampers or other means until the density conforms to adjacent embankment, compacted in accordance with these specifications.

- E. Embankment material shall be placed in uniform approximate horizontal layers not exceeding eight (8) inches in loose thickness, for the entire width of the embankment. Each layer of embankment shall be completed, leveled and compacted before the succeeding layer is placed.
- F. Embankment which has been subjected to freezing shall be refinished to grade, cross-section and compaction requirements after the frost is out of the ground and the embankment is in suitable condition of work.

3.02 MOISTURE AND DESTINY CONTROL

- A. The Contractor shall provide watering and rolling as required to obtain the density of ninety (90) percent of maximum dry density for all the embankment placed and no separate pay compensation shall be allowed for rolling and watering other than the earthwork bid item or items listed on the Proposal. In the case of embankment material with Plasticity Indexes greater than zero, as determined by ASTM D-424, the amount of water required for rolling shall be within plus two or minus four percentage points of optimum moisture content as determined by AASHTO T-180, Modified Proctor Density, Maximum densities will be determined by AASHTO T-180, Modified Proctor Density.
- B. Within the areas indicated on the plans or as directed by the Engineer, earth shall be removed to the designated depth below subgrade, except for the lower 6-inch layer. This 6-inch layer shall be thoroughly scarified, the moisture content increased or reduced as necessary, and then compacted to not less than eighty-five (85) percent of the maximum density. The remainder of the area up to subgrade elevation shall be constructed of suitable material compacted to not less than ninety (90) percent of maximum density.

3.03 HAUL

- A. When constructing embankments as specified, or wasting, as the case may be, no haul will be allowed on excavated material as a haul item but shall be included in the contract unit price bid for earthwork item or other items listed on the Bid Schedule.

- A. After the earthwork has been substantially completed and after all underground utilities, manholes, catch basins, valve boxes, etc., have been installed or adjusted to grade, the subgrade shall be brought to the lines, grades, and cross-sections shown on the plans, and compacted to the required density.
- B. All soft and unstable material and other portions of the subgrade which, in the opinion of the Engineer, cannot be compacted satisfactorily shall be removed to lines and grades as directed by the Engineer.
- C. All boulders appearing in the earth excavation shall be removed or broken off to a depth of not less than four (4) inches below subgrade. All rock sections shall be brought to grade by depositing a satisfactory cushion material to a depth authorized by the Engineer.
- D. If the surface of an old stone or gravel roadbed conforms approximately to the surface of the finished subgrade, such sections shall be scarified superficially for the full width of the subgrade to a depth sufficient to eliminate all depressions and to permit uniform reshaping and compaction.
- E. At all times, ditches and drains along the subgrade shall be so maintained as to drain effectively. When ruts of two (2) inches or more in depth are formed, the subgrade shall be brought to grade and if necessary be reshaped and rerolled. In no case shall any surface course or pavement be placed on a frozen or muddy subgrade. The top inches of the subgrade shall have a minimum compacted density as specified for embankment.
- F. In addition, the finish grade shall not deviate more than 1/10 foot at any point from the staked elevation. Until the subgrade has been checked and approved, no surface course or pavement shall be laid thereon. Under the square yard method of measurement and payment the Contractor has the option of deviating from the above tolerances as long as the specified base coarse section and profile is maintained.

PART 4**METHOD OF MEASUREMENT AND BASIS OF PAYMENT****4.01****METHOD OF MEASUREMENT**

- A. AREA BASIS - UNCLASSIFIED EXCAVATION ABOVE SUBGRADE. This item shall be measured by the square yards of asphalt pavement surface area.
- B. VOLUMETRIC BASIS - UNCLASSIFIED EXCAVATION ABOVE SUBGRADE. This item shall be measured by the number of cubic yards, measured in its original position, computed to the neat lines and grades shown on the plans, except as these lines

and grades may be modified in the field by the Engineer during construction, with measurement to be made by the method of average end area of material acceptably excavated as herein specified. It shall be specifically understood that the top limit of cross sections for determining end area shall be the top of the existing surface.

- C. EXCAVATION BELOW SUBGRADE. This item shall be measured by the average end area method of calculating cubic yards of material removed.
- D. BORROW EXCAVATION. Borrow Excavation shall be measured by the same method as "Unclassified Excavation Above Subgrade - Cubic Yard Basis."
- E. IMPORTED BORROW EXCAVATION. Imported Borrow Excavation shall be measured by the same method as "Borrow Excavation."
- F. ROCK EXCAVATION. When the plans call for payment to be made under the item rock excavation by volume, the quantity will be computed by the average end area method.
- G. G. MUCK EXCAVATION. Measurement for muck excavation, when set up on the contract, will be by cross-section. If the material does not meet the requirements for muck excavation, it shall be measured as unclassified excavation.

4.02

BASIS OF PAYMENT

- A. AREA BASIS - UNCLASSIFIED EXCAVATION ABOVE SUBGRADE. This item shall be paid for at the contract unit price bid multiplied by the number of square yards measured as excavated, which price and payment shall constitute full compensation for all labor, equipment, tools and incidentals necessary to accomplish all clearing, grubbing, street and drainage excavation, including excavation for sidewalk, curb and/or combined curb and gutter and grading behind sidewalk, curb and/ or combined curb and gutter as shown on the plans; to construct, shape and slope embankments, cuts, subgrades, shoulders, gutters, ditches, street and alley intersections, approaches and private driveway entrances in the locations, to the elevations and according to details shown on the plans; to backfill ditches, depressions and behind sidewalk, curb and/or combined curb and gutter; to remove and to make satisfactory disposal of all unsuitable and surplus materials occurring within the limits of the work; to compact, water and fine grade embankment, backfill and compact areas where unstable material has been removed and all other incidental items and operations to complete this item.
- B. VOLUMETRIC BASIS - UNCLASSIFIED EXCAVATION ABOVE SUBGRADE. This item shall be paid for at the contract unit price bid multiplied by the number of cubic yards measured as excavated, which price and payment shall constitute full compensation

full compensation for all labor, equipment, tools and incidentals necessary to accomplish all clearing, grubbing, street and drainage excavation, including excavation for sidewalk, curb and/or combined curb and gutter as shown on the plans; to construct, shape and slope embankments, cuts, subgrades, shoulders, gutters, ditches, street and alley intersections, approaches and private driveway entrances in the locations, to the elevations and according to details shown on the plans; to backfill ditches, depressions and behind sidewalk, curb and/or combined curb and gutters; to remove and to make satisfactory disposal of all unsuitable and surplus materials occurring within the limits of the work; to compact, water and fine grade embankment, backfill and compact areas where unstable material has been removed and all other incidental items and operations to complete this item.

- C. EXCAVATION BELOW SUBGRADE. This item shall be paid for by the cubic yards of material removed at the contract unit price bid for "Excavation Below Subgrade" which price and payment shall constitute full compensation for all labor, equipment, tools and incidentals necessary to complete the excavation and disposal of unstable material in embankment foundations and soft or unstable material in the subgrade. The cost of backfilling and compacting holes created by the removal of unstable material shall be included in "Unclassified Excavation Above Subgrade."
- D. BORROW EXCAVATION. This item shall be paid for by the same method as "Unclassified Excavation Above Subgrade - Cubic Yard Basis".
- E. IMPORTED BORROW EXCAVATION. This item shall be paid for by the same method as "Unclassified Excavation Above Subgrade - Cubic Yard Basis".
- F. ROCK EXCAVATION. This item shall be paid for by the same method as "Unclassified Excavation Above Subgrade - Cubic Yard Basis".
- G. MUCK EXCAVATION. This item shall be paid for at the contract unit price bid multiplied by the number of cubic yards measured as excavated.

END OF SECTION

SECTION 02220 — TRENCH EXCAVATION

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of excavation and trenching for pipelines, handling and storage of materials and preparation of subgrade, pumping and dewatering as necessary, and dressing and surface restoration cleanup of the site.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. During excavation, materials suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Excavated material shall be piled on one side of the trench only, to permit ready access to existing fire alarm boxes, fire hydrants, valves, manholes and other appurtenances. Surface drainage of adjoining areas shall be unobstructed.
- B. All excavated materials not required or suitable for backfill shall be removed from the site and disposed of in a manner and/or by methods acceptable to jurisdictional government agencies. The Engineer may require certification of proper disposal procedures.
- C. Grading shall be done as may be necessary to prevent surface water from flowing into excavations, and any other water accumulating therein shall be promptly removed. Under no circumstances shall water be permitted to rise in unbackfilled trenches until after the pipe has been placed, tested and covered to final grade with backfill. Any pipe having its alignment or grade changed as a result of a flooded trench shall be relayed at no additional cost to the Owner.
- D. Adequate provisions shall be made for maintaining the flow of sewers, drains and water courses encountered during construction. Culverts, ditches, fences, crosswalks and structures which are disturbed by this construction shall be satisfactorily restored to their original condition upon completion of the work.
- E. Contractor shall coordinate with Owner to comply with all applicable DEQ permit regulations as set forth in the Contract Documents and as referenced in Specification Section 01041.

3.02 SITE CONDITIONS

A. CONTRACTOR'S SAFETY RESPONSIBILITIES

1. The Contractor shall be responsible for enforcing safety and maintaining safe working conditions in all trenching, shoring, and blasting operations to conform to OSHA regulations.
2. The Contractor shall employ qualified, properly trained personnel to design shoring, perform safety inspections of the trenches, and supervise the handling of explosives and other operations involving safety procedures, as prescribed by OSHA.

3.03 TRAFFIC CONTROL AND WARNING DEVICES

- A. The Contractor shall plan and construct the project in such a manner as to minimize the interruption of the use of roads, highways, streets and sidewalks involved and shall provide for emergency access to adjacent property and fire hydrant access at all times.
- B. The Contractor is responsible for providing and maintaining adequate barricades of high visibility design, flares, lanterns, signs, flaggers and prewarning devices to alert the public, motorists and pedestrians of hazardous conditions in accordance with the latest edition of the Manual on Uniform Traffic Control Devices for Streets and Highways published by the U.S. Department of Transportation. Work shall also be done in accordance with the most-recent edition of the Manual on Uniform Traffic Control Devices for Work Zone Areas.
- C. The Contractor shall submit his traffic control plan to the local government officer having authority.

3.04 STRUCTURES

- A. The Contractor shall exercise every precaution to prevent damage to existing buildings or structures in the vicinity of his work. In the event of such damages, he shall repair them to the satisfaction of the Owner of the damaged structure and at no cost to the Owner.

3.05 OVERHEAD UTILITIES

- A. The Contractor shall use extreme caution to avoid a conflict, contact or damage to overhead utilities, such as power lines, street lights, telephone lines, television lines, poles or other appurtenances during the course of construction of this Project.

3.06 SURVEY MARKERS AND MONUMENTS

- A. The Contractor shall use every care and precaution to protect and not disturb any survey marker or monuments, such as those that might be located at lot or block corners, property pins, intersection of street monuments or addition line demarcation. Such protection shall include marking with flagged high lath and close supervision. No monuments shall be disturbed without prior approval of the Owner and Engineer. Any survey marker or monument that is disturbed or destroyed by the Contractor without approval during the construction of this Project shall be replaced at no cost to the Owner by a licensed land surveyor.

3.07 CLEANUP

- A. As work progresses, that portion of the work completed shall be cleared of debris and brought to the finished grade. Upon completion of the work, the entire site shall be cleared of all debris and ground surfaces shall be finished to smooth, uniform slopes and shall present a neat and workmanlike appearance. All rocks brought to the ground surface by excavation or backfilling operations shall be removed.
- B. At all times during construction, the Contractor shall be responsible for dust control as directed by the Engineer.
- C. The CONTRACTOR (as DEQ Permittee) shall be responsible for maintaining any Best Management Practices (BMPs) as adopted in his/her Storm Water Pollution Prevention Plan (SWPPP) until stabilization/regrowth is established or throughout the warranty period / time frame adopted in the Special Provisions, whichever is greater. Cleanup will include the removal of adopted BMPs, as appropriate, upon the completion of site restoration, or as otherwise directed in the Special Provisions.

3.08 TRENCH EXCAVATION

- A. Trench excavation shall be performed in accordance with minimum requirements of Wyoming State OSHA Regulations.

3.09 PREPARATION

- A. PROTECTION OF EXISTING PROPERTIES
 - 1. Prior to beginning construction, the Contractor must fulfill and meet the requirements of Wyoming Statutes 37-12-301 through 37-12-304 relating to public utilities; providing definitions; providing that notice of intended excavation be given to public utilities with underground facilities located in the area of proposed excavation; and providing for exceptions.

2. Existing utilities which intersect with the new pipelines or structures will be relocated by the CONTRACTOR, unless expressly noted otherwise in the Special Provisions.
3. Existing water or sewer services from the mains to private property which interfere with trenching operations may be cut and replaced at the Contractor's expense. The use of such services shall in no case be interrupted for more than 4 hours, unless temporary service is provided.
4. Existing water mains and water services shall be protected at all times during construction operations.

3.10 PRIVATELY OWNED UTILITIES

- A. Gas mains, underground electrical and telephone cables, telephone poles, light poles, etc., required to be moved to make way for new construction will be moved by others. The Contractor shall assure that all necessary arrangements are made with the appropriate utility Owner(s) prior to beginning work in the affected area, and he shall assure that all required work is coordinated with the appropriate utility Owner(s) as work progresses.

3.11 EXPLORATORY EXCAVATION

- A. Location of buried utilities that might interfere with alignment or grade shall be verified by exploratory excavation prior to construction. If any existing utility interferes with the work in either alignment or grade and has to be moved, such work shall be done by the Contractor.

3.12 SHORING, SHEETING AND BRACING

- A. The Contractor shall do all shoring, bracing and tight sheeting required to prevent caving and to protect his workmen, in accordance with Occupational Safety and Health Regulation Requirements, and to protect adjacent property and structures.

3.13 DEWATERING

- A. Where ground water is encountered in excavation, it shall be removed to avoid interfering with pipe laying and other construction operations.
- B. Discharge from dewatering operations shall be directed to approved natural drainages or storm sewers as appropriate and approved by the Owner/Engineer.
- C. Discharge from dewatering operations shall be in accordance with rules and regulations established by the Wyoming Department of Environmental Quality. Contractor shall coordinate with Owner to comply with all applicable DEQ permit

regulations as set forth in the Contract Documents and as referenced in Specification Section 01041. The Wyoming Department of Environmental Quality (DEQ) has issued a general permit for temporary discharges. The general permit for temporary discharges currently authorizes the discharge of wastewaters to surface waters of the state associated with: hydrostatic testing of pipes, tanks or other similar vessels, disinfection of potable water lines, pump tests of water wells, or construction dewatering.

- D. The ENGINEER shall determine the source of water in the trench as either storm water infiltration or ground water.
1. If the source is storm water, trench dewatering shall be covered under the construction activities (Small Construction or Large Construction) permit / site SWPPP and no additional permit from DEQ required.
 2. If the source is ground water, the Contractor shall secure a Temporary Discharge Permit from DEQ. The authorization to discharge under a general permit will include effluent limitations and monitoring requirements deemed necessary to protect the surface waters of the State. Note that, depending upon how the Contractor completes the application form, the same temporary discharge permit can be used to cover discharges resulting from dewatering, hydrostatic testing and pipeline disinfection.
 3. For additional information on dewatering permit requirements from DEQ, please refer to Specification Section 01041.
- E. Effluent associated with construction dewatering shall comply with all applicable regulations. Refer to the following table for general DEQ discharge requirements. Contractor shall comply with site-specific discharge requirements shall be as set forth by DEQ under the Authorization to Discharge.

PARAMETER	EFFLUENT LIMITATION	FREQUENCY	SAMPLE TYPE
Flow, gpm	N/A	Daily	Instantaneous or Continuous
Total suspended solids, mg/L	The concentration shall not exceed a monthly average of 30mg/L, a weekly average of 45mg/L, or a daily maximum of 90mg/L.	Weekly	Grab
pH, s.u.	The p.H. shall not be less than 6.5 nor more than 9.0 standard units.	Daily	Grab
Oil and Grease	The concentration shall not exceed 10mg/L.	Daily	Visual
Turbidity	A discharge to Class 2 water shall not result in a turbidity net increase of 10 nephelometric turbidity units (NTUs). A discharge to Class 2ww or Class 3 waters shall not result in a turbidity net increase of 15 NTUs.	Daily	Grab

3.14**GENERAL EXCAVATION OPERATIONS**

- A. The Contractor shall excavate as necessary at the locations shown on the drawings, staked in the field or otherwise specified for the installation of pipelines
- B. The Contractor shall take precautions and protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, and fences. Any disturbed or damaged facilities will be suitably restored or replaced by the Contractor.
- C. Crossings under sidewalks or curbs may be made by tunneling only if approved by Engineer. If the Contractor elects to remove a portion of the sidewalk or curb, he must use a concrete saw for making neat joints corresponding to existing joints, compact the backfill as specified, and pour a new concrete sidewalk or curb section.
- D. EXCAVATION FOR APPURTENANCES
 - 1. Excavations for manholes, hydrants, structures and other appurtenances shall be sufficient to leave clearance adequate for proper compactive effort on all sides. The depth, provisions for removing water, and other applicable portions of these specifications shall apply to excavation for appurtenances.

3.15**TRENCH DIMENSIONS**

- A. Trench dimensions shall be as specified below:
 - 1. Trench width FROM the trench bottom to a point one (1) foot above the top of the pipe shall be no less than the outside diameter of the pipe plus twelve (12) inches, but not more than twenty-four (24) inches plus the pipe outside diameter. The width of the trench from the bottom of the trench to the existing ground surface shall be adequate to allow proper compactive effort along both sides of the pipe.
 - a. Depth of Trench. Trench depth shall be as required for the invert grade or pipe bury shown on the plans. Care shall be taken not to excavate below the required depth.
 - b. When soft or unstable material or rock is encountered at the subgrade which will not uniformly support the pipe, such material shall be excavated to an additional depth necessary to provide uniform pipe support, as determined by the Engineer, and backfilled with Type 2 Bedding Material. Type 2 Bedding Material shall conform to the requirements of Specification Section 02225.

2. TRENCH BOTTOM

- a. The bottom of the trenches shall be accurately graded to the line and grade shown on the drawings. Bedding material shall provide uniform bearing and support for each section of the pipe at every point along its entire length. Bell holes and depressions for joints shall be dug after the trench bedding has been graded, and shall be only of such length, depth and width as required for properly making the particular type of joint. Unauthorized over depths shall be backfilled with bedding material at the Contractor's expense.

3.16 TIME OF OPEN TRENCHES

- A. The Contractor will be required to conduct his work so that trenches will remain open a minimum possible time.
- B. No trench excavating shall begin until approved compaction equipment is at the site where the excavating is to take place. All backfill and compacting shall be completed in all trenching and structural excavations within a maximum distance of four hundred (400) feet behind the end of newly installed pipe and the maximum distance between the newly installed pipe and the excavator shall be two hundred (200) feet. For each work group consisting of trench excavator, a pipe-laying crew, and a backfilling and compacting crew, the maximum allowable open ditch at any time will be four hundred (400) feet.
- C. Certain conditions may necessitate the closing of certain sections of trench prior to daily, weekend or holiday shutdown.

3.17 EQUIPMENT

- A. The use of trench digging machinery will be permitted except in places where its operation will cause damage to existing structures or features, in which case hand methods shall be employed.
- B. Any equipment on tracks, which is to be used on pavement, shall be equipped with suitable pads to prevent damage to the pavement. All pavement damaged during construction by the Contractor's equipment shall be restored to its original condition by the Contractor.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. No separate measurement will be made for items under this section, unless otherwise addressed in the Special Provisions.

4.02**BASIS OF PAYMENT**

- A. No separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for excavation costs, or various other contract items and no additional compensation will be allowed therefore unless otherwise addressed in the Special Provisions.

(COPY)

ARTICLE III.

DAMAGE TO UNDERGROUND PUBLIC UTILITY FACILITIES

37-12-301 DEFINITIONS

A. As used in this act:

1. "Business day" means any day other than Saturday, Sunday or legal holiday;
2. "Excavation" means any operation in which earth, rock or other material on or below the ground is moved or otherwise displaced by means of power tools, power equipment or explosives, and includes grading, trenching, digging, ditching, drilling, auguring, tunneling, scraping and cable or pipe blowing and driving, except tilling of soil and gardening or agricultural purposes;
3. "Person" means an individual, partnership, municipality, state, county, political subdivision, utility, joint venture or corporation, and includes the employer of an individual; and
4. "Underground facility" means any item of personal property buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephonic or telegraphic communications, electric energy, oil, gas or other substances and including but not limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments and those parts of poles below ground;
5. "This act" means W.S. 37-12-301 through 37-12-304. (Laws 1978, ch. 46, para. 1.)

37-12-302 PUBLIC UTILITIES TO FILE NAMES AND ADDRESSES OF OWNERS OF UNDERGROUND FACILITIES WITH COUNTY CLERK; NOTICE OF EXCAVATION BY EXCAVATOR; PUBLIC UTILITIES TO SUPPLY INFORMATION UPON NOTICE; EXCEPTIONS.

- A. Every person having the right to bury underground facilities shall file with the county clerk in each county where underground facilities are located a general description of the area served together with the name, address and telephone number of the person in that county from whom necessary information may be obtained concerning the location of underground facilities within that county. In counties where an association pursuant to W.S. 37-12-304 is established, the name, address and telephone number of the association shall be filed with the county clerk on behalf of all participating members.
- B. Architects, engineers, or other persons designing or requiring excavation shall obtain information from persons with underground facilities, as to the nature and location of underground facilities and then make such information and location a part of the plan by

which the contractors operate.

- C. Except as hereafter provided, no person shall make or begin excavation without first notifying any person having underground facilities in the area of the proposed excavation except an employee with respect to his employer's facility. Notice shall be given by telephone or in person. If an association exists within the county pursuant to W.S. 37-12-304, notice to the association is notice to each member thereof in the county.
- D. A person shall, upon receipt of the notice provided for in subsection (c) of this section, advise the excavator of the location and size of underground facilities in the proposed excavation area by marking the location of the facilities with stakes, paint or by other clearly identifiable marking within eighteen (18) inches (458 mm) horizontally from the exterior sides of the underground facilities, and the depth of the underground facility, if known. The person providing information shall respond no later than two (2) full business days after receipt of the notice.
- E. Emergency excavations are exempt from the provisions of subsections (c) and (d) of this section.
- F. If information requested pursuant to subsections (c) and (d) of this section is not provided within the time specified therein, or if the information provided fails to identify the location of the underground facilities in accordance with subsection (d) of this section, then any person damaging or injuring underground facilities shall not be liable for such damage or injury except on proof of negligence.
- G. Compliance with this section does not excuse a person from acting in a careful and prudent manner, nor does compliance with this section excuse a person from liability for damage or injury for failure to so act. (Laws 1978, ch. 46, para. 1.)

37-12-303 NOTICE TO PUBLIC UTILITIES OF DAMAGES TO UNDERGROUND FACILITIES.

A person who, in the course of excavation, contacts or damages an underground facility shall immediately notify the person owning the facility. (Laws 1978, ch. 46, para. 1.)

37-12-304 ASSOCIATION OF PUBLIC UTILITIES; FORMATION; DUTIES.

- A. Two (2) or more public utilities, municipalities or other persons having underground facilities may form an association providing for mutual receipt of notification of excavation activities in a specified area. In areas where an association is formed, public utilities, municipalities or other persons with underground facilities in the area shall become members of the association, receive the service furnished by the association and pay their share of the cost for the service provided.
- B. The association shall:
 - 1. File with the county clerk a description of the geographical area served by the association;

2. List the name, address and telephone number of every member and submit the list to the county clerk; and
3. Maintain adequate records documenting compliance with the requirements of this act.
(Laws 1978, ch. 46, para. 1.)

Effective date - Section 2, Ch. 46, Laws 1978, makes the act effective May 27, 1978.

END OF SECTION

SECTION 02222 — ROCK EXCAVATION

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of requirements for rock removal and the use of explosives to assist in rock removal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 3.01 CONSTRUCTION

- A. Blasting for excavation will be permitted only after securing the approval of the Engineer, and the hours of blasting will be fixed by the Engineer. The Contractor shall use utmost care to protect life and property. All explosives shall be safely and securely stored in compliance with local laws and ordinances, and all such storage places shall be clearly marked "Dangerous Explosives". No explosives shall be left unprotected where they could endanger persons or property.
- B. When blasting rock in trenches, the Contractor shall cover the area to be shot with earth backfill or approved blasting mats that will prevent the scattering of rock fragments outside the excavation. Prior to blasting, the Contractor shall station men and provide signals of danger in suitable places to warn people and stop vehicles. The Contractor will be responsible for all damage to property and injury to persons resulting from blasting or accidental explosions that may occur in connection with his use of explosives.
- C. The Contractor shall furnish the following information to the Owner and Engineer prior to commencing blasting operations: Name of his powder man, powder man's experience, type of shot, type of explosives and detonator being used, proof of insurance covering liability for such operation, traffic control plans and planned procedures for protecting the public.
- D. The Contractor's blasting procedures shall conform to Federal, State and local ordinances. The Contractor shall acquire all required permits prior to the start of blasting.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section.

4.02 BASIS OF PAYMENT

- A. There will be no differentiation between common and rock trench excavation, except when listed as separate items on the bid proposal or bid form. Excavation shall include the removal and subsequent handling of all earth, gravel, rock or other material encountered regardless of the type, character, composition or condition of the material. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 02225 — TRENCH BACKFILL

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of handling and storage of materials to be used for fill and backfill; backfill; and final grading.

PART 2 PRODUCTS

2.01 MATERIALS

A. PIPE BEDDING MATERIAL

1. Type 1 Bedding material around the pipe shall consist of select coarse-grained soils, with less than 5 percent passing a #200 sieve, such as gravel, sand, or silty sand meeting unified soil classification requirements as per ASTM designation D-2487 for type GW, GP, GM, GC, SW, SP, SM & SC, or as specifically approved by the engineer. Bedding material shall not consist of silt, clay & organic soils meeting requirements for soil types ML, CH, & PT. Bedding material shall be free from clods, frozen material, or stones larger than 3/4 inch in their maximum dimension. Where wet or otherwise unstable conditions exist, the material in this zone shall be free draining, non-plastic material. Where suitable material is available in the material excavated from the trench, the Contractor may procure the select material by screening, sifting or manually sorting the material removed from the trench in a manner approved by the Engineer.
2. Type 2 Pipe Bedding is required for foundation in over-excavated trenches and shall consist of the bedding material from six (6) inches under the pipe and below. The bedding material shall consist of sand, sandy gravel, compacted rock or gravel having a maximum size of 1-1/2 inches, uniformly graded and having a maximum plasticity of six (6) as determined by AASHTO Methods T-89 and T-90.

B. CEMENT TREATED FILL

Cement treated fill, when specified, shall meet the following criteria:

Ingredients	Lbs/C.Y.
Cement (0.45 sack)	42 lbs.
Water (39 gallons)	325 lbs.
Coarse aggregate (Size No. 57)	1700 lbs.
Sand (ASTM C-33)	1845 lbs.

The maximum desired twenty-eight (28) day strength is from thirty (30) to sixty (60) psi.

Other cement treated fill designs may be submitted to the Engineer for review and approval.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. COMMON AND SELECT BACKFILL

1. All trenches shall be backfilled immediately after grade, alignment and jointing of the pipe has been inspected and approved. Leakage tests, pressure tests or tests for alignment and grade shall be performed after backfill. If any test fails, the Contractor shall be responsible for work required to correct the defects.
2. After the select pipe bedding material has been placed and compacted as specified in subsection 3.02.A., the remainder of the trench backfilling shall be done. All backfill material shall be free from cinders, ashes, refuse, organic and frozen material, boulders, or other materials that are unsuitable. From one (1) foot above the top of the pipe to six (6) inches below the ground surface, or to the subgrade elevation for streets or paved surfaces, material containing stones up to four (4) inches in the greatest dimension may be used.
3. Trench backfill from the top of the pipe bedding material to ground surface or to the subgrade of street surfacing is separated into two classifications. Type A trench backfill refers to compacted backfill in streets, paved areas, or alleys. Type B backfill is designated for fields, borrow pits, unimproved streets or other un-surfaced areas where special compaction of the trench backfill is not required. Locations of the types of backfill required shall be as shown on the plans.
4. Where shown on the plans, the Contractor shall provide embankment over the pipe above the original ground surface to a height which will satisfy the minimum depth of cover requirements. Such embankment shall be constructed to the cross section shown on the plans.

B. TYPE A TRENCH BACKFILL

1. Materials used for bedding and backfill shall be carefully deposited in depth layers suitable to the equipment used for compaction, wetted to three (3) percent below to two (2) percent above optimum moisture content, and

compacted to at least ninety-six (96) percent of maximum density as determined by AASHTO T-99 (Standard Proctor).

2. Compaction by flooding will not be permitted.
3. If the backfilled trench has not been tested at required intervals during backfilling, the Contractor shall provide excavation equipment to dig compaction test holes through each layer of backfill. Compaction tests shall be required for each one foot layer of backfill at linear intervals not to exceed two hundred (200) feet whether tests are performed during backfilling or via test holes. Should tests fail, the Contractor shall remove all trench backfill above the failed lift and rework to passing compaction the area of deficiency. Engineer shall determine the area of deficiency. In no case shall it extend into areas of known acceptable compaction. All work required to bring the failed test area into spec shall be at the CONTRACTORS expense. Passing backfill tests only assures the Owner that the minimum acceptable level of testing was achieved. The passing tests do not relieve the Contractor of his responsibility to compact the entire trench and does not relieve his guarantee of the trench as identified in this specification.
4. For graveled streets and alleys, the backfill shall be completed by blading the stripped gravel back over the trench.
5. Each service line shall be backfilled and compacted to the same requirements as the main line trench. Each service must have at least one passing compaction test.

C. TYPE B TRENCH BACKFILL

1. Materials used for Type B Trench Backfill shall not require special compaction. The material shall be compacted in layers to achieve a density approximately equal to the density of the existing soil.
2. The Contractor may be required to mound excess earth over the top of the trench so that a depression will not be formed after the trench settles. In cultivated areas, the stripped topsoil shall be placed uniformly over the backfilled trench. The topsoil shall not be compacted but shall be graded to provide a smooth surface conforming to the adjoining ground surfaces.

3.02

COMPACTION

- A. Bedding material under and around the pipe shall be distributed by hand in maximum layers of six (6) inches and thoroughly compacted by tamping. Special care shall be taken to assure complete compaction under the haunches of the pipe.

- B. Backfill material shall be placed in the trench for its full width on each side simultaneously. Compaction of pipe bedding shall be in accordance with this specification.
- C. Cement treated fill may be used for backfill at the option of the Contractor. Provided it meets or exceeds the requirements set forth, no specific compaction will be required.
- D. Cement treated fill may be used at the option of the Contractor provided it meets the requirements of the Engineer. Engineer may require certification of mix design and batching ingredients.

3.03 TESTING

- A. Field density testing of compacted fill will be run at all levels. These tests will be performed by a reputable testing firm at the discretion of the engineer and hired and approved by the owner. The contractor shall provide necessary equipment to dig test holes. The contractor shall be responsible for correction of any areas failing compaction tests, and the expense of such correction shall be borne by the contractor.

3.04 TRENCH GUARANTEE

- A. The Contractor shall, for a period of one (1) year after completion and final acceptance of the work, repair any trench settlement which may occur and shall make suitable repairs to any pavement, sidewalks or other structures which may become damaged as a result of backfill settlement.
- B. If the Contractor elects to perform such repairs by subcontract with the Owner or with others, he shall furnish the Owner and the Engineer a copy of such subcontract or authorization as evidence of his faithful intention to perform the work.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. No separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed.

4.02 BASIS OF PAYMENT

- A. No separate payment will be made for this section. Full compensation shall be considered as included in the prices paid for various contract items and no additional compensation will be allowed.

END OF SECTION

SECTION 02226 — BACKFILLING FOR APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of backfilling for appurtenances.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

- A. Backfill around appurtenances shall be deposited in such a manner as not to disturb the appurtenance from its proper alignment, and compacted to the finished grade. Backfill material, compaction and backfill procedures shall conform to the requirements of the related Type A or Type B backfill as specified for trenches in Specification Section 02225.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefor.

END OF SECTION

SECTION 02227 — BACKFILLING FOR PAVEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of backfilling and compacting operation for construction or reconstruction of roadways, embankments, streets, parking lots and other paved surface areas.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Surfaces for trenches in paved streets or alleys shall be restored to their original shape and the surfacing material shall be of equal quality and equal thickness to that of the original surface. Surfacing material shall be approved by the Engineer. Care shall be taken not to contaminate existing surfaces outside the trench area.
- B. Subgrade for trench pavement resurfacing shall be prepared per Sections 02511 and 02520, as applicable.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 02231 — AGGREGATE SUB-BASE AND BASE COURSES

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of furnishing and placing one or more courses of aggregate and additives, if required, on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness, and typical cross sections shown on the plans or established by Engineer.

1.02 RELATED WORK

- A. Section 02190, Aggregates.
- B. Section 02210, Excavation and Embankment.
- C. Section 02227, Backfilling for Pavement.
- D. Section 02895, Engineering Fabric.

1.03 REFERENCES

- A. ASTM C 911: Quick Lime, Hydrated Lime and Limestone for Chemical Uses.
- B. AASHTO M 85: Portland Cement.
- C. AASHTO T 180: Modified Proctor Moisture Density Relations of Soils using a ten (10) lb. (4.54 kg) Rammer and an eighteen (18) in (457mm) Drop.
- D. AASHTO T 191: Wyoming Modified. Density of Soil in Place (Sand Cone Method).
- E. AASHTO T 99: Standard Proctor Moisture Density Relations of soils using a 5.5 lb. (2.5 kg) Rammer and a twelve (12) inch (305mm) drop.

1.04 SUBMITTALS

- A. When the stationary plant method is used, the aggregate will be accepted immediately before mixing and prior to the addition of water based on periodic samples taken from the pug mill input.
- B. When a road mix method is used, the aggregate will be accepted after necessary blending and before laying, based on samples taken from the combined windrow for each lift.

PART 2 MATERIALS

2.01 MATERIALS

- A. The aggregates shall meet the requirements of Section 02190, AGGREGATES.
- B. Stockpiled materials shall meet the requirements of Section 02190, Subsection 3.01, STOCKPILED AGGREGATE.
- C. Commercial additives, when required, shall meet the following requirements:
 - 1. HYDRATED LIME - Hydrated lime shall conform to the requirements of ASTM C 415.
 - 2. PORTLAND CEMENT - Portland Cement shall conform to the requirements of AASHTO M 85. Unless otherwise designated or permitted, Types I or II shall be used.
 - 3. FLY ASH - Fly ash shall conform to the requirements of ASTM C 311 and ASTM C 618 (including Table 1A) for either Class C or Class F, as specified in the Contract Documents. Aggregates determined to be reactive shall require the use of ASTM C 618, Table 2A, Supplementary Optional Physical Requirements.
- D. Unless otherwise permitted by Engineer, the product of only one mill for any one brand and type of Portland cement shall be used on the project.
- E. Contractor shall provide suitable means for storing and protecting the additives against dampness and other forms of damage. Cement additives which, for any reason, have become partially set or which contain lumps of caked cement shall be rejected. Cement additives may not be salvaged from discarded or used bags.
- F. Other additives, when specified, shall meet the requirements set forth in the Special Provisions.

PART 3 EXECUTION

3.01 PREPARATION

- A. Contractor shall mix the aggregate, water, and commercial additive by the Stationary Plant Method unless otherwise specified by Engineer in the Special Provisions.
- B. The Stationary Plant Method shall meet the following requirements:

1. The aggregate and water shall be mixed in an approved pug mill mixer. Water shall be added during the mixing operation in the amount necessary to maintain the required moisture content for compacting.
- C. The mixer shall be capable of uniformly distributing the aggregate, additives, and water throughout the mixture without evidence of over-wet or dry pockets

3.02 APPLICATION

- A. Stationary Plant Method - Materials mixed by the stationary plant method shall be transported to the job site while it contains the proper moisture content, and shall be placed on the roadbed by means of an approved method.
- B. Travel Plant Method - After the material for each layer has been placed through an aggregate spreader, windrow sizing device or aggregate hopper, the material shall be uniformly mixed by a traveling mixing plant. During mixing, water shall be added in an amount sufficient to maintain the required moisture content for compacting.
- C. Road Mix Method - After material for each layer of the course has been placed, the materials shall be mixed while in the range of plus 2% or minus 4% of optimum moisture content, by means of motor graders or other approved equipment until the mixture is uniform throughout.
- D. Stockpile Method - Commercial additives, if required, will be introduced into the aggregate during stockpiling operations. Water will be introduced by pre-wetting the stockpile of aggregate and additive. Additional water may have to be introduced during the placing of the aggregate courses.

3.03 SHAPING AND COMPACTION

- A. The moisture content of the material at the time of compaction shall be within plus two or minus four percentage points of optimum.
- B. If the required compacted depth of sub-base course exceeds six (6) inches, the course shall be constructed in two (2) or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed six (6) inches. When vibrating or other approved types of special compacting equipment are used, the depth of a single layer of the course may be increased upon approval by Engineer.
- C. Each layer shall be compacted to a density of not less than ninety-five (95) percent of maximum density as determined in accordance with AASHTO T-180, unless otherwise noted in the Special Provisions. Compactions or in-place field densities will be determined by AASHTO T-191 (Wyoming Modified), or by other approved methods. The surface of each layer shall be maintained during compaction

operations in such manner that a uniform texture and surface is produced and the aggregates firmly keyed. Water shall be uniformly applied over the materials during compaction in the amount necessary for proper consolidation.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Aggregate base and sub-base courses will be measured by the cubic yard, compacted in place.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of Aggregate Sub-base and Base Course of size specified will be paid for at the contract prices per cubic yard for aggregate sub-base, base course, and additives, complete in place. Payment includes reuse of existing material or supplying new material, stockpiling, scarifying substrate surface, placing where required, and compacting, with moisture and density control. Payment also includes hauling and delivery of material, as well as water necessary for moisture control. Payment will be made under:

PAY ITEM	PAY UNIT
Crushed Base	Cubic Yard
Pit Run Sub-base	Cubic Yard
Crusher Run Sub-base	Cubic Yard
Crushed Sub-base	Cubic Yard
Sub-base	Cubic Yard
Pit Run Base	Cubic Yard
Crusher Run Base	Cubic Yard
Commercial Additives	Cubic Yard

END OF SECTION

SECTION 02273 — RIPRAP

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of the bank or watercourse protection courses in accordance with these specifications and in reasonably close conformity with the lines, grades, and thickness shown on the plans or established by Engineer.

1.02 RELATED WORK

- A. Section 02190, Aggregates.
- B. Section 02210, Excavation and Embankment.
- C. Section 02895, Engineering Fabric.
- D. Section 03600, Grout.

1.03 REFERENCES

- A. ASTM A 116: Zinc coated (Galvanized) Steel Woven Wire Fence Fabric.
- B. ASTM A 777: Specification for Galvanized Round Steel Tying Wire.
- C. ASTM C 881: Epoxy-Resin-Base Bonding System for Concrete.

1.04 SUBMITTALS

- A. Wire and wire hardware shall be accepted based upon the Manufacturer's Certificate of Compliance.

1.05 DEFINITIONS

- A. Class 1 Riprap - hand placed stones on earth or gravel bedding.
- B. Class 2 Riprap - machine placed stones on earth or gravel bedding.
- C. Grouted Riprap - Class 1 or 2 Riprap as described above with voids filled with sand-cement grout.
- D. Wire Enclosed Riprap - stones placed in wire fabric enclosures.
- E. Sacked Concrete Riprap - hand-placed sacked concrete.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregates used for riprap shall meet the requirements of Section 02190, AGGREGATES.
- B. Wire for wire enclosed riprap shall meet the following requirements unless otherwise noted in the Special Provisions:
 - 1. Woven wire shall be 2- by 4-inch V-mesh fabric having 12 1/2 gauge horizontal wires of 2-strand, twisted construction and 12 1/2 gauge cross wires. All wire shall meet the requirements of ASTM A 116, Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Fencing, and shall be Class 1 or better.
 - 2. Lacing and tie wire shall be galvanized, 12-1/2 gauge smooth steel wire. In lieu of lacing, 9 gauge galvanized hog rings at four inch spacing may be used for fastening ends, sides, and top panels.
- C. Anchorage for Wire Enclosed Riprap shall meet the following requirements unless otherwise noted in the Special Provisions:
 - 1. Steel stakes may be crane rails, 3-inch nominal standard pipe, or 4- by 4-inch by 3/8-inch angles or other approved materials as shown on the Drawings or otherwise noted in the Contract Documents. Stakes shall not be less than five (5) feet in length.
 - 2. Used materials are acceptable provided that the material is not rusted or damaged to an extent that would affect the strength of the stake.
- D. Grout for grouted riprap shall consist of one part Portland cement and three parts of sand, thoroughly mixed with water to produce a workable mix or as otherwise specified in the Contract Documents.
- E. Sacks for sacked concrete riprap shall be made of at least 10-ounce burlap or other approved materials as shown on the Drawings or otherwise noted in the Contract Documents. Sacks shall be approximately 19-1/2 inches by 36 inches measured inside the seams when the sack is laid flat, with an approximate capacity of 1.25 cubic feet. Sound, reclaimed sacks may be used.
- F. Concrete for sacked concrete riprap shall consist of a mixture of not less than four (4) sacks (376 pounds total weight) of Portland Cement per cubic yard and sufficient water to obtain a slump of three (3) inches to five (5) inches or as otherwise specified in the Contract Documents.

PART 3 EXECUTION

3.01 PREPARATION

- A. Slopes on which the riprap is to be placed shall be shaped to allow the full thickness of the specified riprap and any bedding or filter gravel, where required. The slopes shall not be steeper than the natural angle of repose of the slope as shown on the plans or directed. Whenever possible, the excavation shall be undisturbed material or, where this is not possible, the underlying material shall be compacted to at least ninety (90) percent of maximum at optimum moisture content in accordance with the applicable provisions of Section 02225.

3.02 APPLICATION

- A. When called for on the Drawings or otherwise specified in the Contract Documents, a layer of filter gravel shall be placed on the slope immediately prior to placement of the riprap stone. The layer shall be shaped to provide the minimum thickness specified. The surface should generally fit the bottom surface of the riprap.
- B. At the completion of slope protection work, the footing trench shall be filled with excavated material and compaction will not be required.
- C. Class 1 riprap shall meet the following requirements:
 - 1. The larger stones shall be placed first with close joints.
 - 2. The largest stones shall be placed in the footing trench.
 - 3. Stones shall be placed with their longitudinal axis normal to the embankment face and arranged so that each rock above the foundation course has a 3-point bearing on the underlying stones. The foundation course is the course placed on the slope in contact with the ground surface. Bearing on smaller stones which may be used for chinking voids will not be acceptable. Placing of stones by dumping will not be permitted. Interstices shall be as nearly filled as practicable with smaller stones and spalls.
- D. Class 2 riprap shall meet the following requirements:
 - 1. Stones shall be so placed as to provide a minimum of voids, and the larger stones shall be placed in the toe course and on the outside surface of the slope protection.
 - 2. The stones may be placed by dumping and may be spread in layers by bulldozers or other suitable equipment.
- E. WIRE ENCLOSED RIPRAP

1. Wire enclosed segments shall be hand or machine formed to the dimensions shown on the plans. Enclosure segments shall be placed, laced, and filled in a workmanlike manner to provide a uniform, dense, protective coat over the area specified.

F. GROUTED RIPRAP

1. Clean stone shall be placed on the slope in accordance with the class specified. After the stone has been placed, it shall be drenched or sprinkled with water until the stone is thoroughly moistened. The mixed grout shall be applied while the stone is still moist. During application, the grout shall be worked into the interstices to completely fill the voids with grout.
2. Where the depth specified for grouting is in excess of twelve (12) inches, such as in cut-off walls, the riprap stone shall be placed in 12-inch lifts, or as otherwise specified in the Contract Documents. Each lift shall be grouted prior to placement of the next lift. The succeeding lifts shall be constructed and grouted before the grout in the previous lift has set.
3. Grout shall be placed only when the weather is suitable for such work and shall be protected from freezing for at least four (4) days if frost is imminent. The surface of grouted riprap shall be covered with moist earth or wet burlap for not less than three (3) days after placing to allow the grout to properly cure.

3.03 ACCEPTANCE

- A. Sampling of materials shall be in accordance with standard material sampling practices unless otherwise specified in the Contract Documents.
- B. At the direction of Engineer, wire and wire products used on the project which do not meet the specification requirements for the type of material specified may:
 1. Be rejected and Contractor required to remove and replace all of the out-of-specification material at his expense;
 2. Be accepted and left in place and the Contractor's cost of the wire product deducted; or,
 3. Be accepted at a reduced unit price.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Class 1 Riprap, Class 2 Riprap, Grouted Riprap, and Filter Gravel will be measured by the cubic yard in place.

- B. Wire enclosed riprap will be measured by the square yard of top surface area.
- C. Excavation and backfill unless included under some other item, grouting materials, hauling, placing or shaping, and other incidentals necessary for the completion of the work will not be measured for payment, but will be considered as subsidiary to other items of the contract.

4.02

BASIS OF PAYMENT

- A. The accepted quantities of riprap and filter gravel will be paid for at the contract unit price per cubic yard or square yard, complete in place. Payment will be made under:

PAY ITEM	PAY UNIT
Riprap, Class	Cubic Yards
Wire Encl. Riprap	Square Yards
Grouted Riprap, Class	Cubic Yards
Filter Gravel	Cubic Yards

END OF SECTION

SECTION 02280 — TOPSOIL

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of excavating and depositing topsoil in accordance with the specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross-section shown on the plans or established. Removing and stockpiling topsoil prior to grading operations shall be classified as “Unclassified Excavation.”
- B. “Unclassified Excavation” shall consist of the excavation and disposal of all materials encountered in the work, including excavation obtained from borrow sources, not classified under other items of the contract.
- C. The item “Topsoil Borrow” will apply only to borrow material obtained from borrow areas and placed directly in its final location. When topsoil is obtained from borrow areas and stockpiled for later use in the work the first handling will be classed as “Unclassified Excavation” and measured and paid for in accordance with Section 02210, EXCAVATION AND EMBANKMENT.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Topsoil shall consist of any soil suitable for the growth of grass or other cover crops reasonably free from hard dirt, clay, rocks, or other materials which would inhibit the germination of seeds or the growth of the cover crop. Classification of soils suitable for topsoil will be at the discretion of the Engineer.

PART 3 EXECUTION

3.01 STRIPPING AND STORING TOPSOIL

- A. Prior to stripping topsoil from the designated areas, brush, grass, agricultural crops, or other suitable material shall be conserved as mulch and incorporated into the topsoil. The material shall be chopped through a brush chopper, shredded by means of a commercial-sized rotary blade mower, or reduced by other approved methods.
- B. Unless it can be placed directly on the prepared slopes, topsoil shall be stockpiled for later incorporation into the work. Stockpiles shall be placed at the location and to the dimensions designated by the Engineer.

3.02 PREPARATION OFF AREAS

- A. The embankment or cut slope areas to be covered with topsoil shall be completed to the designated lines and grades. Areas that have become crusted or hard-packed shall be scarified to a depth of approximately three (3) inches, prior to placement of the topsoil.

3.03 PLACING TOPSOIL

- A. Topsoil shall be placed in a uniform manner to a depth commensurate with the quantity of topsoil available and the area to be covered.
- B. After the topsoil has been spread, large stiff clods, stones, or other foreign material that would seriously affect the effectiveness or appearance of the topsoil, shall be raked up and removed from the area. Topsoil shall be keyed to the underlying material by scarifying.
- C. Water shall be applied to the topsoil at the locations and in the amounts designated. Water shall be applied in a fine spray by nozzles or spray bars in such a manner that it will not wash or erode the topsoil areas.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. When topsoil is taken from stockpiles, the measurement will be made as the difference, in cubic yards, between the quantity in the stockpile and the remaining after the topsoil required under the contract has been removed.
- B. Topsoil borrow will be measured by the cubic yard. The volume will be determined by preliminary and final cross-sections of the borrow area or by other approve methods of determining actual volumes removed from the borrow area and agreed to prior to the work by the Engineer and the Contractor.
- C. The item "Topsoil Borrow" will include all work required for stripping the material from its original position and placing the material in its final position.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of topsoil will be paid for at the contract price per cubic yard, complete in place. Payment will be made under:

PAY ITEM	PAY UNIT
Topsoil	Cubic Yards
Topsoil Borrow	Cubic Yards

END OF SECTION

SECTION 02290 — WATERING

PART 1 GENERAL

1.01 SUMMARY

- A. This item shall consist of furnishing and applying water required in the compaction of embankments, sub-grades, base courses and surface course, or for the control of dust for the safety and convenience of the public, for the reduction of the dust nuisance with adjacent property, or for other purpose as directed by the Engineer, in accordance with the requirements of these specifications.

PART 2 MATERIALS

2.01 WATER SOURCE

- A. Water required for compaction, dust control or other purposes shall be the responsibility of the Contractor to obtain. Water quality shall meet or exceed that required by Federal, State or local government agencies of authority.

PART 3 EXECUTION

3.01 WATER ADDED

- A. Deficiencies in moisture content of embankment materials, aggregate sub-base, base, or surfacing courses shall be corrected by the addition of water by approved water distribution equipment. Water for dust control, finishing operations, and seeding shall be applied by approved distributor equipment.
1. Grading Operations. Pre-wetting does not guarantee that additional water will not be required. Water added to embankment material during grading operations shall be distributed in a manner that will avoid ponding or over-wetting materials for the full width of each layer of material placed.
 2. Aggregate Courses. Water added to aggregate courses shall be applied to the material immediately prior to mixing and placing the material.
 3. Finishing Operations. Water added during finishing operations shall be uniformly applied in a fine spray across the full width of the course by means of controllable pressures and spray bars or nozzles.
 4. Seeding. Water added to seeded areas shall be applied in a spray that will not wash or erode the seeded area.

5. Dust Control. Water ordered for dust control measures for the protection and safety of traffic, for abatement of air pollution, or for other purposes, shall be applied in a manner that will best accomplish the elimination of dust.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. No method of measurement is required except that agreed upon by the Contractor and the entity from which he receives water.

4.02 BASIS OF PAYMENT

- A. This item shall be considered subsidiary to other work with no additional pay necessary.

END OF SECTION

SECTION 02510 — PORTLAND CEMENT TREATED MIXTURES

PART 1 GENERAL

1.01 SUMMARY

A. Provide Portland cement treated mixtures over prepared sub-base as follows:

1. Cement treated base

1.02 RELATED WORK

- A. Section 02190 Aggregates
- B. Section 02231 Aggregate Sub-Base and Base Courses
- C. Section 03304 Portland Cement Concrete
- D. Section 02210 Excavation and Embankment
- E. Section 02225 Trench Backfill

1.03 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three (3) years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.04 SUBMITTALS

- A. Submit for approval product data, test reports and mix design.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cement and water: Comply with Section 03304, PORTLAND CEMENT CONCRETE.
- B. Aggregate:
 - 1. Cement treated base: Comply with pavement base coarse specification under Section 02231, AGGREGATE SUB-BASE AND BASE COARSE.
- C. Admixtures (when required): Comply with pozzolan admixture, or fly ash specification, under Section 03304, PORTLAND CEMENT CONCRETE, and with ASTM C311 and C618, Class C or F.

- D. Bituminous curing/sealing compound: Comply with liquid or emulsified asphalt specification under Section 02545, BITUMINOUS MATERIALS.

PART 3 EXECUTION

3.01 PROPORTIONING OF MATERIALS

A. Cement treated base:

1. Comply with applicable measurement, proportioning, and mixing specifications under Section 03304, PORTLAND CEMENT CONCRETE.
2. Mixing can be performed as follows, at the Contractor's option:
 - a. Roadbed: Uniform windrows of untreated base shall be shaped and the tops slightly flattened to receive the cement. The size of the windrows shall be limited such that all the material can pass through the mixing machine in one operation. Cement shall be spread uniformly on the base material, and completely mixed. Water shall be applied under pressure with controlled distributing equipment, and mixing shall continue until the base is a homogeneous mixture with uniform moisture content.
 - b. Central plant: Cement, water, aggregate and admixture(s) if required, shall be stored separately. Plants shall use an approved pug mill or continuous flow mixer, to produce a homogeneous mixture of uniformly distributed and properly coated aggregates with consistent appearance. The total elapsed time between the addition of water to the mixture and the start of compaction shall not exceed forty-five (45) minutes. The mixture shall be transported to the site in clean equipment with suitable protective devices to prevent material loss and significant moisture change.

3.02 INSTALLATION

- A. Comply with applicable subgrade preparation and compaction specifications under Sections 02210, EXCAVATION AND EMBANKMENT and 02225, TRENCH BACKFILL. Subgrade shall conform to the lines, grades, and cross sections shown on the Plans.
- B. Cement treated base: Spread mixture with a jersey spreader and motor grader over properly prepared subgrade. Uniformly compact the treated base with pneumatic rollers to at least one hundred (100) percent of maximum density determined in accordance with AASHTO T 99. The maximum compacted thickness of any one layer shall not exceed six (6) inches. The surface of the base course shall be lightly scarified, re-graded, reshaped, and re-compacted to the lines, grades, and cross sections shown on the Plans.

3.03 CURING AND PROTECTION

- A. Moist curing (water fogging): Exposed surfaces of controlled density backfill and cement treated base shall be kept continuously moist with a fog spray for seven (7) days.
- B. Bituminous seal: Immediately after final rolling, bituminous curing of either liquid or emulsified asphalt shall be applied in sufficient quantity to provide a continuous membrane over the treated mixture, at a rate of between 0.1 and 0.2 gallons per square yard of surface area.
- C. Remove and replace entire depth of defective work.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 02511 — ROAD MIX AND BITUMINOUS PAVEMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. These specifications include general requirements that are applicable to all types of road mix bituminous pavements irrespective of the gradation of aggregate, kind, and the amount of bituminous material or pavement used.
- B. This work shall consist of constructing one or more courses of a road mix bituminous mixture on the prepared foundation in accordance with these specifications, and in reasonably close conformity with the lines, grades, thickness, and typical cross sections on the plans or established by Engineer.

1.02 RELATED WORK

- A. Section 02190, Aggregates.
- B. Section 02512, Plant Mix Pavements.
- C. Section 02545, Bituminous Materials.
- D. Section 02550, Prime Coat.
- E. Section 02551, Tack Coat.

1.03 REFERENCES

- A. AASHTO T 40; Sampling Bituminous Materials.
- B. AASHTO T 2; Sampling Aggregates.
- C. AASHTO T 27; Wyoming Modified Sieve Analysis.
- D. ASTM C 136; Sieve Analysis.

PART 2 PRODUCTS

2.01 MATERIALS

- A. The type and grade of bituminous material will be specified in the Contract Documents. The grade may be changed one step by Engineer during construction at no change in unit price. The bituminous material shall meet the applicable requirements of Section 02545, BITUMINOUS MATERIALS.

- B. The aggregate will be accepted immediately preceding addition of bituminous material to the mix. The aggregates shall meet the requirements of Section 02190, AGGREGATES. This acceptance will be based on periodic samples of the windrow after all aggregates have been blended for each lift.
- C. Stockpiled material shall meet the requirements of Section 02190, Subsection 3.01, STOCKPILED AGGREGATE.

PART 3 EXECUTION

3.01 PREPARATION

- A. Before materials for road mixing are spread, the surface on which the road mix is to be placed shall be conditioned as specified in Section 02512, PLANT MIX PAVEMENTS, Subsection 3.01, and primed and tacked, where required, in accordance with Section 02550, PRIME COAT, and Section 02551, TACK COAT, respectively.
- B. The construction of road mix bituminous pavement shall be carried on only when the surface on which the material is to be placed is dry and when the atmospheric temperature is above 50°F and has not been below 40°F during the preceding twenty-four (24) hours.
- C. The equipment used by Contractor shall include scarifying, mixing, spreading, finishing, and compacting equipment, a bituminous distributor, and equipment for heating bituminous material.
- D. The distributor shall be so designed, equipped, maintained, and operated that bituminous material at even heat may be applied uniformly on variable widths of surface up to fifteen (15) feet at readily determined and controlled rates, from 0.05 to 2.0 gallons per square yard, with uniform pressure and with an allowable variation from any specified rate not to exceed 0.02 gallon per square yard. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.
- E. Traveling or stationary mixing plants or other equipment of proven performance may be used by Contractor in lieu of the specified equipment if approved.
- F. Rollers shall be of self-propelled steel wheel tandem or 3-wheel rollers weighing not less than eight (8) tons each. Pneumatic-tired rollers shall have a total compact width of not less than sixty (60) inches and a gross weight adjustable within the range of two hundred (200) to three-hundred-fifty (350) pounds per square inch of

compaction width. The operating weight shall be as directed. Tire pressure or contact pressure may be specified for pneumatic-tired rollers.

3.02 INSTALLATION

A. PLACING AGGREGATES

1. Aggregates shall be uniformly spread on the road by the use of spreader boxes or other approved mechanical spreading devices. When two or more sizes of aggregates are used, each size of aggregate shall be placed in the proper amount to provide for surfacing of the required width and thickness. Each size of aggregate shall be windrowed to uniform section and left undisturbed until measuring and sampling are completed, after which they shall be mixed until they are uniformly blended and then spread over the road surface.
2. If the surface moisture of the aggregate is more than two (2) percent of the dry weight of the aggregate, except when the bituminous material is emulsified asphalt, the aggregate shall be turned by blades or disc harrows or otherwise aerated until the moisture content is reduced to two (2) percent or less. The aggregate shall then be spread smoothly and uniformly over half the road or other convenient width of the surface ready for the application of bituminous material, except that when a traveling mixing plant is used, the aggregate shall be formed into a uniform cross section.
3. In lieu of aerating and drying the aggregate, Contractor may use an approved additive. The additive shall permit suitable coating of the wet aggregate and shall prevent the bituminous coating from stripping in the presence of water.

B. APPLICATION OF BITUMINOUS MATERIAL

1. The bituminous material shall be uniformly distributed in successive applications, in such amounts and at such intervals as directed. The mixing equipment shall follow immediately behind the distributor after each application of bituminous material to partially mix the aggregate and the bituminous material. Application temperature shall be in accordance with Section 02545, BITUMINOUS MATERIALS, Subsection 3.02.

C. MIXING

1. After the last application of bituminous material and partial mixing, the entire mass of bituminous material and aggregate shall be windrowed on the road surface and then mixed, by blading the mixture from side to side of the road or by manipulations producing equivalent results, until all aggregate particles are coated with bituminous material and the whole mass has a uniform color, and the mixture is free from rich or lean spots, balls, or uncoated particles. During

the mixing operations, care shall be taken to avoid cutting into the underlying coarse or contaminating the mixture with the earth or other extraneous matter. The mixing process shall be confined to part of the width or area of the road when required to allow traffic to pass.

2. Should the mixture show an excess, deficiency, or uneven distribution of bituminous material, the condition shall be corrected by the addition of aggregate or bituminous material as required, and remixing. If the mixture contains excessive amounts of moisture or volatile matter, it shall be bladed, aerated, or otherwise manipulated until the moisture and volatile contents are satisfactory. The spreading of the mix shall not be done when the surface to be covered is in an unsatisfactory condition.
3. At the end of the day's work, or when the work is interrupted by weather conditions or otherwise, all loose material shall be bladed into a windrow whether or not mixing is completed, and shall be retained in a windrow until operations are resumed.
4. When the mixing operations have been satisfactorily completed, the mixture shall be formed into a windrow of uniform cross section.
5. If Contractor requests, and is authorized to use, traveling or stationary mixing plants in lieu of the specified equipment, the same requirements regarding residual moisture and evaporation of volatiles given above shall apply.

D. SPREADING, COMPACTING AND FINISHING

1. The material shall be spread by a self-propelled, pneumatic-tired blade grader or a mechanical spreader of approved type. Care shall be taken to avoid cutting into the underlying base when the material is spread from the windrow.
2. After the material is spread, the surface shall be rolled. Rolling shall be parallel to the road centerline and shall commence at the outer edges of the road, overlapping the shoulders, and progress toward the center, overlapping on successive passes by at least one-half the width of the roller, except that on super-elevated curves rolling shall progress from the lower to the upper edge. Each pass shall terminate at least three (3) feet in advance or to the rear of the end of the preceding pass. Curing the compaction, the surface shall be dragged or bladed as necessary to fill ruts and to remove incipient corrugations or other irregularities. Rolling shall continue until the surfacing is of uniform texture and satisfactory compaction has been obtained. Initial rolling shall be performed with a pneumatic-tired roller, and final rolling shall be performed with a 3-wheel or tandem-type steel wheel roller. Rolling shall be discontinued whenever it

begins to produce excessive pulverizing of the aggregate or displacement of the mixture.

3. Where the compacted thickness of the road mix surface is to be more than two (2) inches, the mixture shall be spread from the windrow and compacted in two layers, the first layer to be bladed and rolled before the second layer is spread.
4. While the surface is being compacted and finished, Contractor shall trim the edges neatly to line.

3.03 SURFACE REQUIREMENTS

- A. The surface will be tested by Engineer using a 10-foot straightedge at selected locations. The variation of the surface shall at no point exceed one-quarter (1/4) inch. All humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as specified.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Aggregate and bituminous material will be measured by the ton. The weight of the natural moisture in the aggregate will not be deducted from the pay quantities.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of road mix bituminous pavement will be paid for at the contract unit price per ton for aggregates and bituminous material complete in place. Payment will be made under:

PAY ITEM	PAY UNIT
Aggregate for Road Mix Bit. Pavement	Ton
Liquid Asphalt (RM Bit. Pavement.)	Ton or Gal.
Emulsified Asphalt (RM Bit. Pavement.)	Ton or Gal.

END OF SECTION

SECTION 02512 — PLANT MIX PAVEMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. These specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type irrespective of gradation of aggregate, kind, and amount of bituminous material or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.
- B. This work shall consist of one or more courses of bituminous mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the type under contract, and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by Engineer.

1.02 RELATED WORK

- A. Section 02190, Aggregates.
- B. Section 02545, Bituminous Materials.
- C. Section 02550, Prime Coat.
- D. Section 02551, Tack Coat.
- E. Section 02552, Seal Coat.

1.03 REFERENCES

- A. ASTM C 150: Portland Cement.
- B. AASHTO M 303: Hydrated Lime for Asphalt Mixtures.
- C. AASHTO T 230: Density of Bituminous Aggregate Mixtures.

1.04 SUBMITTALS

- A. Contractor shall submit for Engineer's approval a job-mix formula for each mixture to be supplied for the project. The job-mix formula with the allowable tolerances shall be within the master range specified. The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size and a single mixing temperature. Should a change in sources of material be made, a new job-mix formula shall be established before the new material is used. When

unsatisfactory results or other conditions make it necessary, Engineer may establish a new job-mix formula.

- B. Mixing plant scales shall be checked as often as deemed necessary to assure their continued accuracy. Contractor shall have on hand not less than ten (10) 50-pound weights for checking of the scales.

1.05 DEFINITIONS

- A. Plant mix pavement is considered a surface course in all cases.
- B. Plant mix bituminous base is considered a sub-surface course.

PART 2 PRODUCTS

2.01 MATERIALS

A. BITUMINOUS MATERIALS

- 1. The percentage of bituminous material to be added to the job-mix formula will be designated by Engineer and specified in the Contract Documents.
- 2. The type and grade of bituminous material will be specified in the Contract Documents. The grade may be changed one step by Engineer during construction at no change in unit price.
- 3. The bituminous material shall meet the applicable requirements of Section 02545, BITUMINOUS MATERIALS.

B. AGGREGATE MATERIALS

- 1. Aggregates shall meet the applicable requirements of Section 02190, AGGREGATES.
- 2. During crushing operations, the coarse and fine aggregates shall be stockpiled in separate piles in such manner that they can later be combined to meet the required specifications.
- 3. Stockpiled material shall meet the requirements of Section 02190, AGGREGATES, Subsection 3.01.
- 4. Natural filler, when required, shall be stockpiled separately. The plans may limit or prohibit the use of crusher rejects or material from the same source as the aggregate material.

C. COMMERCIAL ADDITIVES

1. The type of commercial additive to be used will either be designated on the plans, or when no specific type is designated, any of the Commercial Additives conforming to either of the following requirements may be used:
 - a. PORTLAND CEMENT - Portland cement shall conform to the requirements of ASTM C 150.
 - 1) Unless otherwise permitted by Engineer, the product of only one mill of any one brand and type of Portland cement shall be used on the project.
 - 2) Contractor shall provide suitable means for storing and protecting the cement against dampness. Cement which, for any reason, has become partially set or which contains lumps of caked cement shall be rejected. Cement salvaged from discarded or used bags shall not be used.
 - b. HYDRATED LIME - Hydrated lime shall conform to the requirements of AASHTO M 303, except that not less than ninety-three (93) percent of the hydrated lime shall consist of calcium and magnesium oxides.

D. COMPOSITION OF MIXTURES

1. The bituminous plant mix shall be composed of a mixture of aggregate, natural filler or commercial additive, if required, and bituminous material. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resultant composite blend meets the job-mix formula.
2. After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerances:

Passing #4 and Larger Sieves	-7 to +7 percent
Passing #8 to #100 Sieves	-5 to +5 percent
Passing #200 Sieve	-3 to +3 percent
Bituminous Material	-0.5 to +0.5 percent
Mixing Temperature	-20 to +20 degrees F

3. In general, the point of acceptance for the aggregate will be after the material has passed through the gradation unit and prior to the addition of bituminous material. If this point of acceptance proves unsatisfactory, an alternate point of acceptance may be selected by Engineer. The bituminous material will be conditionally accepted at the source. The plant-mixed material will be accepted after blending and mixing at the plant.

PART 3 EXECUTION

3.01 PREPARATION

A. CONDITIONING OF EXISTING SURFACE

1. Irregular surfaces of existing pavements or bases shall be brought to uniform grade and cross section as directed.
2. When specified in the Contract Documents, all longitudinal and transverse joints and all cracks shall be sealed by the application of an approved joint sealing compound before the mixture is spread upon a pavement surface. All excessive bituminous material shall be removed from joints and cracks prior to placement of the mixture.

B. PREPARATION OF BITUMINOUS MATERIAL

1. The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times. Charts showing specified temperature range for each source of supply are available from the Headquarters Laboratory of the Wyoming Department of Transportation.

C. PREPARATION OF AGGREGATE

1. The aggregates for the mixture shall be dried and heated to the required temperature. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate or coating the aggregate with soot, oil, or other contaminants. Burner fuels may be specified by Engineer in the Special Provisions.
2. The aggregates, immediately after heating and drying, shall be screened into two or more fractions and conveyed into separate compartments ready for batching and mixing with bituminous materials. Screening shall be at such rate and in such manner that the coarse aggregate bin or bins shall contain less than ten (10) percent of minus #4 sieve material and the fine bin shall contain less than ten (10) percent of plus #4 sieve material.

D. MIXING

1. The dried aggregate shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.

2. After the required amounts of aggregate and bituminous 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 bituminous material throughout the aggregate is secured.
3. For hot mix bituminous pavement, the mixture shall be produced at the lowest possible temperature that will produce a workable mix within the application temperatures specified under Section 02545, BITUMINOUS MATERIALS, Subsection 3.02. The bituminous material and aggregate shall be introduced into the mixer within the specified temperature range and shall be within 25°F of each other.

E. BITUMINOUS MIXING PLANT - GENERAL

1. Sufficient storage space shall be provided for each size of aggregate, and the different aggregate sizes shall be kept separated until they have been delivered to the cold elevator feeding the drier.
2. Plants used for preparation of bituminous mixtures shall conform to all requirements under Subsection 3.01(F) below, except that scale requirements shall apply only where weight proportioning is used. In addition, batch mixing plants shall conform to the requirements under Subsection 3.01(G) herein, continuous mixing plants shall conform to the requirements under Subsection 3.01(H) herein, and dryer-drum mixers shall conform to the requirements under Subsection 3.01(I) herein.
3. Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.

F. REQUIREMENTS FOR ALL PLANTS

1. Plant Scales - Scales shall be accurate to one-half (0.5) percent of the maximum load that may be required. Poles shall be designed to be secured in any position to prevent inadvertent change of position. Contractor may provide an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weigh ticket for each load.
2. Equipment for Preparation of Bituminous Material - Tanks for the storage of bituminous 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 bituminous material shall be designed to

assure proper and continuous circulation during the operating period. Provision shall be made for measuring and sampling storage tanks.

3. Feeder for Drier - 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.
4. Drier - The plant shall include a drier or driers which continuously agitate the aggregate during the heating and drying process. For cold-type bituminous mix, equipment for mechanical cooling of the dried aggregate to the temperature prescribed for cold mixtures shall be provided and shall be capable of supplying prepared material for the mixer to operate at full capacity.
5. 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.
6. 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 assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for commercial additives when used, and the plant shall be equipped to feed such material into the mixer. Each bin shall be provided with overflow pipes of such size and at such location as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with its individual outlet gate, constructed so that when closed, there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be so constructed that samples can be readily obtained. Bins shall be equipped with adequate telltale devices to indicate the position of the aggregates in the bins at the lower quarter points.
7. Sampling Facilities - The plant shall be equipped with suitable sampling devices or facilities to insure representative samples. If Engineer is unable to obtain samples which represent the material being accepted for incorporation into the project, Contractor shall make necessary adjustments or revisions to the plant before any further mixing is done.
8. Bituminous Control Unit - Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix. The accuracy of bituminous content measured either by weighing or metering may be checked by computing the daily yield of total material being processed.
9. Thermometric Equipment

- a. An armored thermometer of adequate range in temperature reading shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit.
 - b. The plant shall also be equipped with an approved temperature recording device so placed at the discharge chute of the drier as to register automatically or indicate the temperature of the heated aggregates. The printed temperature recordings shall be furnished to Engineer after each day's run.
10. 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 as directed.
11. Truck Scales - The bituminous mixture shall be weighed on approved scales. Such scales shall be inspected as often as Engineer deems necessary to assure their accuracy.

G. REQUIREMENTS FOR BATCHING PLANTS

- 1. 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 running over. The gate shall close tightly so that no material is allowed to leak into the mixer while a batch is being weighed.
- 2. Bituminous Control
 - a. The equipment used to measure the bituminous material shall be accurate to plus or minus one-half (0.5) percent.
 - b. The bituminous material bucket shall be non-tilting type with a loose sheet metal cover. The capacity of the bituminous material bucket shall be at least fifteen (15) percent in excess of the weight of bituminous material required in any batch. The length of the discharge opening or spray bar shall be not less than three-quarters of the length of the mixer, and it shall discharge directly into the mixer. The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer.
 - c. The bituminous material 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 so constructed that they will not interfere with the efficient operation of the bituminous scales. The plant

shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.

- d. The indicator dial shall have a capacity of at least fifteen (15) percent in excess of the quantity of bituminous material used in a batch. The controls shall be constructed so that they may be secured at any dial setting and will automatically reset to that reading after the addition of bituminous material to each batch. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled so that it will begin when the dry mixing period is over and all of the bituminous material required for one batch will be discharged in not more than fifteen (15) seconds after the flow has started.

3. Mixer

- a. The batch mixer shall be an approved twin pug mill type capable of producing a uniform mixture within the job-mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.
- b. The clearance of blades from all fixed and moving parts shall not exceed one (1) inch.
- c. The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the bituminous material bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of bituminous material. The wet mixing period is the interval of time between the start of introduction of bituminous material and the opening of the mixing gate.
- d. The control of the timing shall be flexible and capable of being set at intervals of five (5) seconds or less throughout a total cycle of up to three (3) minutes.
- e. The setting of time intervals shall be performed in the presence of Engineer, who shall then lock the case covering the timing device until such time as a change is to be made in the timing periods.

H. REQUIREMENTS FOR CONTINUOUS MIXING PLANTS

1. Aggregate Proportioning

- a. The plant shall include means for accurately proportioning each size of aggregate.
- b. 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 and secured against inadvertent movement.
- c. Indicators shall be provided for each gate to show the respective opening in inches.

2. 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 two hundred (200) pounds, and accurate scales shall be provided by Contractor to weigh such test samples.

3. Synchronization of Aggregate Feed and Bituminous Material Feed - Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of bituminous material from the meter or other proportioning device. This control shall be accomplished by interlocking mechanical means or by any other positive, satisfactory method.

4. Mixer

- a. The plant shall include a continuous mixer of an approved twin pug mill type, adequately heated and capable of producing a uniform mixture within the job-mix tolerances.
- b. 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.

- c. The clearance of blades from all fixed and moving parts shall not exceed one (1) inch.

I. REQUIREMENTS FOR DRYER-DRUM MIXER

1. The plant shall be equipped to control aggregate gradation as described for cold feed control. The total cold aggregate feed shall be weighed continuously by an approved belt scale. When tested for accuracy, the weighing system shall register within plus and minus one-half (0.5) percent. Provisions shall be made for determining the moisture content of the cold feed and correcting the aggregate weight to a dry weight.
2. An automatic digital record of the dry aggregate and the asphalt shall be displayed, recorded and totaled in appropriate units of weight and time. A positive interlock shall be provided between the dry weight of the aggregate and the bituminous material. The flow of the bituminous material shall be adjusted to compensate for the changes in the dry weight of the aggregate.
3. The dryer-drum mixer shall be capable of drying and heating the aggregate to the moisture and temperature requirements. A uniform mixture of aggregates and bituminous material shall be produced. The plant shall have a temperature recording device at the discharge chute of the dryer.

3.02

APPLICATION

- A. The temperature of the mixture prior to laydown shall not be more than 25°F less than the mixing temperature.
- B. Plant mix wearing course shall be placed between the dates of June 1st and September 15th unless otherwise specified by Engineer in the Special Provisions.
- C. Bituminous plant mix shall not be placed on any wet surface; when the atmospheric 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:

* Minimum Ambient Temperature (°F)		
COMPACTED THICKNESS	SURFACE COURSE	SUBSURFACE COURSE
Less than 1"	60	55
1" to and including 2"	40	40
More than 2"	40	35

* May 1 to October 15 or as specified in the Contract Documents.

- D. Spot leveling or the bottom lift of a leveling course may be placed at 50°F if additional courses are placed on the same contract.

E. HAULING EQUIPMENT

1. Trucks used for hauling bituminous 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. This material shall not be used in amounts which will contaminate the mixture. When required, each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather. When necessary, so that the mixture will be delivered on the road at the specified temperature, truck beds shall be insulated and covers shall be securely fastened.
2. Railroad cars used for transportation of cold-laid bituminous mixtures shall be in good condition and without pockets. All projecting spikes, nails, foreign material, and other obstructions likely to interfere with efficient unloading shall be removed from the cars. The bottoms of the cars shall be covered with a thin layer of clean sand or screenings, and the top of the load shall be protected from contamination by moisture or foreign materials, and from the loss of volatile material.

F. SPREADING AND FINISHING

1. The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.
2. When the total compacted thickness of the mat is to be in excess of two (2) inches, it shall be placed in two or more lifts. The compacted thickness of any one lift in multiple-lift construction shall not exceed two (2) inches.
3. Except on tapers, narrow median areas, shoulders, and other such areas of irregular shape, limited length or restrictive width, or such other areas as directed, the paver screed shall be controlled by the automatic screed control described under Subsection 3.02(G) herein.
4. Engineer will perform such engineering as may be required to establish controls for the work and will set references for line and grade controls at reasonable intervals along the work.
5. Contractor shall furnish, place, and maintain such materials, devices, and equipment as may be required to provide specified independent line and grade control references and other controls which may be required for proper execution of the work.

6. Line and grade control for use with automatic paver control systems shall be an independent control reference consisting of:
 - a. A tightly stretched wire or string line offset and paralleling true line for pavement edge and established grade for pavement surface;
 - b. A floating beam of not less than twenty (20) feet in length attached to the paver and riding on previously placed base or pavement material. The beam shall be equipped with a floating string or other device that will actuate the automatic screed control in reference to the base on which it is riding. Unless otherwise permitted by Engineer, the first ribbon of the first course of pavement material shall be controlled by the independent control wire. Subsequent ribbons may be controlled by the beam reference system.
7. The longitudinal joint in one layer shall offset that in the layer immediately below, by at least six (6) inches. Longitudinal joint locations may be otherwise specified in the Contract Documents.
8. Defects caused by trucks bumping into the laydown machine or by unnecessary stopping due to lack of coordination between mixing, hauling, and laydown shall be removed and replaced in accordance with Subsection 3.04.
9. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked and luted by hand tools. For such areas the mixture shall be dumped, spread, and screeded to give the required compacted thickness.
10. Plant mix surfacing ribbons shall be brought up approximately even at the end of each shift on those projects being constructed under traffic.

G. BITUMINOUS PAVERS

1. Bituminous 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 bituminous plant mix material in lane widths applicable to the specified typical section and thickness shown on the plans. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plant mix material in widths shown on the plans.
2. The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

3. 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.
4. Pavers shall be equipped with a paver control system which will automatically control the laying of the mixture to specified transverse slope and established longitudinal grade. The paver control system shall be automatically actuated from an independent line and grade control reference and through a system of mechanical sensors and sensor directed devices which shall maintain the paver screed at the proper transverse slope and at proper height to establish the top surface of the finally compacted mixture at specified slope and grade. In case of failure of the control system, the paver shall be operated by mechanical control only until the material under production at the time of breakdown is laid.
5. The paver shall be capable of being operated, when laying mixtures, at forward speeds consistent with satisfactory laying of the mixture.
6. A paving leveler shall be used when specified as shall be described in the Special Provisions.

H. ROLLERS

1. All rollers shall be in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. The use of equipment which results in excessive crushing of the aggregate will not be permitted.
2. The pneumatic-tired roller shall be self-propelled with a total weight, including ballast, no greater than thirty (30) tons. The roller shall be constructed so contact pressure may be varied between forty (40) psi and ninety (90) psi.
3. Wobble wheel rollers are not permitted. Each roller shall be equipped with not less than seven (7) wheels with tires of equal size and ply and having a smooth tread design. The wheels shall be staggered on the front and rear axles to provide complete coverage, have a system for uniformly moistening each wheel without an excess of water, and have close-fitting scrapers for each wheel. The tire pressures shall not vary by more than five (5) psi between individual tires from the designated pressure.

I. COMPACTION

1. Immediately after the bituminous mixture has been spread and struck off and the surface irregularities adjusted, it shall be thoroughly and uniformly

compacted by rolling. Rolling shall be continued while the mixture is in a workable condition until all roller marks are eliminated and, unless otherwise designated on the plans, until a minimum of ninety-five (95) percent of the maximum density, as established by Marshall Test Results as determined by an approved laboratory, has been obtained. Samples will be taken in accordance with AASHTO T 230, or density will be determined by the use of properly calibrated Nuclear Density Gauge.

2. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction without undue displacement, cracking, or shoving. Pneumatic tires shall be inflated to obtain the contact area pressures designated by Engineer.
3. Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping one-half of the roller width. Roller shall move at a slow, uniform speed with the drive wheels or rolls nearest the paver except on steep grades.
4. When the pavement is placed by machines in echelon or abutted against a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. On super-elevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.
5. Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required. Care should be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.
6. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.
7. Along forms, curbs, headers, walls, and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons, or mechanical tampers. On depressed areas, a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.
8. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of bituminous material shall be removed and replaced.

J. JOINTS

1. Placing of the bituminous paving shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by Engineer. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. When directed by Engineer, a brush of bituminous material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

3.03 PROTECTION

- A. During any delays or suspensions of work, as outlined in the Contract Documents, Contractor shall be responsible for maintaining the quality of all leveling courses until the placement of additional courses. Maintenance of leveling courses because of delays or suspension of work will be done at Contractor's expense unless otherwise specified in the Contract Documents.

3.04 ACCEPTANCE

- A. The surface will be tested by Engineer using a 10-foot straightedge at selected locations. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall at no point exceed three-sixteenths inch. All humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material, or as directed.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Plant mix bituminous pavement will be measured by the ton or the square yard, delivered and placed. In lieu of truck scales, batch weights will be permitted.
- B. Weigh tickets shall be issued for each load either by an automatic printer system as described under Subsection 3.01(F) herein, or by a weighman who witnesses the batches loaded into the hauling vehicles. In the case of a non-automatic plant, an inspector will be assigned to check the scales and metering devices during the batching process.
- C. The accumulative weight of all batches incorporated in the work will be used for payment. No deduction will be made for the weight of bituminous material in the mixture.

- D. When specified in the contract as pay items, the quantity of bituminous materials and commercial additive will be the number of tons of each used in the accepted work.

4.02 BASIS OF PAYMENT

- A. All work performed and measured as prescribed above will be paid for as provided in the respective sections for each type specified.
- B. Work prescribed in Subsection 3.01(A) herein will be paid for at the contract unit prices for the material used. Payment will be made under:

PAY ITEM	PAY UNIT
Plant Mix Bituminous Base	Ton or Square Yard
Plant Mix Bituminous Pavement	Ton or Square Yard
Plant Mix Wearing Course	Ton or Square Yard

END OF SECTION

SECTION 02520 — PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of constructing a pavement composed of Air-Entrained Portland Cement Concrete constructed on a prepared subgrade or base course in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or designated by the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. CONCRETE

- 1. Section 03304, Subsection 2.01, Cement
- 2. Section 03304, Subsection 2.07, Admixtures
- 3. Section 03304, Subsection 2.02, Water
- 4. Section 03304, Subsection 2.05, Fine Aggregate
- 5. Section 03304, Subsection 2.04, Coarse Aggregate
- 6. Section 03200, Subsection 2.01, Concrete Reinforcement Materials

B. JOINT FILLERS

- 1. The filler for each joint shall be furnished in a single piece for the full depth required for the joint unless otherwise authorized by the Engineer. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened securely, and held accurately to shape by stapling or other positive fastening satisfactory to the Engineer.
- 2. Preformed joint filler shall conform to the requirements of AASHTO M-213, ASTM D 944, ASTM D 1751 or ASTM D 1752 unless otherwise shown on the plans, and shall be punched to admit the dowels where called for on the plans.

C. JOINT SEALERS

- 1. Hot poured sealer for joints shall conform to the requirements of ASTM D3405-75T unless otherwise shown on the plans.

2. Elastic joint sealer, where called for on the plans, shall be two component polyurethane sealant meeting ASTM C920-79, Type M, Grade P, Class 25, Use TMO. Sealant for horizontal joints may be either Class A (self-leveling) or Class B (non-sag). Sealant for sloped or vertical joints shall be Class B.
3. Preformed compression joints shall be manufactured to the size and shape shown on the plans, from materials conforming to the requirements of ASTM D-2628. The Contractor shall furnish a certification for each shipment indicating that the material has been sampled, tested, and inspected in accordance with the provisions of ASTM D-2628. Each certification so furnished shall be signed by an authorized agent of the manufacturer or independent testing agency. If recommended by the manufacturer, an approved lubricant-adhesive may be used to provide lubrication and bond for the joint. The lubricant shall be manufactured of material that is compatible with the sealer.
4. Silicone Rubber Base joint sealant shall conform to Federal Spec TT-S-001543A Sealing Compound.

D. CURING MATERIALS

1. Burlap Cloth made from Jute or Kenaf AASHTO M-182 (Class 3)
2. Waterproof Paper for Curing Concrete AASHTO M-171 (ASTM C-171)
3. Liquid Membrane-Forming Compounds for Curing Concrete AASHTO M-148, Type 2, white pigmented.

E. STOCKPILED AGGREGATES

1. Stockpiled materials shall meet the requirements of Section 02190, Subsection 3.01, STOCKPILED AGGREGATES.

PART 3 EXECUTION

3.01 PROPORTIONING CONCRETE MIX

- A. The concrete shall meet the following requirements:
1. Maximum slump of 3-1/2 inch.
 2. Design flexural strength as specified or shown on the drawings.
 3. The cement content shall not be less than six (6.0) sacks per cubic yard with a maximum water-cement ratio of 0.47.

4. Fly ash may be substituted for Portland cement up to a maximum of twenty (20) percent based on replacing seventy-five (75) pounds of Portland cement with one hundred (100) pounds of fly ash.
 5. The percentage of air entrained in the mix shall be 4 - 7 percent.
 6. Pavement shall be class 4000 or higher.
- B. The mix proportions will be based upon trial mixes conducted by an Independent Testing Laboratory in accordance ACI 211. The proportions will be stated in terms of aggregates in a saturated, surface-dry condition, and the batch weights will have to be adjusted periodically to take into account the actual moisture content of the aggregates at time of use.
- C. The designated proportions shall govern during the progress of the work, except as provided below in paragraphs (1) through (3), inclusive.
1. If it is found impossible to obtain concrete of the desired plasticity and workability with the proportions originally approved by the Engineer, he may approve changes in aggregate weights, provided that in no case shall the cement content originally designated be changed except as provided below.
 2. If it is found impossible to produce concrete having the required consistency without exceeding the maximum allowable water-cement ratio specified, the cement content shall be increased or admixtures added as approved by the Engineer so that the maximum water-cement ratio will not be exceeded.
 3. No change in the sources or character of the materials shall be made without due notice to the Engineer, and no new materials shall be used until approved by the Engineer and he has approved new proportions based upon Independent Laboratory tests and trial mixes.

3.02

EQUIPMENT

- A. 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 hopper shall be properly sealed and vented to preclude dusting operation.
1. Bins and Hoppers - Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.
 2. Scales - The scales for weighing aggregates and cement shall be of either the beam type or the springless-dial type. They shall be accurate within 0.5 percent

throughout the range of use. When beam-type scales are used, provision, such as a "telltale" dial, shall be made for indicating to the operator that the required load in the weighing hopper is being approached. A device on weighing beams shall indicate critical position clearly. Poises shall be designed to be secured in any position and to prevent inadvertent change. The weigh beam and "telltale" device shall be in full view of the operator while the hopper is charged, and he shall have convenient access to all controls. Weighing may be accomplished using electronic load cells and computer controls. Scales shall be tested as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than ten (10) 50-pound weights for frequent testing of all scales.

- B. Concrete may be mixed at the site of construction or at a central point, 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.
 - 1. Central plant mixers shall be capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging and distributing the mixture without segregation on the prepared grade. 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 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 1 inch or more. The Contractor shall: (1) have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth; or (2) provide permanent marks on blade to show points of 1 inch wear from new condition. Drilled holes of 1/4-inch diameter near each end and at the midpoint of each blade are recommended.
 - 2. Truck Mixers and Truck Agitators - Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling central mixed concrete shall conform to the requirements of ASTM C 94.
 - 3. Non-agitator Trucks - Bodies of non-agitating 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. The concrete shall be discharged from the Bottom of the container. 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.

- C. The finishing machine shall be of an approved type. The finishing machine shall be of ample weight and power for proper finishing of the concrete. The finishing machine shall be designed and operated to strike off, screed and consolidate the concrete. Screed and float adjustments of these machines shall be checked at the start of each day's paving. Machines that cause displacement of side forms or frequent delays due to mechanical failure shall be replaced. When the finishing machines ride the edge of previously constructed slabs, provisions shall be made to protect the surface of these slabs.
- D. Vibrators, for full width vibration of concrete paving slabs, may be either the surface pan type or the internal type with either immersed tube or multiple spuds.
 - 1. Vibrators may be attached to the spreader or the finishing machine, or may be mounted on a separate carriage.
 - 2. Vibrators shall not come in contact with the joint, load transfer devices, subgrade, or side forms.
 - 3. The frequency of the surface vibrators shall not be less than 3,500 impulses per minute, and the frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators. When spud-type internal vibrators, either hand-operated or attached to spreaders or finishing machines, are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.
- E. The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel at the required rate. 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. A backup saw will be available.
- F. Straight side forms shall be made of a metal having a thickness of not less than 7/32-inch and shall be furnished in sections not less than ten (10) feet in length.
 - 1. Forms shall have a depth at least equal to the prescribed edge thickness of the concrete, without horizontal joint, and a base width equal to not less than the depth of the forms.
 - 2. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer.

3. Forms shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.
4. Flange braces shall extend outward on the base not less than two-thirds (2/3) the height of the form.
5. Forms with battered top surfaces, and bent, twisted, or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved.
6. Built-up forms shall not be used except where the total area of pavement of any specified thickness on the project is less than 2,000 square yards.
7. The top face of the form shall not vary from a true plane more than one-eighth (1/8) inch in ten (10) feet, and the upstanding leg shall not vary more than one-quarter (1/4) inch.
8. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and secure setting.

3.03 PREPARATION OF GRADE

- A. After the base has been graded and compacted, in accordance with the provisions for the material specified, the grade shall be trimmed to an acceptable elevation.

3.04 SETTING FORMS

- A. The foundations under the forms shall be hard and true to grade so that the form, when set, will be firmly in contact for its whole length and at the specified grade. Any grade which at the form line is found below established grade shall be filled to grade and thoroughly compacted. Imperfections or variations above grade shall be corrected by tamping or by cutting, as necessary.
- B. Forms shall be set sufficiently in advance of the point where concrete is being placed.
 1. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms.
 2. Forms shall be staked into place with not less than three pins for each 10-foot section. A pin shall be placed at each side of every joint.

3. Form sections shall be tightly locked, free from play or movement in any direction. No excessive settlement or springing of forms under the finishing machine will be tolerated.
 4. Forms shall be cleaned and oiled prior to the placing of the concrete.
- C. The forms shall not deviate from true line by more than one-quarter (1/4) inch at any point. The alignment and grade elevation of the forms shall be checked and corrections shall be made by the Contractor immediately before the concrete is placed. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.
- D. In lieu of setting forms the edge of a previously placed concrete gutter section may be used as a form.

3.05 CONDITIONING OF SUBGRADE OR BASE COURSE

- A. When side forms have been securely set to grade, the subgrade or base course shall be brought to proper cross section. Low areas may be filled with subgrade or base coarse material and compacted to the specified density, or filled with concrete integral with the pavement. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed.
- B. The subgrade or base course shall be uniformly moist when the concrete is placed. If it subsequently becomes too dry, the subgrade or base course shall be sprinkled, but the method of sprinkling shall not be such as to form mud or pools of water.
- C. No concrete shall be placed on frozen ground.

3.06 HANDLING, MEASURING, AND BATCHING MATERIALS

- A. The batch plant site, layout, equipment, and provisions for transporting material shall be such as to assure a continuous supply of material to the work. Aggregates from different sources and of different grading shall not be stockpiled together.
- B. Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to secure a uniform grading of the material. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.
1. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least twelve (12) hours before being batched. In case the aggregates contain high or non-uniform moisture content, storage or stockpile periods in excess of twelve (12) hours may be required by the Engineer.

2. Rail shipment requiring more than twelve (12) hours will be accepted as adequate binning only if the car bodies permit free drainage.
 3. The fine aggregate and each size of coarse aggregate shall be weighed into separate hoppers in the respective amounts set by the job mix.
- C. Cement shall be measured by the sack or by weight. Separate scales and hoppers shall be used for weighing the cement, with a device to indicate positively the complete discharge of the batch of cement into the mixer. Ninety-four pounds of bulk cement shall be considered one sack. Batches involving fractional sacks shall not be allowed, except when bulk cement is used.
- D. Fly ash shall be stored in a separate silo. If both cement and fly ash are used, they may be batched cumulatively provided Portland cement is batched first.
- E. Methods and equipment for adding air-entraining agent or other admixtures into the batch, when required, shall be approved by the Engineer. All admixtures shall be measured into the mixer with an accuracy of plus three (3) percent.

3.07

MIXING CONCRETE

- A. The concrete may be mixed at the site of the work, in a central-mix plant, or in truck mixers. The mixer shall be of an approved type and capacity.
- B. Ready-mix concrete shall be mixed and delivered in accordance with requirements of AASHTO M-157.
- C. When concrete is mixed in a central mixing plant, the mixing time shall not be less than recommended by the manufacturer unless tests can show the mix can be thoroughly mixed in less time. Mixing time shall be measured from the time all materials, except water, are in the drum. Transfer time in multiple drum mixers is included in mixing time.
1. The contents of an individual mixer drum shall be completely removed before a succeeding batch is emptied therein.
 2. The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the approved mixer.
 3. The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform, and all water shall be in the drum by the end of the first fifteen (15) seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

- D. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at his expense.
- E. 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, except that an overload up to ten (10) percent above the mixer's nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.
- F. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed:
 - 1. Forty-five (45) minutes when the concrete is hauled in non-agitating trucks.
 - 2. Ninety (90) minutes when hauled in truck mixers or truck agitators.
- G. Re-tempering concrete by adding water or by other means will not be permitted, except that when concrete is delivered in transit mixers or agitators, and when approved by the Engineer. When additional water is added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements, the following conditions must be met:
 - 1. Water must be measured through a water meter
 - 2. Maximum allowable water-cement ratio is not exceeded
 - 3. Maximum allowable slump is not exceeded
 - 4. Maximum allowable mixing and agitating time (or drum revolutions) are not exceeded
 - 5. Concrete is remixed for at least half the minimum required mixing time or number of revolutions.
 - 6. Concrete that does not meet the above provisions shall be rejected.
- H. No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.
- I. Unless otherwise authorized, the temperature of the mixed concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F and not resumed until an ascending air temperature in the shade away from artificial heat reaches 35°F.
- J. The temperature of the mixed concrete shall be not less than 50°F and not more than 90°F at the time of placing it in the forms.

1. The mixing water may be heated to no more than 150°F.
2. 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 so arranged as to preclude the possible occurrence of overheated areas which might injure the materials.

3.08

PLACING CONCRETE

- A. The concrete shall be deposited on the grade in such manner as to require as little re-handling as possible. Unless truck mixers, truck agitators, or non-agitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade in such manner as to prevent segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly-mixed concrete with boots or shoes coated with earth or foreign substances.
- B. Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will be operated upon the existing lane of pavement, that lane shall have attained eighty (80) percent of design strength. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after three days.
- C. Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than fifteen (15) seconds in any one location.
- D. D. Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.

3.09

TESTING

- A. The Contractor shall furnish the concrete necessary for testing and shall cooperate fully with the Engineer in obtaining the material for testing purposes.
- B. The concrete shall be sampled, specimens made, and compliance determined in accordance with the following:
 1. Slump AASHTO T-119/ASTM C 143

2. Air Content AASHTO T-152/ASTM C 231
 3. Unit Weight AASHTO T-121/ASTM C 138
 4. Strength (compressive) AASHTO T-22/ASTM C 39 (flexural, third point) AASHTO T-97/ASTM C 78
 5. Making and Curing Test Specimens in the Field AASHTO T-23/ASTM C 31
- C. Tests will be performed on all pours over twenty (20) cubic yards. Slump, Air Content and Unit Weight tests will be performed every one-hundred-fifty (150) cubic yards. For strength testing, one group of test specimens will be made during the first half of each shift and another group of test specimens will be made during the last half of each shift. Test ages will be seven (7) and twenty-eight (28) days.
- D. All testing will be pre-formed by an ACI certified technician.

3.10

STRIKEOF OF CONCRETE AND PLACEMENT OF REINFORCEMENT

- A. Following the placing of the concrete, it shall be struck off to conform to the cross section shown on the plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the plans or established by the Engineer.
- B. When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense.
- C. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed by mechanical or vibratory means in plastic concrete, after the concrete is spread.
- D. Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale, and loose or thick rust which would impair bond of the steel with the concrete.

3.11

JOINTS

- A. Joints shall be constructed of the type and dimensions, and at the locations required by the plans or special provisions.

- B. Bars shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement.
- C. Tie bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves.
- D. Dowels, when used as load transfer devices, shall be held in position parallel to the surface and centerline of the slab by a metal device that is left in the pavement.
 - 1. One half of each dowel shall be painted with one coat of lead or tar paint, to prevent the concrete from binding to that portion of the dowel.
 - 2. An approved metal dowel cap or sleeve shall be furnished for each dowel bar used with the expansion joints. The caps or sleeves shall fit the dowel bar tightly.
 - 3. In lieu of using dowel assemblies at contraction joints, dowel bars may be placed in the full thickness of pavement by a mechanical device approved by the Engineer.
- E. Sawed joints shall be cut by means of concrete saws with diamond blades or other approved equipment to the depth, width, and line shown on the plans.
 - 1. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually four (4) to twenty-four (24) hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on both during the day and night, regardless of weather conditions. The sawing of any joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing, and sawing shall be discontinued when a crack develops ahead of the saw. In general, all joints should be sawed in sequence. Where the saw cut was discontinued because of interference of the form the saw cut must be completed when the form is stripped.
 - 2. Suitable guide lines or devices shall be used to assure cutting the joint as shown on the plans.
 - 3. The saw cut shall not vary by more than one-quarter (1/4) inch in ten (10) feet.
 - 4. When shown on the plans, a second shallower cut must be made to provide adequate space for joint sealer. This sawing may commence as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing.

- F. When approved by the Engineer joints may be cut into the fresh concrete with a finishing tool. This tool must be capable of cutting to the depth specified.
 - 1. Suitable guide lines or devices shall be used to assure cutting the joint as shown on the plans.
 - 2. The cut shall not vary by more than one-quarter ($\frac{1}{4}$) inch in ten (10) feet.
- G. LONGITUDINAL JOINTS. Deformed steel tie bars of specified length, size, spacing, and material shall be placed perpendicular to the longitudinal joints when shown on the plans.
 - 1. When adjacent lanes of pavement are constructed separately, steel side forms shall be used which will form a keyway along the construction joint or dowels shall be installed at the spacing and size shown on the drawings. Tie bars or load transfer bars may be installed through holes in the forms or approved two-piece connectors may be used.
 - 2. Longitudinal contraction joints shall consist of planes of weakness created by cutting grooves in the surface of the pavement and, when shown on the plans, shall include load transfer assemblies.
- H. TRANSVERSE EXPANSION JOINTS - The expansion joint filler shall be continuous from form to form, shaped to the subgrade. Damaged or repaired joint filler shall not be used unless approved by the Engineer.
 - 1. The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete.
 - 2. Finished joints shall not deviate more than one-quarter ($\frac{1}{4}$) inch in the horizontal alignment from a straight line.
 - 3. If joint fillers are assembled in section, there shall be no offsets between adjacent units.
 - 4. No plugs of concrete shall be permitted anywhere within the expansion space.
- I. TRANSVERSE CONTRACTION JOINTS - Transverse contraction joints shall consist of planes of weakness created by cutting grooves in the surface of the pavement and, when shown on the plans, shall include load transfer assemblies.
- J. When directed by the Engineer, random cracks shall be routed or sawed and filled with joint sealer. Care shall be taken so that the depth of cut is uniform.

- K. TRANSVERSE FORMED CONTRACTION JOINTS - These joints shall comply with the requirements of Subsection 3.11(G) for the longitudinal formed joint.
- L. TRANSVERSE CONSTRUCTION JOINT - Transverse construction joints shall be constructed when there is an interruption of more than thirty (30) minutes in the concreting operations. No transverse joint shall be constructed within five (5) feet of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least five (5) feet long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed.

3.12

FINAL STRIKEOFF

- A. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging, and final surface finish.
- B. First, the concrete shall be consolidated and struck off.
 - 1. Unless otherwise permitted for small areas or for short periods of time due to equipment failure, all pavement concrete shall be consolidated using vibrators for full width of paving slabs.
 - 2. Concrete adjacent to joints shall be mechanically vibrated, also under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement.
 - 3. After the concrete has been placed and vibrated adjacent to the joints as required, the finishing machine shall be brought forward, operating in a manner to avoid damage to or misalignment of joint devices.
- C. After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated, by means of a longitudinal float, by the use of one of the following methods as specified or permitted:
 - 1. Hand Method - The hand-operated longitudinal float shall be not less than twelve (12) feet in length and 6 inches in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete, shall be worked with a sawing motion, while held in a floating position parallel to the road centerline, and shall be passed gradually from one side of the pavement to the other. Movement ahead along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or soupy material shall be wasted over the side forms on each pass.

2. Mechanical Method - The mechanical longitudinal float shall be of a design approved by the Engineer and shall be in good working condition. The tracks from which the float operates shall be securely adjusted to the required crown. The float shall be accurately adjusted and coordinated with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward speed shall be adjusted so that the float will lap the distance specified by the Engineer on each transverse trip. The float shall pass over each area of pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.
 3. Alternative Mechanical Method - As an alternative to Item (2) above, the Contractor may use a machine composed of a cutting and smoothing float, or floats, suspended from and guided by a rigid frame. This frame shall be carried by four or more visible wheels riding on, and constantly in contact with, the side forms.
 4. If necessary, following one of the preceding methods of floating, long handled floats having blades not less than five (5) feet in length and six (6) inches in width may be used to smooth and fill in open-textured areas in the pavement. Long handled floats shall not be used to float the entire surface of the pavement in lieu of, or supplementing, one of the preceding methods of floating. When strike-off and consolidation are done by the hand method and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a straightedge ten (10) feet or more in length. Successive drags shall be lapped one-half of the length of the blade.
- D. After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 10-foot straightedge. For this purpose the Contractor shall furnish and use an accurate 10-foot straightedge swung from handles three (3) feet longer than one-half (1/2) the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the road centerline and the whole area gone over from one side of the slab to the other, as necessary. Advance along the road shall be in successive stages of not more than one-half (1/2) the length of the straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from

observable departures from the straightedge and the slab conforms to the required grade and cross section.

E. The final finish will be specified on the plans as to the type of surface texture. The following types of surface textures may be specified:

1. Type I - Transverse Tining - The mainline finish shall be produced by mechanical equipment described as follows: The transverse grooving machine shall be either a vibrating roller or a comb equipped with steel tines. The machine shall be self-propelled and shall automatically lift the roller or tine comb at the end of the pavement. Hand grooving methods will be permitted in a manner approved by the Engineer in those areas where the mechanical equipment cannot be used. This equipment shall have rectangular or circular shaped spring steel tines which are randomly spaced at one-half (1/2) to one (1) inch intervals from center to center. The grooves shall be made perpendicular to the center line of the pavement and the resulting transverse grooves shall be .090 to .125 inches wide and shall be 1/8 to 3/16 inch deep. Acceleration lanes, deceleration lanes, and irregular sections may be finished by methods other than mechanical provided they produce a similar type of transverse groove.
2. Type II - Longitudinal Tining - The mainline finish shall be produced by mechanical equipment described as follows: The longitudinal grooving machine shall be either a vibrating roller or a comb equipped with steel tines. The machine shall be self-propelled and shall automatically lift the roller or tine comb at the end of the pavement. Hand grooving methods will be permitted in a manner approved by the Engineer in those areas where the mechanical equipment cannot be used. This equipment shall have rectangular or circular shaped spring steel tines which are randomly spaced at one-half (1/2) to one (1) inch intervals from center to center. The grooves shall be made parallel to the center line of the pavement and the resulting longitudinal grooves shall be 0.090 to 0.125 inch wide and shall be one-eighth (1/8) to three-sixteenths (3/16) inch deep. The mechanical equipment shall be operated from a bridge when the pavement is sixteen (16) feet or more in width. Acceleration lanes, deceleration lanes, and irregular sections may be finished by methods other than mechanical, provided they produce a similar type of longitudinal groove.
3. Type III - Artificial Grass Drag - The pavement finish shall be produced by a nylon or artificial grass drag as approved by the Engineer. A uniform surface of gritty texture shall be produced by pulling the drag longitudinally. For a pavement width of sixteen (16) feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The drag shall be at least three (3) feet wide and in full contact with the full width of the pavement. Drags shall be

maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new ones substituted.

4. Type IV - Bristle Broom - The surface texture produced by a broom shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operation shall be so executed that the corrugations produced in the surface shall be uniform in appearance and shall have a minimum depth of approximately one-sixteenth ($1/16$) inch and a maximum depth of approximately one-eighth ($1/8$) inch. Brooming shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operation. The finished surface shall be free from rough and porous areas, irregularities and depressions resulting from improper handling of the broom. Mechanical brooming, in lieu of the manual brooming, will be permitted if satisfactory results can be obtained.
 5. Type V - Belt Finish (Paving with Rigid Forms) - When straight-edging is complete and the water sheen has practically disappeared and just before the concrete becomes non-plastic, the surface shall be belted with a two-ply canvas belt not less than eight inches wide and at least three feet longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the road centerline and with a rapid advance parallel to the centerline.
 6. Type VI - Burlap Drag - The drag shall be a seamless strip of damp burlap or cotton fabric which shall produce a uniform surface of a gritty nature after dragging it longitudinally along the full width of pavement. For pavement 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric, at least three feet wide, is in contact with the full width of pavement surface while the drag is used. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags shall be substituted.
- F. After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints shall be worked with an approved tool and rounded to a radius of one-quarter ($1/4$) inch.
1. A well-defined and continuous radius shall be produced, and a smooth, dense mortar finish shall be obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

2. At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by texturing the surface. The rounding of the corner of the slab shall not be disturbed when the surface is textured. All concrete on top of the joint filler shall be completely removed.
 3. All joints shall be tested with a straightedge before the concrete has set, and correction shall be made if one side of the joint is higher than the other or if an edge is higher or lower than the adjacent slabs.
- G. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.
- H. Unless otherwise specified, hand finishing methods will not be permitted except under the following conditions:
1. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.
 2. Narrow widths or areas of irregular dimensions where operation of the mechanical equipment is impractical may be finished by hand methods.
 3. Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. In operation the screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the striking off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.
 4. The screed for the surface shall be at least two (2) feet longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and shall be constructed either of metal or other suitable material shod with metal.
 5. Consolidation shall be attained by the use of a suitable vibrator or other approved equipment.

3.13

SURFACE TEST

- A. As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 10-foot straightedge or other specified devices.
1. Areas showing high spots of more than one-quarter ($1/4$) inch, but not exceeding one-half ($1/2$) inch in ten (10) feet, shall be marked and immediately

ground down with an approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of one-quarter (1/4) inch when tested with a 10-foot straightedge. Grinders shall be of the stacked head, vertical blade type that will not polish or smooth the surface but will provide a coefficient of friction approximately equal to that of the unground pavement. Grinding grooves shall be kept parallel with the direction of travel.

2. Where the departure from correct cross section exceeds one-half (1/2) inch, the pavement shall be removed and replaced by and at the expense of the Contractor. Any area or section so removed shall be neither less than five (5) feet in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than five (5) feet in length shall also be removed and replaced.

3.14

CURVING

- A. 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 following methods.
 1. COTTON OR BURLAP MATS - The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that as laid they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mat shall be placed so that the entire surface and both edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mats shall be so placed and weighed down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wetted and in position for seventy-two (72) hours after the concrete has been placed, unless otherwise specified.
 2. WATERPROOFED PAPER - The top surface and sides of the pavement shall be entirely covered with waterproofed paper. The units shall be lapped at least eighteen (18) inches. The paper shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The paper shall be of such dimensions that each unit as laid will extend beyond the edges of the slab at twice the thickness of the pavement or shall be of pavement width and 2-foot strips of paper provided for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do not open up or separate during the curing period. Unless otherwise

specified, the covering shall be maintained in place for seventy-two (72) hours after the concrete has been placed. The surface of the pavement shall be thoroughly wetted prior to the placing of the paper.

3. WHITE PIGMENTED IMPERVIOUS MEMBRANE - The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with burlap or cotton mats, the curing compound may be applied upon removal of the mats.
 - a. The curing compound shall not be applied during rainfall.
 - b. Curing compound shall be applied under pressure at the rate of approximately one (1) gallon to one-hundred-fifty (150) square feet by mechanical sprayers. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During the application the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and on concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall be applied to the inside faces of joints to be sealed.
 - c. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound.
 - d. Upon removal of side forms, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.
 4. WHITE POLYETHYLENE SHEETING - The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least eighteen (18) inches. The sheeting shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for seventy-two (72) hours after the concrete has been placed.
- B. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations.

The concrete shall not be left exposed for more than one-half (1/2) hour between stages of curing or during the curing period.

- C. When concrete is being placed and the average daily temperature is below 40°F or the air temperature may be expected to drop below 35°F, a sufficient supply of straw, hay, grass, or other suitable blanketing material shall be spread over the pavement to a sufficient depth to prevent freezing of the concrete. The period of time such protection shall be maintained shall be not less than ten (10) days or until the concrete has reached full strength. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather, and any concrete injured by frost action shall be removed and replaced at the Contractor's expense.

3.15 REMOVING FORMS

- A. Forms shall not be removed from freshly placed concrete until it has set for at least twelve (12) hours, except auxiliary forms used temporarily in widened areas.
- B. Forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated above.
- C. Major honeycombed areas will be considered as defective work and shall be removed and replaced. Any area or section so removed shall not be less than five (5) feet in length or less than full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than five (5) feet in length shall also be removed and replaced.

3.16 SEALING JOINTS

- A. When joints are specified to be sealed on the plans, they shall be filled with joint-sealing material before the pavement is opened to traffic and as soon after completion of the curing period as is feasible.
- B. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound, and the joint faces shall be clean and surface dry when the seal is applied.
- C. Material for seal shall be installed in accordance with the manufacturer's recommendations. A copy of the instructions shall be submitted to the Engineer for information.
- D. The sealing material shall be applied to each joint opening to conform to the details shown on the plans or as directed by the Engineer.

- E. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed, and the pavement surface shall be cleaned. The use of sand or similar material as a cover for the seal will not be permitted.
- F. Poured joint-sealing material shall not be placed when the air temperature in the shade is less than 50°F, unless approved by the Engineer.

3.17 PROTECTION OF PAVEMENT

- A. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs and lights. He will indicate the location and type of device or facility required to protect the work and provide adequately for traffic.
- B. In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete. Such protection materials shall consist of standard metal forms or wood plank having a nominal thickness of not less than two inches and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper, or plastic sheeting material for the protection of the surface of the pavement. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the side of the pavement and covering the surface of the unhardened concrete with the protective covering.
- C. Any damage to the pavement occurring prior to final acceptance or opening to traffic shall be repaired or the pavement shall be replaced.

3.18 OPENING TO TRAFFIC

- A. The Engineer shall decide when the pavement shall be opened to traffic.
- B. Prior to being opened to traffic, the pavement shall be cleaned and all pavement markings shall be in place.

3.19 CONCRETE PAVEMENT – SLIPFORM METHOD

- A. GRADE - After the grade or base has been placed and compacted to the required density, the grade and areas which are to support the paving machine shall be cut to the proper elevation by means of an approved fine-grading machine.

1. The fine-grading machine shall be of sufficient weight, and shall be either self-propelled or towed by sufficient power to trim the compacted material without gouging or tearing the surface.
 2. The machine shall have cutting edges or surface shavers controlled from an independent control reference wire by means of an automatic control device.
 3. To avoid excessive depths of cut the machine may accomplish the fine grading by means of successive passes with each pass controlled from the independent reference line through the automatic control.
 4. If the density of the base is disturbed by the grading operations, it shall be corrected by additional compaction before concrete is placed.
 5. The grade shall be constructed sufficiently in advance of the placing of the concrete. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately ahead of the placing of the concrete.
- B. PLACING CONCRETE - The concrete shall be placed with an approved slip-form paver designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine in such manner that a minimum of hand finish will be necessary to provide a dense and homogenous pavement in conformance with the plans and specifications.
1. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibrations shall be accomplished with vibrating tubes or arms working in the concrete, or with a vibrating screed or pan operating on the surface of the concrete.
 2. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur.
 3. The concrete shall be held at a uniform consistency, having a slump of not more than two inches.
 4. 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 so coordinated as 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.

- C. The surface smoothness and texture shall meet the requirements of Section 02520, Subsection 3.12, FINAL STRIKEOFF, CONSOLIDATION, AND FINISHING, Part E, and Section 02520, Subsection 3.13, SURFACE TEST.
- D. Curing shall be done in accordance with one of the methods included in Section 02520, Subsection 3.14, CURING. The curing material shall be applied at the appropriate time and shall be applied uniformly and completely at all surfaces and edges of the pavement.
- E. All joints shall be constructed in accordance with Section 02520, Subsection 3.11, JOINTS.

3.20 TOLERANCE IN PAVEMENT THICKNESS

- A. The thickness of the pavement shall be determined by average caliper measurement of cores tested.
- B. For the purpose of establishing an adjusted unit price for pavement, a minimum of two cores per mile per lane or areas such as intersections, entrances, crossovers, ramps, etc., will be considered as one unit and the thickness of each unit will be determined separately. Small irregular unit areas may be included as part of another unit. At such points as the Engineer may select in each unit, one core will be taken for each 1,000 square yards of pavement, or fraction thereof, in the unit. Should any thickness deviation be found, additional cores may be taken to define the horizontal limits of the deviation.
- C. When the measurement of the core from a unit is not deficient more than 0.2 inch from the plan thickness, full payment will be made.
- D. When such measurement is deficient more than 0.2 inch and not more than one (1.0) inch from the plan thickness, two (2) additional cores at intervals not less than three hundred (300) feet will be taken and used in the average thickness for that unit.
- E. In calculations for the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch, and measurements which are less than the specified thickness by more than one (1) inch will not be included in the average.
- F. When the measurement of any core is less than the plan thickness by more than one (1) inch, the actual thickness of the pavement in this area will be determined by taking additional cores at not less than 10-foot intervals parallel to the centerline in each direction from the affected location until in each direction a core is found which is not deficient by more than one (1) inch. Areas found deficient in thickness by more than one (1) inch shall be evaluated by the Engineer; if in his judgment the

deficient areas warrant removal, they shall be removed and replaced with concrete of the thickness shown on the plans. Exploratory cores for deficient thickness will not be used in averages for adjusted unit prices.

3.21 REPAIR OF DEFECTIVE PAVEMENT SLABS

- A. Spalls along joints shall be replaced by saw cutting at least one-half (1/2) inch outside the spalled area and to a minimum of two (2) inches. The area shall be chipped out at least three (3) inches to solid concrete and then cleaned with compressed air sandblasting. First, the surface of the cavity shall be coated with an approved epoxy-resin binder. Then the cavity shall be filled with an approved non-shrink grout.
- B. Random cracks that occur away from joints and, in the judgment of the Engineer, will not cause future maintenance problems may be routed and sealed. If not accepted, the slab shall be replaced at the Contractor's expense.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. The quantity of pavement laid shall be the number of square yards of full depth pavement. The number of square yards shall be determined by the Engineer after construction of the pavement has been completed.

4.02 BASIS OF PAYMENT

- A. The quantity of accepted pavement shall be measured as above provided and shall be paid for at the contract unit price per square yard bid as called for in the proposal. This price shall constitute full compensation for furnishing and preparation of all materials, including all joints, joint filler, dowels, and reinforcing if required in the construction drawings or special provisions; placing, finishing, curing; and all labor, equipment, tools and incidentals necessary to complete these items.
- B. Payment will be made under: Concrete Pavement Sq. Yd.
- C. CONCRETE PAVEMENT DEFICIENCY:
 - 1. Where the average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than one (1) inch, payment will be made at an adjusted price as specified in the following table:

Deficiency in thickness as determined by cores	Proportional part of contract price
Inches	Percentage Allowed
0.00 to 0.20	100 percent
0.21 to 0.30	80 percent
0.31 to 0.40	72 percent
0.41 to 0.50	68 percent
0.51 to 0.75	57 percent
0.76 to 1.00	50 percent

- D. When thickness of pavement is deficient by more than one (1) inch and the judgment of the Engineer is that the area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

END OF SECTION

SECTION 02528 — CONCRETE CURBS AND COMBINED CURBS AND GUTTERS

PART 1 GENERAL

1.01 SUMMARY

- A. Curbs or combined curbs and gutters shall consist of air-entrained Portland Cement Concrete constructed in accordance with these specifications. This work shall be in reasonably close conformity with the lines and grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer. See Standard Drawing 02528-01.
- B. Concrete curbs and combined curbs and gutters shall be constructed to meet requirements of American Disabilities Act, Title II, when applicable.

PART 2 PRODUCTS

2.01 MATERIALS

- A. PORTLAND CEMENT CONCRETE - Air-entrained Portland Cement Concrete shall conform to the requirements of Section 03304, Subsection 2.08, Class 4000.
- B. REINFORCING STEEL - Reinforcing steel shall conform to the requirements of Section 03200, CONCRETE REINFORCEMENT.
- C. PREFORMED EXPANSION JOINT MATERIAL - Joint material shall comply with the requirements of AASHTO M-213, ASTM D-994, ASTM D-1751, or ASTM D-1752.

PART 3 EXECUTION

3.01 GENERAL

- A. Curbs and curb and gutter shall be constructed at the locations shown on the plans and where directed by the Engineer and shall be in accordance with these specifications and plans.

3.02 SUBGRADE AND BASE COARSE PREPARATION

- A. The subgrade shall be excavated or filled with suitable material to the required grades and lines.
- B. All soft, yielding, and otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted and extend a minimum of one (1) foot outside the form lines.

- C. The subgrade shall be ninety-five (95) percent of maximum dry density as determined by AASHTO T-180 modified proctor density.
- D. When required on the plans base coarse will be installed to the required grade in accordance with Section 02231, Subsection 3.03.

3.03

CONCRETE PLACEMENT

- A. The concrete shall be placed either by an approved slip-form/extrusion machine, by the formed method, or by a combination of these methods.
- B. The slip-form/extrusion machine approved shall be so designed as to place, spread, consolidate, screed, and finish the concrete in one complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous concrete section.
 - 1. The machine shall shape, vibrate, and/or extrude the concrete for the full width and depth of the concrete section being placed.
 - 2. It shall be operated with as nearly a continuous forward movement as possible. All operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the machine held to a minimum.
- C. The formed method shall consist of setting forms, placing concrete and finishing.
 - 1. Form material shall be straight and free from warp, having sufficient strength to resist the pressure of the concrete without displacement and sufficient tightness to prevent the leakage of mortar. Flexible or rigid forms of proper curvature may be used for curves having a radius of one hundred (100) feet or less. Division plates shall be metal.
 - 2. The front and back forms shall extend for the full depth of the concrete. All of the forms shall be braced and staked so that they remain in both horizontal and vertical alignment until their removal.
 - 3. They shall be cleaned and coated with an approved form-release agent before concrete is placed against them.
 - 4. The concrete shall be deposited into the forms without segregation and then it shall be tamped and spaded or mechanically vibrated for thorough consolidation.
 - 5. Low roll or mountable curbs may be formed without the use of a face form by using a straightedge and template to form the curb face. When used, face forms shall be removed as soon as possible to permit finishing.

6. Front and back forms may be removed at such time as the concrete is sufficiently set that removal will not chip, spall or otherwise damage the concrete. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with curing compound.

3.04 FINISHING

- A. The surface of the concrete shall be finished true to the lines and grades shown on the plans.
- B. Concrete shall be worked until the coarse aggregate is forced down into the body of the concrete and no coarse aggregate is exposed. The surface shall then be floated with a wooden float to a smooth and uniform surface.
- C. When the concrete has hardened sufficiently the surface shall be given a broom finish. The broom shall be an approved type. The strokes shall be square across the concrete from edge to edge with adjacent strokes overlapped. Strokes shall be made without tearing the concrete. The broomed finish shall produce regular corrugations not over one-eighth (1/8) inch in depth.
- D. Concrete that is adjacent to forms and formed joints shall be edged with a suitable edging tool to the dimensions shown on the plans.
- E. Street names shall be placed in the first tangent section of curb with 4-inch letter stamps.

3.05 JOINTING

- A. CONTRACTION JOINTS - Transverse weakened-plane contraction joints shall be constructed at right angles to the curb line at intervals not exceeding fifteen (15) feet. Joint depth shall average at least one-quarter (1/4) of the cross section of the concrete.
 1. Contraction joints may be sawed, hand-formed, or made by 1/8-inch-thick division plates in the formwork.
 2. Sawing shall be done early after the concrete has set to prevent the formation of uncontrolled cracking.
 3. The joints may be hand-formed either by (1) using a narrow or triangular jointing tool or a thin metal blade to impress a plane of weakness into the plastic concrete, or (2) inserting 1/8-inch-thick steel strips into the plastic concrete temporarily. Steel strips shall be withdrawn before final finishing of the concrete.

4. Where division plates are used to make contraction joints, the plates shall be removed after the concrete has set and while the forms are still in place.
- B. EXPANSION JOINTS - Expansion joints shall be constructed at right angles to the curb line at immovable structures and at points of curvature for short-radius curves.
1. Filler material for expansion joints shall be furnished in a single 3/4-inch-thick piece for the full depth and width of the joint.
 2. Expansion joints in a slip-formed curb or curb and gutter shall be constructed with an appropriate hand tool by raking or sawing through partially set concrete for the full depth and width of the section. The cut shall be only wide enough to permit a snug fit for the joint filler. After the filler is placed, open areas adjacent to the filler shall be filled with concrete and then troweled and edged.
 3. Alternately, an expansion joint may be installed by removing a short section of freshly extruded curb and gutter immediately, installing temporary holding forms, placing the expansion joint filler, and replacing and reconsolidating the concrete that was removed. Contaminated concrete shall be discarded.
- C. Construction joints may be either butt or expansion type joints.
- D. Curbs or combined curbs and gutters constructed adjacent to existing concrete shall have the same type of joints as in the existing concrete, with similar spacing; however, contraction joint spacing shall not exceed fifteen (15) feet.

3.06 PROTECTION

- A. The Contractor shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper or plastic sheeting. For slip-form construction, materials such as wood planks or forms to protect the edges shall also be required.
- B. When concrete is being placed in cold weather and the temperature may be expected to drop below 35°F, suitable protection shall be provided to keep the concrete from freezing until it is at least seventy-two (72) hours old. Concrete injured by frost action shall be removed and replaced at the Contractor's expense.

3.07 CURING

- A. Curing shall be in accordance with Section 03370, CONCRETE CURING.

3.08 BACKFILLING

- A. After the concrete has set sufficiently, the spaces in front and back of curbs shall be backfilled with original material or as shown on the drawings to the required elevations.
- B. The backfill material shall be thoroughly compacted to a density equal to that of adjacent materials.

3.09 TOLERANCES

- A. The work shall be performed in a manner which results in a curb and gutter constructed to specified line and grade, uniform in appearance and structurally sound.
- B. Curb and gutter found with unsightly bulges, ridges, low spots in the gutter or other defects shall be removed and replaced at the Contractor's expense if the Engineer considers them to be irreparable.
- C. When checked with a 10-foot straightedge, grade shall not deviate more than one-quarter (1/4) inch, and alignment shall not vary more than one-half (1/2) inch.
- D. Final elevation shall not depart from plan elevation by more than one-half (1/2) inch.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. This item shall be measured along the flow line of the curb by the linear feet of concrete curbs and combined curb and gutter in place.

4.02 BASIS OF PAYMENT

- A. Payment shall constitute full compensation for all materials, curing of concrete, for all pre-molded mastic material for expansion joints, contraction joints, steel dowels and sleeves, and for the excavation and the placing and compaction of embankment under the curb, furnishing and placing of backfill and topsoil behind the curb, and for all equipment, tools and labor and for the performance of all work and incidentals necessary to complete the item.
- B. Payment will be made at the contract unit price bid multiplied by the number of linear feet constructed.

END OF SECTION

SECTION 02545 – BITUMINOUS MATERIALS

PART 1 GENERAL

1.01 SUMMARY

- A. These specifications include general requirements applicable to all types of bases or pavements that require the application of bituminous materials by spray or mix. Deviations from these general requirements will be indicated in the specific requirements for each type.

1.02 RELATED WORK

- A. Section 02511, Road Mix Bituminous Pavements.
- B. Section 02512, Plant Mix Pavements.
- C. Section 02550, Prime Coat.
- D. Section 0255 1, Tack Coat.
- E. Section 02552, Seal Coat.

1.03 REFERENCES

- A. AASHTO M 8 1: Cut-Back Asphalt (Rapid Curing Type).
- B. AASHTO M 82: Cut-Back Asphalt (Medium Curing Type).
- C. AASHTO M 140: Emulsified Asphalt.
- D. AASHTO M 141: -70 Slow Curing Liquid Road Material.
- E. AASHTO M 208: Cationic Emulsified Asphalt.
- F. AASHTO M 226: Table 1, Viscosity Graded Asphalt Cement.
- G. AASHTO T 40: Sampling Bituminous Materials.

1.04 SUBMITTALS

- A. Bituminous material may be conditionally accepted at the source based on test reports furnished by Contractor for each forty (40) tons or 10,000 gallons loaded.
- B. A sample of each load of Asphaltic Materials is to be obtained at the time of conveyance loading, and the Certificate of Compliance, together with this sample, shall be surrendered to Engineer on the project. Sampling shall be accomplished using methods described and outlined in AASHTO T 40.

- C. Tank trucks delivering bituminous material to the project shall be equipped with a sampling cock on the discharge pipe.
- D. Bituminous materials used on the project which do not meet the specification requirements for the type and grade specified may, at the direction of Engineer:
 - 1. Be rejected and Contractor required to remove and replace all materials affected by the out-of-specification material at his expense;
 - 2. Be accepted and left in place and the contract price of the bituminous material deducted, or be accepted at a reduced unit price as directed by Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bituminous materials shall meet all applicable requirements. No materials or products other than those designated in this Section will be added to bituminous material without the express permission of Engineer.

2.02 ASPHALT CEMENTS

- A. The grades shown on the plans shall conform to the specifications of AASHTO M 226, Table 1, with the following modifications:

Test	AC-2.5	AC-5	AC-10	AC-20
Penetration, 77°F, 100g., 5 sec. (minimum)	175	100	60	35

- B. The spot test shall be negative for all grades when tested with naphtha xylene solvent using fifteen (15) percent xylene.

2.03 LIQUID CUTBACK ASPHALTS

- A. Liquid cutback asphalts shall conform to the requirements of AASHTO M 81, AASHTO M 82, and AASHTO M 141. The spot test shall be negative for all grades when tested with naphtha xylene solvent using fifteen (15) percent xylene. The Saybolt-Furol viscosity alternate will not apply.

2.04 EMULSIFIED ASPHALTS

- A. Emulsified asphalts shall conform to the following requirements:
 - 1. Emulsified Asphalt (Anionic) AASHTO M 140
 - 2. Emulsified Asphalt (Cationic) AASHTO M 208

- B. The designation “h” added to any grade of Emulsified Asphalt requires the residue from distillation to have a penetration from forty (40) to ninety (90).
- C. The following exceptions apply to grade CMS-2 only:
 - 1. Viscosity: Seconds Saybolt-Furol at 122°F 50 Min.-500 Max.
 - 2. Distillation: Percent Residue Sixty (60) Min.
 - 3. Distillation: Oil Distillate, by volume of emulsion - to be determined by independent laboratory from produced materials, not to exceed twenty (20) percent.
- D. The letter “F” following the bituminous material type designation shall require a satisfactory anti-stripping agent be added to the material at the refinery.
- E. The presence of anti-tripping agents will be determined in accordance with the Wyoming Quick Bottle Test or other approved means.

PART 3 EXECUTION

3.01 PREPARATION

- A. The water used for the dilution shall be free of sediment and other deleterious matter.

3.02 APPLICATION

- A. The rate of emulsified asphalt used for fog seal or tack shown in the Contract Documents is the rate of Emulsified Asphalt as received from the refinery.
- B. The emulsified asphalt used for tack may be diluted in the field at a rate of fifty (50) percent emulsified asphalt and fifty (50) percent additional water.
- C. The emulsified asphalt used for fog seal may be diluted in the field at a rate of thirty-three (33) percent emulsified asphalt and sixty-seven (67) percent additional water.
- D. Both the dilution water and the emulsion shall be heated to approximately 110°F prior to mixing, and this approximate temperature shall be maintained during the application. Dilution shall be made by introducing the water into the emulsified asphalt.
- E. Bituminous materials for the various types of applications shall be loaded and applied within the temperatures indicated in the following table:

Type and Grade of Material	Application – Spray		Mixing Temperature	
	°F	°C	°F	°C
RT 1, 2, & 3	60-130	16-54	60-130	16-54
RT 5 & 6	85-150	29-66	85-150	29-66
RT 7, 8, & 9	150-225	66-107	150-225	66-107
RT 10, 11, & 12	175-250	79-121	175-250	79-121
RTC70	100-180	38-82	90-140	32-60
250	160-220	71-104	140-175	60-79
800	175-250	79-121	170-210	77-99
3000	220-275	104-135	200-240	93-116
Mc30	90-180	32-82	60-120	16-49
70	120-200	49-93	95-140	35-60
250	160-220	71-104	140-200	60-93
800	175-250	79-121	175-240	79-116
3000	200-290	93-143	200-250	93-121
SC70	120-200	49-93	95-140	35-60
250	160-220	71-104	140-200	60-93
800	175-250	79-121	175-210	79-99
3000	200-290	93-143	200-250	93-121
SC70	120-200	49-93	95-140	35-60
250	160-220	71-104	140-200	60-93
800	175-250	79-121	175-210	79-99
3000	200-290	93-143	200-250	93-121

All emulsions

50-140

50-140

All penetration grades

350 max.

As required to achieve
Viscosity of 75-150
Seconds Saybolt-Furol

F. The maximum loading temperature for asphalt cements shall be 350°F.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Bituminous material will be measured by the ton. When volumetric measurements are used to determine the amount of bituminous material furnished to the project, stored, or returned to the plant, the volume will be converted to weight by calculation of gallons per ton at 60°F.
- B. The weight of asphalt emulsions will include the weight of water specified to be mixed at the refinery as a part of the type of emulsified asphalt designated. Water added on the road or at the mixing plant will not be measured for payment as emulsified asphalt.

4.02 BASIS OF PAYMENT

- A. All work performed and measured as provided above will be paid for as provided in the respective sections for each type of bituminous materials specified.

- B. All water, labor, and equipment necessary to make the field dilution will not be measured for payment, but will be considered subsidiary to other pay items of the contract.

END OF SECTION

SECTION 02550 — PRIME COAT

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of preparing and treating an existing surface with bituminous material and blotter material, if required, in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the Engineer.

1.02 RELATED WORK

- A. Section 02190, Aggregates.
- B. Section 02511, Road Mix Bituminous Pavements.
- C. Section 02512, Plant Mix Pavements.
- D. Section 02545, Bituminous Materials.
- E. Section 02553, Bituminous Surface Treatment.

1.03 REFERENCES

- A. AASHTO M 140: Emulsified Asphalt.
- B. AASHTO M 141: -70 Slow Curing Liquid Road Material.
- C. AASHTO M 208: Cationic Emulsified Asphalt.
- D. AASHTO M 226: Table 1, Viscosity Graded Asphalt Cement.
- E. AASHTO M 81: Cut-Back Asphalt (Rapid Curing Type).
- F. AASHTO M 82: Cut-Back Asphalt (Medium Curing Type).
- G. AASHTO T 40: Sampling Bituminous Materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bituminous materials - The type of bituminous material will be specified in the contract, and the grade will be designated by Engineer. The bituminous material shall meet the applicable requirements of Section 02545, BITUMINOUS MATERIALS.

- B. Blotter Material - Blotter material shall meet the requirements of Section 02190, AGGREGATES, Subsection 2.11. The material will be accepted based on periodic samples taken at the latest practicable point prior to incorporation into the work.

PART 3 EXECUTION

3.01 PREPARATION

- A. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations segregated material, or other irregularities, and shall be uniformly compacted.
- B. Delays in priming shall require reprocessing or reshaping to provide a smooth, compacted surface.

3.02 APPLICATION

- A. Weather Limitation - Prime coat shall be applied only when the surface on which the material is to be applied is dry and when the atmospheric temperature is above 50°F.
- B. Equipment - Contractor shall provide equipment for heating and applying the bituminous material and for applying blotter material.
- C. The quantities, rate of application, and areas to be treated shall be approved before application of the prime coat. Application temperatures shall be in accordance with Section 02545, BITUMINOUS MATERIALS.
- D. Excess bituminous material shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected.
- E. After the application of the prime coat, if the bituminous material fails to penetrate and the roadway must be used by traffic, blotter material shall be spread in the amounts required to absorb any excess bituminous material.
- F. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. When traffic is maintained through construction, not more than one-half of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount.

3.03 PROTECTION

- A. Traffic control shall be in accordance with US DOT FHWA Manual on Uniform Traffic Control Devices unless otherwise specified by Engineer in the Special Provisions.

- B. When traffic is maintained, one-way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and will not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Bituminous material will be measured by the ton. Blotter material will be measured by the ton.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of prime coat will be paid for at the contract price per ton for bituminous material and per ton for blotter material complete in place. No payment for haul of blotter material will be made. Payment will be made under:

PAY ITEM	PAY UNIT
Asphalt Cement	Ton
Liquid Asphalt (Prime)	Ton
Emulsified Asphalt (Prime)	Ton
Blotter Material	Ton

END OF SECTION

SECTION 02551 — TACK COAT

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of preparing and treating an existing bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the Engineer.

1.02 RELATED WORK

- A. Section 02545, Bituminous Materials.
- B. Section 02511, Road Mix Bituminous Pavements.
- C. Section 02512, Plant Mix Pavements.

1.03 REFERENCES

- A. AASHTO M 140: Emulsified Asphalt.
- B. AASHTO M 141: -70 Slow Curing Liquid Road Material.
- C. AASHTO M 208: Cationic Emulsified Asphalt.
- D. AASHTO M 226: Table 1, Viscosity Graded Asphalt Cement.
- E. AASHTO M 81: Cut-Back Asphalt (Rapid Curing Type).
- F. AASHTO M 82: Cut-Back Asphalt (Medium Curing Type).
- G. AASHTO T 40: Sampling Bituminous Materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. The type of bituminous material will be specified in the contract, and the grade will be designated by Engineer.
- B. The bituminous material shall meet the applicable requirements of Section 02545, BITUMINOUS MATERIALS.

PART 3 EXECUTION

3.01 PREPARATION

- A. The existing surface shall be patched and cleaned and shall be free of irregularities to provide a reasonably smooth and uniform surface to receive the treatment. Unstable corrugated areas shall be removed and replaced with suitable patching materials. Payment for the patching will be made at the contract unit price for the various items used unless a reconditioning item is included in the contract. The edges of existing pavements which are to be adjacent to new pavement shall be cleaned to permit the adhesion of bituminous materials.

3.02 APPLICATION

A. APPLICATION OF BITUMINOUS MATERIAL

1. The bituminous material shall be uniformly applied with a pressure distributor.
2. The tack coat shall be applied in such manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.
3. Tack coat shall not be applied during wet or cold weather, after sunset, or to a wet surface. The quantity, rate of application and areas to be treated shall be approved prior to application. Application temperatures shall be in accordance with Section 02545, Subsection 3.02 APPLICATION

B. EQUIPMENT

1. The Contractor shall provide equipment for heating and applying the bituminous material.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. The bituminous material for tack coat will be measured by the ton.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of tack coat will be paid for at the contract unit price per ton for bituminous material complete in place. Payment will be made under:

PAY ITEM	PAY UNIT
Asphalt Cement	Ton
Liquid Asphalt (Prime)	Ton
Emulsified Asphalt (Prime)	Ton
Blotter Material	Ton

END OF SECTION

SECTION 02552 — SEAL COAT

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of an application of bituminous material followed by an application of cover coat material in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the Engineer.

1.02 RELATED WORK

- A. Section 02190, Aggregates.
- B. Section 02511, Road Mix Bituminous Pavements.
- C. Section 02512, Plant Mix Pavements.
- D. Section 02545, Bituminous Materials.

1.03 REFERENCES

- A. AASHTO M 140; Emulsified Asphalt.
- B. AASHTO M 141; -70 Slow Curing Liquid Road Material.
- C. AASHTO M 208; Cationic Emulsified Asphalt.
- D. AASHTO M 226; Table 1, Viscosity Graded Asphalt Cement.
- E. AASHTO M 81; Cut-Back Asphalt (Rapid Curing Type).
- F. AASHTO M 82; Cut-Back Asphalt (Medium Curing Type).
- G. AASHTO T 40; Sampling Bituminous Materials.

1.04 DEFINITIONS

- A. Plain seal shall consist of the application of bituminous material and a sand cover coat, where required.

PART 2 PRODUCTS

2.01 MATERIALS

A. BITUMINOUS MATERIAL

1. The type of bituminous material will be specified in the contract, and the grade will be designated by Engineer.
2. The bituminous material shall meet the applicable requirements of Section 02545, BITUMINOUS MATERIALS.

B. COVER COAT MATERIAL

1. Cover coat material shall meet the requirements of Section 02190, AGGREGATES, Subsection 2.10, for the type specified. The material will be accepted based on periodic samples taken at the latest practicable point prior to incorporation into the work.
2. Stockpiled material shall meet the requirements of Section 02190, AGGREGATES, Subsection 3.01.

PART 3 EXECUTION

3.01 PREPARATION

- A. Seal coating operations shall not be started until the surface is thoroughly compacted.
- B. Bituminous material shall not be spread until the surface has been cleaned as required and the section to be sealed has been approved.

3.02 APPLICATION

A. WEATHER LIMITATIONS

1. Seal coat shall be applied only when the surface on which the material is to be applied is dry and when the atmospheric temperature is above 40°F.
2. Plain seal shall be applied when the surface is dry and the weather conditions are suitable for the proper application of the bituminous material specified.

B. EQUIPMENT - The following equipment or its equivalent shall be required:

1. Equipment for heating and applying bituminous material.
2. A rotary power broom.
3. A pneumatic-tired roller which shall be self-propelled, the gross load of which shall be adjustable to apply two-hundred (200) to three-hundred-fifty (350) pounds of rolling width as directed. Tire pressure or contact pressure may be

specified for pneumatic-tired rollers. Pneumatic-tired rollers shall be operated at a maximum speed of five (5) miles per hour.

4. A self-propelled aggregate spreader of approved design supported by at least four (4) wheels equipped with pneumatic tires on two (2) axles. The aggregate spreader shall be equipped with a means of applying the larger cover coat material to the surface ahead of the smaller cover coat material and with positive controls so that the required amount of material will be deposited uniformly over the full width of the bituminous material. Other types of aggregate spreaders may be used provided they accomplish equivalent results and are approved.

C. BITUMINOUS MATERIALS

1. Bituminous material shall be applied by means of a pressure distributor in a uniform, continuous spread over the section to be treated and within the temperature range specified. The quantity of bituminous material to be used per square yard shall be as directed. If the texture of the surface is such that bituminous material penetrates too rapidly, a preliminary application of from 0.05 to 0.10 gallon per square yard of surface may be required.
2. A strip of building paper, at least three (3) feet in width and with a length equal to that of the spray bar of the distributor plus one foot shall be used at the beginning of each spread. If the cutoff is not positive, the use of paper may be required at the end of each spread. The paper shall be removed and disposed of in a satisfactory manner.
3. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Any skipped areas or deficiencies shall be corrected. Junctions of spreads shall be carefully made to assure a smooth riding surface.
4. The spreads of bituminous material shall not be more than six (6) inches wider than the width covered by the cover coat material from the spreading device. Under no circumstances shall operations proceed in such manner that bituminous material will be allowed to chill, set up, dry, or otherwise impair retention of the cover coat.
5. The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not drip bituminous materials on the surface of the traveled way.

D. COVER COAT MATERIAL

1. Immediately following the application of the bituminous material, cover coat material shall be spread in quantities as designated. Spreading shall be

accomplished in such a manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and newly applied bituminous material.

2. The cover coat material shall be moistened with water when required to eliminate or reduce the dust coating of the aggregate. Moistening shall be done the day before the use of aggregates.
3. Immediately after the cover coat material is spread, any deficient areas shall be covered by additional material. Pneumatic-tire rolling shall begin immediately and shall be continued until three complete coverages are obtained. Pneumatic-tire rolling shall be completed the same day the bituminous material and cover coat materials are applied.
4. After the application of the cover coat material, the surface where specified shall be lightly broomed or otherwise maintained as directed for a period of four (4) days, or as directed. Maintenance of the surface shall include the distribution of cover coat material over the surface to absorb any free bituminous material and cover any area deficient in cover coat materials. The maintenance shall be conducted so as not to displace embedded materials. Excess material shall be swept from the entire surface by means of rotary brooms. The surface shall be swept at the time determined by Engineer.

3.03 PROTECTION

- A. Areas where bituminous materials would be picked up, or the seal otherwise damaged by traffic, shall be covered by a protective coat of sand. When confined to small areas, the sand coat may be applied by hand spreading and smoothed by sweeping.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Bituminous material will be measured by the ton and cover coat material will be measured by the ton.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of seal coat will be paid for at the contract price per ton for bituminous material and per ton for cover coat material complete in place including haul. Payment will be made under:

PAY ITEM	PAY UNIT
Asphalt Cement	Ton
Liquid Asphalt (Prime)	Ton
Emulsified Asphalt (Prime)	Ton
Blotter Material	Ton

END OF SECTION

SECTION 02553 — BITUMINOUS SURFACE TREATMENT

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of the construction of a single- or multiple-course bituminous surface treatment in accordance with these specifications and in reasonably close conformity with the lines shown on the Drawings or as established by Engineer.
- B. The bituminous surface treatment may consist of the application of one or more seal coats or may consist of a prime coat followed by one or more seal coats as specified in the Contract Documents.

1.02 RELATED WORK

- A. Section 02190, Aggregates.
- B. Section 02545, Bituminous Materials.
- C. Section 02550, Prime Coat.
- D. Section 02552, Seal Coat.

1.03 REFERENCES

- A. AASHTO M 140: Emulsified Asphalt.
- B. AASHTO M 141: -70 Slow Curing Liquid Road Material.
- C. AASHTO M 208: Cationic Emulsified Asphalt.
- D. AASHTO M 226: Table 1, Viscosity Graded Asphalt Cement.
- E. AASHTO M 81: Cut-Back Asphalt (Rapid Curing Type).
- F. AASHTO M 82: Cut-Back Asphalt (Medium Curing Type).
- G. AASHTO T 40: Sampling Bituminous Materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. BITUMINOUS MATERIAL
 - 1. The types of bituminous material will be specified in the Contract Documents. The grade will be designated by Engineer.

2. The bituminous material shall meet the applicable requirements of Section 02545, BITUMINOUS MATERIALS.

B. AGGREGATES

1. Aggregates and blotter material shall meet the requirements of Section 02190, AGGREGATES, Subsection 2.11, for the sizes specified. The material will be accepted based on periodic samples taken at the latest practicable point prior to incorporation into the work.
2. Stockpiled material shall meet the requirements of Section 02190, AGGREGATES, Subsection 3.01.

PART 3 EXECUTION

3.01 PREPARATION

- A. See requirements of related Sections.

3.02 APPLICATION

A. PRIME COAT

1. The prime coat, when specified, shall be applied in accordance with the requirements of Section 02550, PRIME COAT.
2. A curing period of three (3) days is required between the application of the prime coat and the next application of bituminous material unless otherwise specified by Engineer in the Special Provisions.

B. SEAL COAT

1. Each seal coat shall be applied in accordance with Section 02552, SEAL COAT. If successive seal coats are to be applied, the previous seal coat shall be maintained and permitted to cure for a period of three (3) days unless otherwise specified by Engineer in the Special Provisions.

3.03 PROTECTION

- A. During the period between the application of the prime coat and the seal coat, the primed surface shall be kept in repair. All holes, ravel, and areas deficient in prime shall be patched and repaired with bituminous treated materials, by penetration methods or other approved procedures.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Bituminous material, cover coat material and blotter material will be measured by the ton.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of bituminous surface treatment will be paid for at the contract unit price per ton for bituminous material complete in place. No payment for haul of blotter material will be made. Payment will be made under:

PAY ITEM	PAY UNIT
Liquid Asphalt (Bit. Surf. Trtmt.)	Ton
Emulsified Asphalt (Bit. Surf. Trtmt.)	Ton
Liquid Asphalt (Prime)	Ton
Cover Coat Material	Ton
Blotter Material	Ton

END OF SECTION

SECTION 02570 — ADJUSTING STREET FIXTURES

PART 1 GENERAL

1.01 SUMMARY

- A. This item shall consist of locating and adjusting to grade existing manholes, cleanouts, inlets, water valve boxes or services and fire hydrants as shown on the plans and as required in the Special Provisions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All material such as concrete brick and mortar shall meet specifications as required in the section on the particular material involved, or if the material is not covered in these specifications, the material used for adjusting shall be equal, and comparable to that in the existing structure. If extensions for water valve boxes or services and fire hydrants are required beyond the length found to exist, they shall be comparable to that in the existing structure.

PART 3 EXECUTION

3.01 METHOD OF CONSTRUCTION

- A. All existing manholes, inlets, cleanouts and water valve boxes or services shall be brought to grade by either lowering or raising as required in accordance with the details shown on the plans. Where lowering of manholes, cleanouts or inlets is required, care shall be used in removing the top portion of the masonry or pipe. Before the ring and cover is replaced, the top of the masonry on the manhole, cleanout or inlet must be true to line and grade.
- B. Water valve boxes and services shall be excavated and exposed in order to determine whether height adjustment can be made without substituting a longer section. Water valve boxes and services shall be adjusted laterally so the valve stem can be operated by the extension. Water services shall be adjusted by raising or lowering the curb key stop or extension box as specified in the Special Provisions or as shown in the plans.
- C. Manholes, cleanouts and water valve boxes shall be adjusted to final grade before the seal coat is applied. Preliminary adjustment may be required to allow placing of base courses and paving over the manholes, cleanout or water valve.
- D. Backfill shall be in conformance with Section 02210. There may be adjustments required in the horizontal location of some existing fire hydrants. At the time of

construction staking, any hydrants that require horizontal adjustment will be located by the Engineer and the adjusted location will be staked by the Engineer as shown on the plans.

- E. There may be minor adjustment required as dimensioned on the plans in the height of some existing fire hydrants to insure that they are at a reasonable height behind the back of curb. At the time of construction staking, any hydrants that require vertical adjustment will be located by the Engineer and the adjusted height will be staked by the Engineer.
- F. Before final acceptance, all manholes, cleanouts, inlets and water valve boxes or services shall be cleaned, and water valve boxes or services and fire hydrants shall be operational.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Existing manholes, cleanouts, inlets, water valve boxes and water services to adjust. These items shall be measured by the number of existing facilities adjusted, complete in place.
- B. LOCATION ADJUSTMENT FOR EXISTING FIRE HYDRANTS. This item shall be measured by the number of existing fire hydrants adjusted horizontally, complete in place.
- C. VERTICAL ADJUSTMENT FOR EXISTING FIRE HYDRANTS. This item shall be measured by the number of existing fire hydrants adjusted vertically, complete in place.

4.02 BASIS OF PAYMENT

- A. Payment shall be made at the contract unit price bid for each item multiplied by the respective number of units adjusted.

Payment will be made under:

Adjust Sewer Manholes – Per Each
Adjust Sewer Cleanouts – Per Each
Adjust Storm Drain Inlets – Per Each
Adjust Water Valve Boxes – Per Each
Adjust Water Services – Per Each
Horizontal Adjust Fire Hydrant – Per Each
Vertically Adjust Fire Hydrant – Per Each

- B. Payment shall constitute full compensation for all materials, excavation, backfill, compaction, cleaning, labor, tools and incidentals necessary to complete each item.

END OF SECTION

SECTION 02645 — FIRE HYDRANTS

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of installation of fire hydrants together with related appurtenances, complete.

1.02 REFERENCES

- A. AWWA C-502: STANDARD FOR DRY BARREL FIRE HYDRANTS

PART 2 PRODUCTS

2.01 MATERIALS

A. DRY-BARREL FIRE HYDRANTS

1. Fire hydrants shall conform to standard for dry barrel fire hydrants, AWWA C-502, and modifications herein specified.
2. Hydrants shall be furnished with 5-inch minimum valve openings, one pumper connection and two 2-1/2 hose connections. Hose nozzle threads, pumper nozzle threads, operating nut, and opening direction shall match existing hydrant (if replacement) or as per local jurisdiction standards (if new).
3. Hydrants shall be of the "Compression" or "Toggle Joint" type with safety flange and safety stem coupling above the ground line so that they can be repaired without shutting off the water. Hydrants shall be of the dry top design with two or more "O" rings sealing the water from the operating mechanism. The portion of the hydrant above the ground line shall be painted in accordance with the Owner's standards. Hydrants shall be furnished for 6-foot cover unless specified otherwise in the Special Provisions. Hydrants installed behind curbs typically require an additional six (6) inches height. Contractor should take this into consideration.
4. Hydrants shall not include drain openings or drain rock if the hydrant shoe is below the local water table, as noted on the construction plans. Hydrants without weep holes shall have markings to identify that the barrel needs to be pumped after normal operations in accordance with the National Fire Protection Association (NFPA) 25 standard.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All hydrants shall stand plumb with the pumper nozzle facing the street or fire lane, as may be appropriate. Hydrant shall be set with the ground line at the location indicated by the hydrant manufacturer. Hydrants shall be installed such that they have drainage away from them at the surface. Proper boot lengths shall be used to avoid hydrants installed in holes or depression.
- B. Drainage shall be provided at the base of the hydrant by placing clean gravel under and around the base of the hydrant. Sufficient gravel shall be used to provide a minimum of one (1) foot on all sides from the base of the hydrant to the point at least six (6) inches above the drain opening. Hydrants shall not include drain openings or drain rock if the hydrant shoe is below the local water table, as noted on the construction plans. Hydrant shall be braced against unexcavated earth at the end of the trench with concrete backing as detailed on the plans. Hydrants shall be furnished with auxiliary gate valves as specified above. Hydrant installation shall be in accordance with Standard Drawing No. 02645-01 OR AS SPECIFIED IN THE SPECIAL PROVISIONS.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Measurement of fire hydrants shall be made by numerical count each.

4.02 BASIS OF PAYMENT

- A. Payment for this item will be made at the contract unit price bid each; which price shall include furnishing and installing the fire hydrant and auxiliary gate valve and box, all additional excavation, backfill, and special compaction required for the installation, thrust and anchor blocking, drain gravel, and all other work necessary or incidental for completion of the item. Payment for this item shall also include furnishing and installing all pipe, joint restraints, tees, and fittings required for hydrant lead/run from water main to hydrant.

END OF SECTION

SECTION 02665 — WATER DISTRIBUTION AND TRANSMISSION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of construction of Water Mains, including fittings, water valves, water services, water service piping, tapping the main, corporation stops, curb stops, and other appurtenances normally used for water supply and distribution systems, including furnishing and installing pipe, water valves, and fittings, construction of thrust blocking, testing, cleaning and disinfection of mains and other related work.

1.02 REFERENCES

- A. AWWA C-110 (A21.10-87): Standard for Ductile-Iron and Gray-Iron Fittings, 3" (75 mm) through 48" (1200 mm), for Water and Other Liquids.
- B. AWWA C-500; Gate Valves for Water and Sewerage Systems.
- C. AWWA C-504; Rubber-Seated Butterfly Valves.
- D. AWWA C-509; Resilient-Seated Gate Valves for Water and Sewerage Systems.
- E. AWWA C-550; Protective Interior Coatings for Valves and Hydrants.
- F. AWWA C-651 "Disinfecting Water Mains"
- G. AWWA C-900; PVC Pressure Pipe, 4" (100 mm) Through 12" (300 mm), For Water.
- H. AWWA C-901 "Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) through 3 In (76mm) for Water Service
- I. AWWA C-907; Polyvinyl Chloride (PVC) Pressure Fittings for Water - 4 In. (100 mm) Through 8 In. (200 mm).
- J. AWWA C-905 Large Diameter (greater than 12") (300 mm) PVC pipe.
- K. ANSI/AWWA C-906-90 Polyethylene Pressure Pipe 4 inches (100 mm) through 63 inches (1575 mm).
- L. AWWA C-909; Molecular Oriented Polyvinyl Chloride (PVCO) Pressure Pipe (4 inch Through 12 inch (100 mm through 300 mm))

1.03 QUALITY ASSURANCE

- A. When required by Engineer, Contractor shall furnish certification by the manufacturer of the pipe to be furnished on this project, certifying that the pipe and fittings comply with the applicable specifications. REQUIRED CERTIFICATION SHALL ACCOMPANY EACH DELIVERY OF MATERIAL.
- B. 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.

PART 2 PRODUCTS

2.01 MATERIALS

A. PIPE

- 1. Pipe used in water main construction shall be as called out in the Special Provisions and shall be in accordance with the following specifications:
- 2. DUCTILE IRON PIPE
 - a. Ductile iron pipe shall conform to the provisions of AWWA Specifications C-151. Wall thickness shall be as shown in the Special Provisions.
 - b. Pipe joints shall be mechanical joint or “Push-On” joints conforming to AWWA Specification C-111.
 - c. The interior of the pipe shall have a cement mortar lining conforming to the requirements of AWWA Specification C-104. The outside surface of pipe designed for underground service shall receive a bituminous coating approximately 1-mil thick.
 - d. When polyethylene encasement is required, the requirements of AWWA Specification C- 105/A21.5-88 shall be met.
- 3. POLYVINYL CHLORIDE (PVC) PRESSURE PIPE
 - a. PVC pipe for the water mains shall meet the requirements of AWWA Specification C-900, “Polyvinyl Chloride Pressure Pipe”, made to ductile iron O.D.’s for “Push-On” joints. Pipe joints shall be with an elastomeric gasket or joint. Pipe class shall be as specified in the Special Provisions.
- 4. Polyethylene (PE) Pressure Pipe and Fittings shall meet the requirements of ANSI/AWWA C906-90 Polyethylene (PE Pressure Pipe and Fittings, 4 inches through 63 inches, for water distribution.

5. LARGE DIAMETER (greater than 12") PVC PIPE shall conform to AWWA C-905 Specifications.
6. Molecular Oriented Polyvinyl Chloride (PVCO) Pressure Pipe for water mains shall meet the requirements of ANSI/AWWA C-909.
7. CASING PIPE
 - a. Pipe used to case waterline - sewer line crossings shall be (PVC) DR-26 water pipe or (PVC) DR-35 sewer pipe with a minimum inside diameter of 1.25 times outside diameter of carrier pipe.
 - b. Casing pipe shall be sealed at both ends with materials to prevent the migration of water into the annular space.

B. FITTINGS AND COUPLINGS

1. Cast iron or ductile iron fittings used for water mains shall be Class 250 conforming to AWWA C-110, Gray-Iron and Ductile Irons Fittings for Water and Other Liquids. Joints for Ductile Iron and PVC Pipe shall be mechanical joint or "Push-On" joints conforming to AWWA C-111. The interior of the fitting shall have a cement mortar lining conforming to AWWA C-104. The outside surface of the fitting shall receive a bituminous coating approximately 1-mil thick. Couplings for making connections to existing pipelines and fire hydrants shall be Smith-Blair Type 413, Type 433, Type 435, or Dresser Style 62, Style 153, Style 162, mechanical-joint connecting pieces and mechanical-joint sleeves, or an approved equal.
2. PVC fittings may be used for water mains four (4) inches through eight (8) inches in diameter and shall conform to AWWA C-907 or an approved equal.

C. AIR RELIEF VALVES, BLOW OFFS, FLUSHING HYDRANTS

1. These shall be of the same material as the main installation and shall meet pressure and flow requirements equal to or exceeding the main installation or as required by the manufacturer.

D. GATE VALVES

1. Gate valves shall be iron body, bronze mounted, double disc gate valves with non-rising stems with design, construction and pressure rating conforming to AWWA C-500, with modifications specified herein.
2. Stem seals shall be double "O" ring seals designed so that the seal above the stem collar can be replaced with the valve under pressure in full open position.

3. Gate valves for underground installation shall have a two-inch square wrench nut for key operation. All valves shall open counterclockwise unless indicated otherwise in the special provisions.

E. BUTTERFLY VALVES

1. Butterfly valves for use in the water distribution system shall be Class 150 rubber seated, tight closing butterfly valves conforming to AWWA C-504. Butterfly valves shall be furnished with mechanical joint ends and lubricated screw type operators designed for underground service.
2. Rubber valve seats shall be replaceable without disassembling the valve and shall not be interrupted by the shafting. Rubber seats may be retained on the disc edge by stainless steel clamping in lieu of bonding to the valve body. Shaft packing shall be of the self-adjusting permanent type.
3. Operators for underground service shall be permanently lubricated screw-type operators, totally enclosed and of watertight construction. Overload protection shall be incorporated into the operator allowing the application of 450 foot-pounds input torque at full-open and full-closed positions without damage to the operator or valve. A 2-inch square wrench nut and valve box shall be provided for operating the valve. Valves shall open counter clockwise unless indicated otherwise in the Special Provisions.
4. Certification of performance, leakage and hydrostatic tests as described in Section 13 of AWWA C-504 shall be furnished when required by Engineer. Valves shall be the product of a manufacturer having a minimum of five (5) years' experience in the manufacture of water works and distribution valves.

F. RESILIENT SEATED GATE VALVES

1. Resilient Seated Gate Valves shall be iron body, with non-rising stems with design, construction, and pressure rating conforming to AWWA C509, standard for Resilient Seated Gate Valves with modifications specified herein.
2. Waterway shall be smooth and shall have no depressions or cavities in seat area where foreign material can lodge and prevent closure or sealing.
3. Stem seals shall be double "O" ring seals designed so that the seal above the stem collar can be replaced with the valve under pressure in full open position.
4. Resilient Seated Gate Valves for underground installation shall have 2-inch square wrench nut for key operation. All valves shall open counterclockwise unless indicated otherwise in the special provisions.

5. The Resilient Seated Gate Valves' interior parts and surfaces shall be coated in accordance with AWWA C550.

G. VALVE BOXES

1. Valve boxes shall be cast iron, 5-1/4-inch-diameter adjustable valve boxes. Valve boxes shall be of the screw type and of sufficient length for the pipe bury as specified. The cast iron cover of the valve box shall have the word "Water" stamped thereon.

H. WATER SERVICE PIPE

1. Pipe used in water service line construction shall be copper, or polyethylene service pipe as called out in the Special Provisions and shall conform to the following specifications:
 - a. Copper Service Pipe shall be type K soft, conforming to Federal Specification WW-T-799 or ASTM B88-62.
 - b. Polyethylene Service Pipe shall conform to the requirements of AWWA C-901, "Polyethylene (PE) Pressure Pipe, Tubing and Fittings, one-half (1/2) inch through three (3) inch for water." PE Pipe shall be pressure tubing conforming to Table 6 of said specification. Tubing shall be class 160 with a DR of 9.0 or class 200 with a DR of 7.3. If not specified, DR 7.3 shall be used.

I. CORPORATION STOPS

1. Corporation stops shall be brass corporation stops with inlet and outlet as specified in the Special Provisions and/or on the Drawings.

J. COMPRESSION CONNECTIONS

1. Ends of polyethylene tubing inserted in compression connections should be fitted with insert reinforcement.

K. SERVICE CLAMPS

1. Service clamps, where required, shall be flat double strap, bronze metal or other noncorrosive material, with Neoprene gaskets and corporation stop threads. Service clamps for PVC shall provide full support around the circumference of the pipe, and have a bearing area of sufficient width along the axis of the pipe so that the pipe will not be distorted when tightened.

L. CURB STOPS

1. Curb stops shall be bronze inverted key stops or ball-valve type as specified on the Drawings and/or in the Special Provisions. Curb boxes shall be likewise specified.

M. PIPE INSULATION

1. Pipe insulation shall be high density, extruded polystyrene foam insulation board for buried service.
2. The 5-year aged R Value per inch shall be five (5) when tested at 75°F mean temperature in accordance with ASTM Specification C518.
3. Minimum compressive strength of twenty-five (25) psi when tested in accordance with ASTM D1621.
4. Maximum water absorption of 0.1% by volume when tested in accordance with ASTM C272.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. GENERAL

1. Pipe shall be installed in accordance with the manufacturer's recommendations for installing the type of pipe used unless otherwise noted in the Special Provisions. Contractor shall provide all tools and equipment including any special tools designed for installing each particular type of pipe used.
2. Service pipe shall be of the size or sizes designated in the Contract Documents. Service lines shall be considered 2-inch size and under. Service lines over 2-inch size shall be considered as water mains and shall be as specified under the applicable sections.

B. DEWATERING OF TRENCH

1. 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. Contractor shall coordinate with Owner to comply with all applicable DEQ permit regulations as set forth in the Contract Documents and as referenced in Specification Section 01041.

C. RESPONSIBILITY FOR MATERIAL

1. Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for the placement of installed material discovered damaged or defective prior to the final acceptance of the work, or during the guarantee period.
2. Contractor shall be responsible for the safe and proper storage of material furnished by him or to him and accepted by him, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe and other accessories shall be kept free from dirt and foreign matter at all times.

D. HANDLING OF PIPE

1. All pipe furnished by Contractor shall be delivered and distributed at the site by Contractor. Pipe, fittings, specials, valves and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
2. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
3. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by Contractor at his expense in a manner satisfactory to Engineer.

E. LAYING OF PIPE

1. Before installation, the pipe and pipe coating shall be inspected for defects. Any damage to pipe coatings shall be repaired AS RECOMMENDED BY THE PIPE MANUFACTURER before laying the pipe.
2. All pipe shall be laid and maintained to the required lines and grades with fittings and valves at the required locations.
3. Grade and alignment on ungraded streets will be given from hubs set parallel to the line of the pipe, and on graded streets the grade and alignment shall be taken from established points on the existing curbs or sidewalks, when directed by Engineer. Trenches for the pipe shall be opened in accordance with the lines and grades given or to the standard depth of cover provided on the Drawings and/or in the Special Provisions. Contractor shall transfer lines and grades to the pipe from marks set by Engineer or from existing concrete curbs or sidewalks as an incidental part of his work.

4. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plan is required, Engineer shall have the authority to change the plans and order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation and reconstruction of the obstructions. If the change in plans results in a change in the amount of work by Contractor, such altered work shall be done on the basis of payment to Contractor for extra work or credit to the Owner for less work.
5. Proper implements, tools and facilities satisfactory to Engineer shall be provided and used by Contractor for the safe and convenient prosecution of the work. All pipe, fittings and valves shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipe materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.
6. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by Engineer.
7. Long radius curves, either horizontal or vertical, may be laid with standard pipe by deflections at the joints, as allowed by the pipe manufacturer's installation instructions. If the pipe is shown curved on the plans and no special fittings are shown, Contractor can assume that the curves can be made by deflection of the joints with standard lengths of pipe. If shorter lengths are required, the plan will indicate maximum lengths that can be used.
8. Where field conditions require deflection or curves not anticipated by the plans, Engineer will determine the fittings to be used and additional payment will be made for specified fittings. No additional payment will be made for laying pipe on curves as shown on the plans, nor for field changes involving standard lengths of pipe deflected at the joints. Upon approval of the Engineer, the Contractor may choose to install additional or substitute fittings during completion of the work, at no additional cost to the project.
9. Maximum deflections at pipe joints for various types of pipe shall not exceed the applicable material and joint specifications of AWWA nor shall they exceed the recommendations of the pipe manufacturer. 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 wide on curves for this purpose.

10. Reaction or thrust blocking shall be applied at all tees, plugs, caps and at bends deflecting 11-1/4 degrees or more, or movement shall be prevented by attaching suitable metal rods or straps as approved by Engineer. Reaction blocking shall be concrete having a compressive strength of not less than 2,000 pounds per square inch at twenty-eight (28) days. Blocking shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground shall be as shown on Standard Drawing 02665-03. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair.
11. The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or coating and so as to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed.

F. SEPARATION OF WATER MAINS AND SEWERS

1. PARALLEL INSTALLATION

- a. NORMAL CONDITIONS - Water mains shall be laid at least ten (10) feet horizontally from any sanitary sewer, storm sewer, or manhole, whenever possible. The distance shall be measured edge-to-edge.
- b. UNUSUAL CONDITIONS - When local conditions prevent a horizontal separation of ten (10) feet, a water main may be laid closer to a sanitary sewer, storm sewer, or manhole, provided that:
 - 1) The bottom of the water main is at least eighteen (18) inches above the top of the sanitary or storm sewer; or
 - 2) The trench backfill consists of cement treated backfill in accordance with Section 02225. Cement treated backfill must bear on undisturbed soil.
 - 3) Where eighteen (18) inches vertical separation as noted above cannot be obtained, the sewer shall be:
 - a) Constructed of materials and with joints that are equivalent to water main standards of construction and tested for water tightness by sewer line methods per Section 02700; or
 - b) Placed in a separate casing pipe.

2. CROSSING

- a. **NORMAL CONDITIONS** - Water mains crossing sanitary sewers, sanitary sewer service lines, or storm sewers shall be laid above to provide a vertical separation of at least eighteen (18) inches whenever possible. The distance shall be measured from the top of the sewer pipe to the bottom of the water pipe.
- b. **UNUSUAL CONDITIONS** - When local conditions prevent a vertical separation of at least eighteen (18) inches as noted above, the following construction shall be used:
 - 1) The sanitary sewer or storm sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be tested for water tightness by sewer line methods as per Section 02700; or
 - 2) The sanitary sewer, storm sewer or water main shall be placed in a separate casing pipe; or
 - 3) The length of the sewer line constructed to water main standards or the casing pipe shall extend a minimum of nine (9) feet each side of the crossing.
 - 4) Water mains passing under sewer lines shall in addition to the above requirements, be protected by providing adequate structural support for the sewer line. Soil structural support shall consist of cement treated backfill in accordance with Section 02225. Cement treated backfill must bear on undisturbed soil.

3.02

SETTING VALVES AND VALVE BOXES

- A. Gate valves shall be set and jointed to the pipe in the manner specified for pipe laying and jointing. Valves shall be set with operating nut vertical. Valve boxes shall be centered and plumb over the operating nut and shall be set so that no shock or stress will be transmitted to the valve.
- B. Resilient Seated Gate Valves shall be set and jointed to the pipe in the manner specified for pipe laying and jointing. Valves shall be set with operating nut vertical. Valve boxes shall be centered and plumb over the operating nut and shall be set so that no shock or stress will be transmitted to the valve.
- C. Butterfly Valves shall be set and jointed to the pipe in the manner specified for pipe laying and jointing. Valves shall be set with operating nut vertical. Valve boxes shall

be centered and plumb over the operating nut and shall be set so that no shock or stress will be transmitted to the valve.

- D. Valve boxes shall be centered and plumb over the operating nut of the valve. Tops of valve boxes shall be set flush with the ground surface or street surfacing unless otherwise directed by Engineer.

3.03 SERVICE CONNECTIONS

A. GENERAL

1. Contractor shall provide all work and materials for the complete service line installation, including trench excavation and backfill; making the water main tap; furnishing and installing the corporation stop, curb stop and box, service clamp where necessary, and service line with fittings as required to make the connections to the stops. The service line adjacent to the water main shall be bent slightly into a figure "S" to avoid a rigid connection. All services shall have a minimum of 6 feet of cover. See Standard Drawing No. 02645-03.
2. Contractor shall furnish and install the service pipe from the main to the property line with a curb stop and extension service box installed at the property line.
3. Installation of water service lines shall be in accordance with Standard Drawing No. 02665-01.

B. SEPARATIONS

1. The service connection shall be installed such that a minimum horizontal separation, measured center to center, of ten (10) feet is maintained.

C. TAPPING

1. Actual tapping of the water mains shall be made by Contractor unless otherwise specified in the Special Provisions. Contractor shall be responsible for notifying Owner and Engineer in advance of the time that a tap will be made, and coordinating all activities in this regard with Owner and Engineer.
2. Tapping directly into the barrel of PVC and AC pipe will be done using service clamps unless otherwise specified in the Special Provisions.

3.04 VALVE THRUST BLOCKS

- A. All valves to be installed which call for thrust blocks and anchor rods shall be installed in accordance with and as detailed on Standard Drawing No. 02665-03.

3.05

PIPE JOINTING

A. RUBBER GASKET "PUSH-ON" JOINTS

1. Jointing of pipe and fittings with a rubber gasket "push-on" joint shall be as recommended by the manufacturer. The rubber gasket and gasket seat inside the bell shall be wiped clean with a cloth. A thin film of lubricant, furnished with the pipe, shall be applied to the inside surface of the gasket. The plain end of the adjoining pipe shall be wiped clean and inserted into the bell a sufficient distance to make contact with the gasket. The plain end shall then be forced "home" by the use of a crow bar, fork tool, or jack assembly. The use of an excavator bucket or other equipment not specifically approved by the manufacturer and the Engineer to assemble the pipe is prohibited. If a stop line exists on the plain end of a pipe, the plain end shall not be pushed into the bell of the adjoining pipe past the stop line.

B. MECHANICAL JOINTS

1. The inside of the bell and the outside of the spigot of the mechanical joint fittings shall be brushed thoroughly with a wire brush to remove all loose rust or other foreign material just prior to assembly. The cleaned surfaces shall be brushed with soapy water just prior to slipping the gasket over the spigot end and into the bell.
2. The spigot end of the pipe or fitting shall be accurately centered in the bell before jointing is begun. After the gasket is in place the gland shall be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. Bolts shall be partially tightened alternately around the socket maintaining approximately equal tension until the final tension is reached.
3. The normal range of bolt torques to be applied to the cast iron bolts in the joints shall be as follows:

BOLT SIZE (inch)	RANGE OF TORQUE (ft. lb.)
5/8	40-60
3/4	60 -90
1	70-100
1-1/4	90-120

The above torque loads may be applied with torque measuring or indicating wrenches, or they may be applied using regular socket wrenches, and checked to torque wrenches.

4. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation practice will not be permitted.

C. CONNECTIONS TO EXISTING MAINS

1. All connections to water mains in use shall be made by Contractor unless otherwise provided in the Special Provisions. Contractor shall furnish the special, as shown on the plans, and all other material required. He shall make all necessary excavations to assure gradual transition between the new and existing water main, and he shall perform all necessary backfilling.
2. Where the connection of new work to old requires interruption of service and notification of customers affected, the Owner, Engineer and Contractor shall mutually agree upon a date for connections which will allow ample time to assemble labor and materials, and to notify all customers affected. Contractor shall be responsible for providing requisite notification to all affected customers.

3.06 INSTALLATION OF SHALLOW WATERLINES

A. SHALLOW WATER LINES

1. Installation of shallow water lines shall only be permitted as shown by the contract documents.
2. All installation procedures shall be reviewed by the Engineer prior to execution of the work.
3. Pipe insulation shall be installed where called for on the plans or required by the Engineer. Insulation shall be two (2) feet wide by two (2) inches thick rigid insulation centered over the pipe. Where shown on the plans or drawings, insulation may be extended vertically on both sides of the pipe.
4. Compact pipe bedding material to top of pipe bell, provide smooth compacted surface for insulation board, center insulation board on pipe, place four (4) to six (6) inches of pipe bedding material over insulation board.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

A. WATER MAINS

1. Measurement of water mains shall be made in lineal feet along the centerline of pipe through all valves, fittings, and appurtenances.

B. FITTINGS

1. Measurement of water main fittings will be by numerical count of the various types and sizes listed in the Proposal.

C. WATER VALVES

1. Measurement of water valves shall be made by numerical count of the sizes and types of valves listed in the Proposal.

D. THRUST BLOCKS

1. Measurement of valve thrust blocks shall be made by numerical count of each size type listed in the bid schedule actually installed.

E. WATER SERVICE LINES

1. This item shall be measured by numerical count of water services of the various sizes listed in the Proposal.
2. No measurement and payment will be made for Trench Excavation and Backfill for water service lines and the cost of this work shall be included in the price bid for service lines.

F. PIPE INSULATION

1. Measurement of pipe insulation shall be made in linear feet along the centerline of the installed insulation.

4.02 BASIS OF PAYMENT

A. WATER MAIN

1. Payment for water main will be made at the contract unit price bid per lineal foot of the various sizes called for, which price shall include trench excavation, backfill, furnishing and installing pipe; furnishing and placing bedding; cleaning, testing and disinfecting the water main and all other work necessary or incidental for completion of the item.

B. FITTINGS

1. Payment for fittings will be made at the contract unit price bid for each fitting, which price shall include furnishing and installing the fittings as required, thrust blocking and any other work necessary or incidental for completion of the item.

C. WATER VALVES

1. Payment for water valves will be made at the contract unit price bid each; which price shall include furnishing and installing the valve and valve box, all additional excavation, backfill, and special compaction required for the installation, and all other work necessary or incidental for completion of the item.

D. THRUST BLOCKS

1. Payment for this item will be made at the contract unit price bid each; which price shall include all additional excavation, installation (including all bolts, strapping and concrete), backfill and compaction.

E. WATER SERVICE LINES

1. Payment for Water Service Connections will be made at the contract unit price bid each, which price shall include furnishing and installing the water service line from the main to the property line; tapping the main; furnishing and installing all fittings, corporation stops, curb stops and boxes, tapping saddles if required; all trench excavation, backfill, pipe bedding, shoring, and dewatering; cleanup and all other work necessary or incidental for completion of the item. Payment for these items shall be full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

F. PIPE INSULATION

1. Payment for pipe insulation will be made at the contract unit price per linear feet of insulation, which price shall constitute full compensation for furnishing all labor, equipment, material, transportation, and incidentals necessary to install the pipe insulation as described herein and shown on the drawings.

END OF SECTION

SECTION 02670 — HYDROSTATIC TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of testing of water main and related appurtenances.

1.02 REFERENCES

- A. AWWA C-600: Installation of Ductile-Iron Mains and Their Appurtenances.
- B. AWWA C-605: Underground Installation of Polyvinyl Chloride (PVC) and Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 HYDROSTATIC TESTING – DIP, PVC, & PVCO

- A. Perform hydrostatic testing in accordance with AWWA C600 (Installation of Ductile-Iron Mains and Their Appurtenances) or AWWA C605 (Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings), as appropriate.
- B. Pressure Test: After pipe has been laid, subject all pipe or any valved section thereof to a hydrostatic pressure test.
 - 1. Test Pressure Restrictions:
 - a. The test pressure should be not less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the sustained working pressure at the lowest elevation of the test section.
 - b. Not exceed pipe or thrust restraint design pressures or pipe pressure class.
 - c. Not exceed twice the rated pressure of valve or hydrants when they form the boundary of the test section.
 - d. Not exceed the rated pressure of gate valves when they form boundary of test section.
 - 2. Air Removal:
 - a. Before applying test pressure, expel all air from test section.

- b. If permanent air vents are not located at all high points, install corporation stops to vent the air.

3. Pressurization:

- a. Slowly fill each valved section of pipe with water.
- b. Bring to the required test pressure, based on the elevation of the highest point in the test section, corrected to the elevation of the test gage using a suitable pressure pump.
- c. Examine all exposed pipe, fittings, valves, hydrants, and joints and correct any visible leakage.
- d. Continue pressure test for minimum of two (2) hours. Pressure test passes if pressure can be maintained sufficiently to complete leakage test.
- e. If test fails, Contractor to make necessary repairs and retest at no cost to Owner. Contractor to perform retests and take corrective actions as required until a "passing" test is achieved.

C. Leakage Test:

- 1. Conduct concurrently with pressure test.
- 2. Leakage Defined: The quantity of water that must be supplied to a valved section of pipe to maintain pressure within five (5) psi of specified test pressure.
- 3. Allowable Leakage not to exceed that determined by the following formula:

$$L = \frac{S * D * P^{0.5}}{148,000}$$

L = Allowable leakage, in gallons per hour

S = Length of pipeline tested, in feet

D = Nominal pipe diameter, in inches

P = Average test pressure, in pounds per square inch (psi) gage

- 4. Re-pressure line as often as needed to maintain pressure within five (5) psi of specified test pressure.
 - 5. Accumulative total water used to re-pressure line is compared to allowable leakage calculated to determine success of test.
- D. If hydrostatic testing will result in a discharge of water from the system, the Contractor will be required to secure coverage under a Temporary Discharge Permit from DEQ. For additional information, refer to Specification Section 01041.

- A. Perform hydrostatic testing of polyethylene pipe in accordance with relevant AWWA standards.
- B. Bleed off any trapped air and then raise the hydrostatic pressure to a pressure that is 1.5 times the system maximum working pressure at the highest elevation in the test section. Do not exceed the rated pressure of gate valves when they form boundary of test section.
- C. To compensate for initial expansion of the pipe under test, add sufficient makeup water to the system at hourly intervals for three (3) hours to return to the test pressure.
- D. Four (4) hours after initial pressurization, begin actual pressure test. Run test for three (3) hours.
- E. Re-pressure line as often as needed to maintain pressure within five (5) psi of specified test pressure. If the amount of makeup water exceeds that amount as determined by the following formula, plus the allowance for expansion, the test failed.

$$L = \frac{S * D * P^{0.5}}{148,000}$$

L = Allowable leakage, in gallons per hour

S = Length of pipeline tested, in feet

D = Nominal pipe diameter, in inches

P = Average test pressure, in pounds per square inch (psi) gage

- F. If test fails, Contractor to make necessary repairs and retest at no cost to Owner. Contractor to perform retests and take corrective actions as required until a "passing" test is achieved.
- G. Allowance for expansion, U.S. Gallons/100 feet of pipe.

Nominal Pipe Dia. Inches	1-Hour Test	2-Hour Test	3-Hour Test
2	0.05	0.10	0.15
3	0.10	0.15	0.20
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.00	1.50
10	0.70	1.30	2.10
12	1.10	2.30	3.40
14	1.40	2.70	4.20

- H. If the test is not completed in 8 hours, allow the test section to "relax" for eight (8) hours before retesting.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefor.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefor.

END OF SECTION

SECTION 02675 — DISINFECTION

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of essential procedures for disinfecting new and repaired water mains.

1.02 REFERENCES

- A. AWWA C-651: Standard for Disinfecting Water Mains.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DISINFECTING WATER MAINS

- A. BASIC PROCEDURE: The basic procedure comprises:
1. Preventing contaminating materials from entering the water mains during construction or repair and removing by flushing materials that may have entered the water main.
 2. Disinfecting any residual contamination that may remain.
 3. Determining the bacteriologic quality by laboratory test after disinfection.
- B. Supplementary Information to be Supplied by Engineer. When the disinfecting of water mains is to be done under a separate contract or as part of a contract for installing the mains, the Engineer shall provide the following items of specific information in his supplementary specifications:
1. Standard of reference; that is--AWWA C-651.
 2. Places where flushing may be done, rates of flushing, and locations of drainage facilities (Item D, PRELIMINARY FLUSHING, and Table 2).
 3. Form of chlorine to be used (Item E, FORM OF CHLORINE FOR DISINFECTION) and method of application (Item F, METHODS OF CHLORINE APPLICATION).
 4. The number of frequency of samples for bacteriologic tests (Item H, BACTERIOLOGIC TESTS).
 5. Method of taking samples (Item H, BACTERIOLOGIC TESTS, Paragraph (2)).

6. Disposal of chlorinated water shall meet requirements of the Water Quality Division of the Wyoming Department of Environmental Quality.

C. PREVENTIVE MEASURES DURING CONSTRUCTION

1. KEEPING PIPE CLEAN AND DRY

- a. Precautions shall be taken to protect pipe interiors, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. When pipelaying is not in progress, as, for example, at the close of the day's work, all openings in the pipeline shall be closed by watertight plugs. Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

Note: Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipelaying, the less the delay.

- b. If dirt that, in the opinion of the OWNER's Engineer or job superintendent, will not be removed by the flushing operation (Item D, PRELIMINARY FLUSHING) enters the pipe, the interior of the pipe shall be cleaned and swabbed as necessary, with a five (5) percent hypochlorite disinfecting solution.

2. PACKING MATERIAL AND JOINTS

- a. No contaminated material or any material capable of supporting prolific growth of micro-organisms shall be used for sealing joints. Packing material shall be handled in such a manner as to avoid contamination.
- b. Yarning or packing material for cast iron pipe shall consist of molded or tubular rubber rings, ropes of asbestos or treated paper. Materials such as jute or hemp shall not be used.
- c. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in enclosed containers and shall be kept clean.

- D. PRELIMINARY FLUSHING: The main shall be flushed prior to disinfection, except when the tablet method is used (Item F, METHODS OF CHLORINE APPLICATION, Paragraph (3)). The sites and velocities of flushing shall be as specified in the supplemental specifications.

Note 1: The flushing velocity shall not be less than 2.5 ft/sec. The rate of flow required to produce this velocity in various diameters is shown in Table 2. No site for flushing should be chosen unless it has been determined that drainage is adequate at that site.

Note 2: Flushing is no substitute for preventive measures taken before and during pipelaying (Item C, PREVENTIVE MEASURES DURING CONSTRUCTION). Certain contaminants, especially in caked deposits, resist flushing at any velocity. Furthermore, with diameters of sixteen (16) inches or more, even the minimum flushing velocity of 2.5 ft/sec is sometimes difficult to achieve.

TABLE 2
Required Openings to Flush Pipelines*
(40 psi Residual Pressure)

Hydrant Outlet Nozzles				
Pipe Size In.	Flow required to produce 2.5fps Velocity gpm	Orifice Size In.	Number	Size In.
4	100	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
14	1,200	3-1/4	2	2-1/2
16	1,565	3-5/8	2	2-1/2
18	1,980	4-3/16	2	2-1/2

* With forty (40) psi residual pressure, a 2-1/2-inch hydrant outlet nozzle will discharge approximately 1,000 gpm and a 4-1/2-inch hydrant nozzle will discharge approximately 2,500 gpm.

E. FORM OF CHLORINE FOR DISINFECTION

The most common forms of chlorine used in the disinfecting solutions are liquid chlorine (gas at atmospheric pressure), calcium hypochlorite granules, sodium hypochlorite solutions, and calcium hypochlorite tablets.

1. Liquid Chlorine: Liquid chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical, and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine gas directly from the supply cylinder is unsafe and shall not be permitted.

Note: The preferred equipment consists of a solution feed chlorinator in combination with a booster pump for injecting the chlorine-gas water mixture into the main to be disinfected. Direct feed chlorinators are not recommended because their use is limited to situations where the water pressure is lower than the chlorine cylinder pressure.

2. Hypochlorites

a. Calcium Hypochlorite

- 1) Calcium hypochlorite contains sixty-five (65) percent available chlorine by weight. It is either granular or tabular in form. The tablets, six (6) to eight (8) to the ounce, are designed to dissolve slowly in water (Item F, METHODS OF CHLORINE APPLICATION, Para. (3)). Calcium hypochlorite is packaged in containers of various types and sizes ranging from small plastic bottles to 100-pound drums.
- 2) A chlorine-water solution is prepared by dissolving the granules in water in the proportion requisite for the desired concentration.

b. Sodium Hypochlorite

- 1) Sodium hypochlorite is supplied in strengths from 5.25 to sixteen (16) percent available chlorine. It is packaged in liquid form in glass, rubber, or plastic containers ranging in size from one-quart bottles to five-gallon carboys. It may also be purchased in bulk for delivery by tank truck.
- 2) The chlorine-water solution is prepared by adding hypochlorite to water. Product deterioration must be reckoned with in computing the quantity of sodium hypochlorite required for the desired concentration.

c. Application

The hypochlorite solutions shall be applied to the water main with a gasoline or electrically-powered chemical feed pump designed for feeding chlorine solutions. For small applications the solutions may be fed with a hand pump, for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.

F. Methods of Chlorine Application

1. Continuous Feed Method

- a. This method is suitable for general application.

- 1) Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of fifty (50) milligrams per liter available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals. Note: In the absence of a meter, the rate may be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of known volume.
 - 2) Table 3 below gives the amount of chlorine residual required for each one hundred (100) feet of pipe of various diameters. Solutions of one (1) percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately one pound of calcium hypochlorite in 8.5 gallons of water.
- b. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least twenty-four (24) hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water shall contain no less than ten (10) milligrams per liter chlorine throughout the length of the main.

TABLE 3
Chlorine Required to Produce 50 mg/L Concentration
in 100 Feet of Pipe — by Diameter

Pipe Size in.	100% Chlorine lb.	1% Chlorine Solutions, gal.
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88

2. Slug Method

This method is suitable for use with mains of large diameter for which, because of the volumes of water involved, the continuous feed method is not practical.

- a. Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate (Item F, METHODS OF CHLORINE APPLICATION, Paragraph (1), Note) into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at no less than three hundred (300) milligram per liter. The chlorine shall be applied continuously and for a sufficient period to develop a solid column or “slug” of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least three hundred (300) milligrams per liter for at least three (3) hours. The application shall be checked at a tap near the upstream end of the line by chlorine residual measurements.
 - b. As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated to disinfect appurtenances.
3. Tablet Method: Tablet disinfection is a requirement for short extensions (up to 500 feet) and smaller diameter mains (up to 12 inches). Because the preliminary flushing step must be eliminated, this method shall be used only when scrupulous cleanliness has been exercised. It shall not be used if trench water or foreign material has entered the main or if the water is below 41°F.
 - a. Placement of Tablets
 - 1) Tablets are placed in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. They shall be attached by an adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. All the tablets within the main must be at the top of the main. If the tablets are fastened before the pipe section is placed in the trench, their position should be marked on the section to assure that there will be no rotation. In placing tablets in joints, they are either crushed and placed on the inside annular space, or, if the type of assembly does not permit, they are rubbed like chalk on the butt ends of the sections to coat them with calcium hypochlorite.
 - 2) The adhesive may be Permatex No. 1 (a product of the Permatex Company, Brooklyn, New York, and Kansas City, Kansas) or any alternative approved by the Engineer. There shall be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached.
 - b. Filling and Contact

- 1) When installation has been completed, the main shall be filled with water at a velocity of less than one (1) foot per second. This water shall remain in the pipe for at least twenty-four (24) hours.
- 2) Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

TABLE 4
Number of Hypochlorite tablets of 5-G
Required for dose of 50 M/L*

	Diameter of pipe in inches					
Length of section, Ft.	2	4	6	8	10	12
13 or less	1	1	2	2	3	5
18	1	1	2	3	5	6
20	1	1	2	3	5	7
30	1	2	3	5	7	10
40	1	2	4	6	9	14

* Based on 3-3/4 g available chlorine per tablet.

- G. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than one (1) milligram per liter.
 1. Points of discharge of heavily chlorinated water shall be shown on drawings or designated in Special Provisions. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.
 2. Contractor shall coordinate with Owner to comply with all applicable DEQ permit regulations as set forth in the Contract Documents and as referenced in Specification Section 01041. Contractor may be required to obtain a permit as "applicant" from DEQ for temporary discharge of heavily chlorinated water resulting from disinfection.
- H. Bacteriologic Tests
 1. After final flushing, and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least one sample shall be collected from chlorinated supplies where a chlorine residual is maintained throughout the new main. From

un-chlorinated supplies, at least two samples shall be collected at least twenty-four (24) hours apart.

Note: In the case of extremely long mains, it is desirable that samples be collected the length of the line as well as at its end.

2. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.
- I. Repetition of Procedure: If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. The tablet method cannot be used in these subsequent disinfections. When the samples are satisfactory, the main may be placed in service.
 - J. Procedure after Cutting into or Repairing Existing Mains The procedures outlined in this section apply primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.
 1. Trench "Treatment": When an old line is opened, either by accident or by design, the excavation will likely be wet and badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.
 2. Main Disinfection
 - a. Swabbing and Flushing

The following procedure is considered as a minimum that may be used.
 - b. Swabbing with Hypochlorite Solution: The interior of all pipe and fittings used in making the repair (particularly couplings and tapping sleeves) shall be swabbed with a five (5) percent hypochlorite solution before they are installed.
 - c. Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be

started as soon as the repairs are completed and continued until discolored water is eliminated.

- d. Slug Method: Where practicable, in addition to the procedures of Paragraph (b), SWABBING WITH HYPOCHLORITE SOLUTION, a section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in Item F, METHODS OF CHLORINE APPLICATION, Paragraph (2), SLUG METHOD, except that the dose may be increased to as much as five hundred (500) milligrams per liter, and the contact time reduced to as little as one-half (1/2) hour. After chlorination, flushing shall be resumed and continued until discolored water is eliminated.
3. Sampling: Bacteriologic samples shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be determined. If the direction of flow is unknown, samples shall be taken on each side of the main break.

3.02 DISINFECTING WATER STORAGE FACILITIES

- A. BASIC PROCEDURE: The basic procedure comprises:
 1. Preventing contaminating materials from entering the water mains during construction or repair and removing by flushing materials that may have entered the water main.
 2. Disinfecting any residual contamination that may remain.
 3. Determining the bacteriologic quality by laboratory test after disinfection.
- B. Disinfection of water storage facilities shall be completed in accordance with AWWA C652.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefor.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in

the prices paid for the various contract items and no additional compensation will be allowed therefor.

END OF SECTION

SECTION 02700 — SANITARY SEWER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of construction of sanitary sewer mains, including manholes, service lines, and other appurtenant structures, complete.

1.02 REFERENCES

- A. Where the reference is made to an ASTM, ANSI or AASHTO designation, it shall be the latest revision at the time of call for bids, except as noted on the Drawings or in the Special Provisions.

1.03 QUALITY ASSURANCE

- A. Sewer pipe and fittings furnished under this contract shall be as called out in the Contract Documents. Wye or tee branches shall be of the same material and design as the sewer pipe used. Pipe strength classifications shall be as listed in the Contract Documents.
- B. When required by ENGINEER, CONTRACTOR shall furnish certification by the manufacturer of the pipe to be furnished on this Project, certifying that the pipe and fittings comply with the applicable specifications. Required certification shall accompany each delivery of material.
- C. 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.
- D. Type of joint, class, thickness designation, castings, lining, marking, testing, etc., shall be as specified.
- E. Pipe that has been damaged during shipment or handling, even if previously approved before shipment.

PART 2 PRODUCTS

2.01 MATERIALS

- A. POLYVINYL CHLORIDE (PVC) PIPE
1. PVC Sewer Pipe shall be produced by a continuous extrusion process, employing a prime grade of un-plasticized polyvinyl chloride. The grade used shall be highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents and other

chemicals commonly found in sewage and industrial wastes. The material shall conform to the requirements of ASTM D-1784, "Rigid Polyvinyl Chloride Compounds". The pipe shall have self-extinguishing flammability characteristics.

2. Pipe and fittings shall conform to ASTM D-3034, "Standard Specification for Polyvinyl Chloride Sewer Pipe and Fittings", or ASTM F-679 for sizes over fifteen (15) inches in diameter. PVC pipe shall have a minimum Standard Dimension Ratio (SDR) of 35.
3. Nominal laying lengths shall be not less than 12.5 feet, except shorter lengths may be used adjacent to manholes, lamp holes or other appurtenances. Each length of pipe shall be marked with size, SDR, "Sewer Pipe" and Code Number.
4. Pipe Jointing
 - a. Each length of pipe shall be provided with a bell designed so that a watertight joint will be obtained when jointing the bell and spigot with a rubber ring.
 - b. The rubber gasket joint for PVC pipe and fittings shall consist of a rubber gasket which is compressed between the outer surface of the spigot and the inner surface of a retaining groove in the bell. The joint shall be completely sealed by the gasket so that the assembly will remain watertight under all conditions of service, including movements resulting from expansion, contraction, settlement and deformation of the pipe. The rubber ring joint assembly shall be made in strict accordance with the manufacturer's recommendations.
5. Wye or tee fittings for connecting service lines shall be of the same material, construction and joint design as the main sewer pipe.

B. CONCRETE PIPE

1. Concrete sewer pipe shall conform to ASTM C-14 and/or ASTM C-76, except as noted hereafter. Strength classifications for C-14 and/or C-76 specification pipe shall be as listed in the Contract Documents.
2. The maximum absorption allowed shall be eight (8) percent, as stated in the above ASTM Specification. For pipe sizes smaller than twelve (12) inches in diameter the proportion of Portland Cement in the concrete mixture shall not be less than 6.5 U.S. standard bags (94 pounds per cubic yard) of concrete, and the water cement ratio shall not exceed six (6) gallons per sack of cement.
3. The referenced ASTM specifications list permissible variations in pipe dimensions. They shall be strictly adhered to, and the uniformity of barrel

thickness shall be such that a constant flow area without projections exists across joints.

4. Wye or tee fittings for connecting service lines shall be of the same material, construction and joint design as the main sewer pipe.
5. Joints for concrete pipe shall be made using flexible watertight, rubber-type gaskets conforming to ASTM C-443.
6. The pipe supplier shall furnish ENGINEER with certified test results from an independent testing laboratory on the following: (1) crushing strength using the 3-edge bearing method, (2) absorption, and (3) hydrostatic performance. Test results shall be furnished for each pipe size supplied for this project and the number of tests performed shall be in accordance with ASTM Specification C-14 and/or C-76, or a minimum of two (2) percent of the number of pipe supplied, whichever is greater. Cost of these tests shall be borne by the pipe supplier and/or CONTRACTOR.

C. ACRYLONITRILE BUTADIENE STYRENE (ABS) COMPOSITE SEWER PIPE

1. ABS pipe shall conform in all aspects to ASTM D-2680, "ABS Sewer Pipe and Fittings."
2. Tee or wye fittings for connecting service lines shall be of the same material, construction and joint design as the main sewer pipe. Fittings shall be shop fabricated or molded from materials listed in paragraphs 4 and 5 of ASTM D-2680 and shall be of equivalent quality to those described.
3. All field joints shall be chemically welded. Primer, then cement shall be applied liberally to the outside of the spigot end and the inside of the coupling immediately prior to stabbing the pipe together. Pipe spigot end shall be supplied with home marks to assure proper jointing.
4. When other than full lengths of pipe are laid, the "cut end" of the pipe must be sealed with a sealant provided by the manufacturer of the pipe.

D. VITRIFIED CLAY PIPE (VCP)

1. VCP pipe shall conform to ASTM C-700, and shall be "Extra-Strength".
2. Wye or tee fittings for connecting service lines shall be of the same material, construction and joint design as the main sewer pipe or a method approved by ENGINEER.
3. All field joints shall meet the manufacturer's requirements for the pipe being used and conform to the latest revision of ASTM C-425.

4. In addition to any deficiencies covered by ASTM C-700, clay pipe which has any of the following visual defects will not be accepted:
 - a. Improperly formed pipe such that pipe intended to be straight has an ordinate, measured from the concave side of the pipe, exceeding one-sixteenth (1/16) inch per foot of length.
 - b. Pipe which is sufficiently out-of-round to prohibit proper jointing.
 - c. Improperly formed bell and spigot ends.
 - d. Fractured, cracked, chipped, or otherwise sufficiently damaged pipe which will result in an improperly constructed pipeline.

E. DUCTILE IRON PIPE

1. Ductile iron pipe shall conform in all aspects to the latest revisions of ASTM A 746.
2. Wye or tee fittings for connecting service lines shall be of the same material, construction and joint design as the main sewer pipe or a method approved by ENGINEER.
3. All field joints shall meet the manufacturers' requirement for the brand of pipe being used.

F. CASING PIPE

1. Pipe used to case waterline crossings shall be SDR-26 PVC water pipe or SDR-35 PVC sewer pipe with a minimum diameter of 1.25 times the outside diameter of the carrier pipe.
2. Acceptance of the pipe at point of delivery will not relieve CONTRACTOR of full responsibility for any defects in material or workmanship of the completed pipeline.
3. Casing pipe shall be sealed to prevent the entry or exiting of water to or from the carrier pipe.

G. MANHOLES

1. Manholes shall be constructed of precast concrete rings with frames and covers and steps in accordance with details shown on Standard Drawings No. 02700-01 and 02.
2. All manholes shall be designed to withstand AASHTO HS-20 (MS18) loading.

H. RINGS AND COVERS

1. Rings and covers shall be in accordance with OWNER's Standards. Covers shall be non-ventilated type unless otherwise noted in the Special Provisions.

I. PRECAST CONCRETE RINGS

1. Adjusting rings may be used for adjusting the manhole top elevation to coincide with existing ground elevations, except the total height of adjusting rings used per manhole shall not exceed twelve (12) inches. Adjusting rings shall be reinforced with the same percentage of steel as the riser and top.
2. Precast Concrete rings for manholes shall conform to ASTM C-478, "Precast Reinforced Concrete Manhole Risers and Tops".

J. STEPS

1. When required, noncorrosive steps of rubber encased steel, aluminum, or nylon shall be used. Steps shall withstand vertical loads of four hundred (400) pounds and pull-out resistance of 1,000 pounds.

K. CONCRETE BASE

1. Concrete bases shall be precast or poured in the field on undisturbed earth. Concrete shall conform to Section 03304, PORTLAND CEMENT CONCRETE.

L. GRAVITY SEWER SERVICE MATERIALS

1. Type of joint, class, thickness designation, castings, lining, marking, testing, etc., shall be as required in the Special Provisions.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. RESPONSIBILITY FOR MATERIAL

1. CONTRACTOR shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include furnishing all material and labor required for the replacement of installed material discovered defective prior to final acceptance of the work or during the guarantee period.
2. CONTRACTOR shall be responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.

B. HANDLING OF PIPE

1. All pipe furnished by CONTRACTOR shall be delivered and distributed at the site by CONTRACTOR. Pipe, fittings and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
2. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. The interior of all pipe and other accessories shall be kept free from dirt and foreign matter at all times.
3. Pipe shall be handled so that no coating or lining will be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by CONTRACTOR at his expense in a manner satisfactory to ENGINEER.

C. LAYING PIPE

1. All pipe shall be laid and maintained to the required lines and grades with fittings, tees and manholes at the required locations.
2. CONTRACTOR shall use good workmanship. All pipe shall be properly jointed home, using wood cushion and protective devices in accordance with manufacturer's recommendations.
3. Proper tools and equipment satisfactory to ENGINEER shall be used by CONTRACTOR for the safe and convenient prosecution of the work. All pipe and fittings shall be carefully lowered into the trench in such a manner as to prevent damage to pipe materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.
4. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a plug or other means approved by ENGINEER. CONTRACTOR shall clean and remove all sand, gravel, concrete and cement grout that has entered the lines in the process of construction.
5. The bottom of the trench shall be shaped to fit the bottom quadrant of the pipe, with holes for couplings just large enough to permit their assembly.

D. JOINTS

1. The spigot and bell ends of the pipe and couplings shall be thoroughly cleaned before joint assembly. Jointing of the pipe shall be in strict accordance with the

recommendations of the manufacturer of the pipe and fittings. The correct position of the rubber gaskets and proper assembly of the pipe shall be checked by means of a feeler gauge prior to backfilling of the trench. On larger diameter pipe, which will provide room for workmen inside, all joints shall be visually inspected and gauged inside for proper position of the gasket and joint gap tolerances.

2. The sewers shall be installed within one-quarter ($1/4$) inch for grade and shall not be off more than one-half ($1/2$) inch for alignment. ENGINEER shall specify joint deflection tolerance where acceptable.

E. TOLERANCES

The sewers shall be installed within one-quarter ($1/4$) inch for grade and shall not be off more than one-half ($1/2$) inch for alignment. ENGINEER shall specify joint deflection tolerance where acceptable.

F. SEPARATION OF WATER MAINS AND SEWERS

1. PARALLEL INSTALLATION

- a. NORMAL CONDITIONS - Sanitary sewer mains and manholes shall be laid at least 10 feet horizontally from any water main whenever possible. The distance shall be measured edge-to-edge.
- b. UNUSUAL CONDITIONS - When local conditions prevent a horizontal separation of ten (10) feet as noted above, a sewer main may be laid closer to a water main, provided that:
 - 1) The top of the sewer main is at least eighteen (18) inches below the bottom of the water main;
 - 2) Where eighteen (18) inches vertical separation as noted above cannot be obtained, the sewer main shall be:
 - a) constructed of materials and with joints that are equivalent to water main standards of construction, and tested to assure watertightness prior to backfilling; or
 - b) placed in a separate casing pipe; or
 - c) the trench backfill consists of cement treated backfill in accordance with Section 02225. Cement treated backfill must bear on undisturbed soil.

2. CROSSING

- a. NORMAL CONDITIONS - Sewers crossing water mains shall be laid below the water mains to provide a vertical separation of at least eighteen (18) inches, whenever possible. The distance shall be measured between the bottom of the water main and the top of the sewer.
- b. UNUSUAL CONDITIONS - When local conditions prevent a vertical separation of at least eighteen (18) inches as noted above, the following construction shall be used:
 - 1) The sewer or water main shall be placed in a separate casing pipe; or
 - 2) The sewer line shall be constructed of materials and with joints that are equivalent to water main standards of construction and tested to assure water tightness prior to backfilling;
 - 3) The length of the sewer line constructed to water main standards or the casing pipe shall extend a minimum of nine (9) feet each side of the crossing.
 - 4) Water mains passing under sewer lines shall in addition be protected by providing adequate structural support for the sewer line. Soil structural support shall consist of cement treated backfill in accordance with Section 02225. Cement treated backfill must bear on undisturbed soil.

3.02 MANHOLE INSTALLATION

- A. Manholes shall be constructed to the general dimensions shown. Invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base or may be half-pipe laid in concrete. The floor of the manhole outside the channel shall be smooth and shall slope toward the channel not less than one (1) inch per one (1) foot (8.33%).
- B. Free drop inside the manhole shall not exceed two (2) feet measured from the invert of the inlet pipe to the invert of the outlet pipe. Where the drop exceeds two (2) feet, drop manholes shall be constructed as shown on the typical manhole detail.
- C. All connections between wall sections shall be joined with "Kent Seal" manufactured by K.T. Snyder Company, "Con Seal" or approved equal, in such a manner to make the manhole watertight.

- D. During sewer main construction, manhole installations may not be constructed further than the next approaching manhole from the exposed end of the currently installed pipe.
- E. Pipe to manhole connections shall be resilient connectors which satisfy ASTM C-923 such as PSX Boot by Press - Seal Gasket or Alok Gasket by Alok Products, Inc. or equal.

3.03

SERVICE LINE INSTALLATION

A. GENERAL

- 1. Service lines shall be constructed in accordance with Standard Drawing No. 02700-05. The service line shall be installed to the property line. The end of the service line shall be plugged with an approved stopper or plug. Grouting of plugs will not be permitted.
- 2. Wye or tee fittings shall be installed in the mainline sewer for connection of service lines. Wye or tee fittings shall be of the same material and design and of the same specifications of the sewer main pipe. Jointing of service pipe to wye or tee branches of main line pipe other than PVC, shall be accomplished with special joint adapters manufactured specifically for jointing the two different types of pipe.

B. CROSSING

- 1. NORMAL CONDITIONS - Sanitary sewer service lines crossing water mains shall be laid to provide a vertical separation of at least eighteen (18) inches whenever possible. The distance shall be measured from the top of the lower pipe to the bottom of the upper pipe.
- 2. UNUSUAL CONDITIONS - When local conditions prevent a vertical separation of at least eighteen (18) inches as noted above, the sanitary sewer service line shall be placed in a separate casing pipe, said casing pipe shall extend a minimum of ten (10) feet each side of center of the crossing.

C. EXTENDING SEWER SERVICES INTO PRIVATE PROPERTY

- 1. Unless otherwise provided by local sewer ordinances, the property owners will be permitted to extend sewer services onto their property and connect fixtures thereto, as soon as the main sewer construction has progressed past the point of side sewer construction and leakage tests have been satisfactorily completed, provided the use of the connections will not interfere with the completion of the other parts of the contract work and provided the extension is approved by

ENGINEER. Such sewer service connections shall be allowed only after final inspection and acceptance of main sewer.

D. END PIPE MARKER

The end of newly installed sewer service lines shall be marked by CONTRACTOR at the property line by a post five (5) feet long buried in the ground a distance of three (3) feet, in addition to a 1/2-inch diameter reinforcing bar, eighteen (18) inches in length, buried vertically two (2) inches below the ground surface.

3.04

TESTING

A. LIGHT TEST

After the trench has been backfilled and compacted as specified in Section 02225, TRENCH BACKFILL a light test shall be made between manholes to check alignment and grade for displacement of pipe. Except for curved alignments shown on the Drawings, the completed pipeline shall be such that a true circle of light can be seen from one manhole to the next. If alignment or grade is other than specified and displacement of pipe is found, CONTRACTOR shall remedy such defects at his own expense.

B. T.V. INSPECTION

1. The OWNER may at his option require any or all sewer, sanitary or storm, to be inspected by the use of a television camera before final acceptance. The costs incurred in making the initial inspection shall be borne by the OWNER unless otherwise noted in the Special Provisions.
2. CONTRACTOR shall bear all costs incurred in correcting any deficiencies found during television inspection including the cost of any additional television inspection that may be required by the OWNER to verify the correction of said deficiency.
3. CONTRACTOR shall be responsible for all costs incurred in any television inspection performed solely for the benefit of CONTRACTOR.

C. LEAKAGE TEST

1. New sewer line will not be finally accepted until leakage tests have been made to assure ENGINEER that pipe laying and jointing are satisfactory.
 - a. Water Test
 - 1) Where groundwater is a minimum of two (2) feet above the sewer line, tests shall be made by sealing off the section of lines between manholes

and measuring the infiltration by collecting or pumping the discharge into barrels or other approved methods. Tests shall be continued over a period of at least four (4) hours for each section tested. Sufficient time shall be allowed to soak lines and manholes in advance of performing tests.

2) When groundwater is not above the pipe, testing shall be as follows:

- a) On flat slopes where the depth over the centerline of the pipe in the lower manhole of the section being tested will be not more than ten (10) feet, the upper manhole shall be filled to a depth of two (2) feet over the top of the pipe and the lower manhole blocked. When the above conditions cannot be met, ENGINEER may order CONTRACTOR to test the line in sections between manholes. The leakage shall be measured by checking the drop in water level in the manhole over a period of four (4) hours.
- b) The maximum allowable infiltration or exfiltration, including manholes, shall not exceed two hundred (200) gallons per day per mile of sewer, per inch of pipe diameter. This does not preclude the fact that obvious and concentrated leaks, such as open joints, pinched gaskets, cracked barrels or bells, etc., will not be allowed. CONTRACTOR shall make repairs on concentrated leaks, and as necessary to reduce infiltration or exfiltration leakage below the specified rate, and at his own expense.

b. Air Test (Alternate)

- 1) As an alternate method to water testing, CONTRACTOR may utilize low pressure air as a means of testing the sewer mains. The test procedure shall be as described below:
 - a) Plug both ends of the pipe under test with airtight plugs and brace adequately to prevent slippage and blowout. One plug shall have an inlet tap or other provision for connecting an air hose.
 - b) The air supply hose, connected between the air compressor and the plug, shall have a throttling valve, an air bleed valve, and a high pressure shut-off valve for control. The low pressure side of the throttling valve shall have a tee for a monitoring pressure gauge, protected by a gauge cock. This cock is kept closed except when the pressure loss is being timed.

- c) If the pipeline is submerged under groundwater, the backpressure, caused by the water head, is measured and added to the standard test pressures to compensate for the groundwater effect on the air test.
 - d) Air shall be applied slowly to the pipeline until the pressure reaches 4.0 psig. The air supply shall then be throttled so that the internal pressure is maintained between 4.0 and 3.5 psig for at least two (2) minutes. During this time the plugs shall be checked with soap solution to detect any plug leakage.
 - e) When the pressure reaches exactly 3.5 psig, a stop watch is started and the time recorded for the pressure to drop to 2.5 psig. The minimum time allowed for this pressure drop shall be computed based on an air loss rate of 2.0 cfm or an air loss rate of 0.0030 cfm per square foot of inner pipe surface under test, whichever rate gives the least time for the pressure drop. Should the time of the pressure drop between 3.5 and 2.5 psig be less than the allowable specified time, CONTRACTOR shall make the necessary leakage repairs and repeat the air test.
- 2) Table 1 on the following page provides a Nomograph which may be used to compute testing times for air testing. Air tests shall conform to ASTM C828.
2. Manhole joints shall be checked for leakage by means of water testing as specified above.

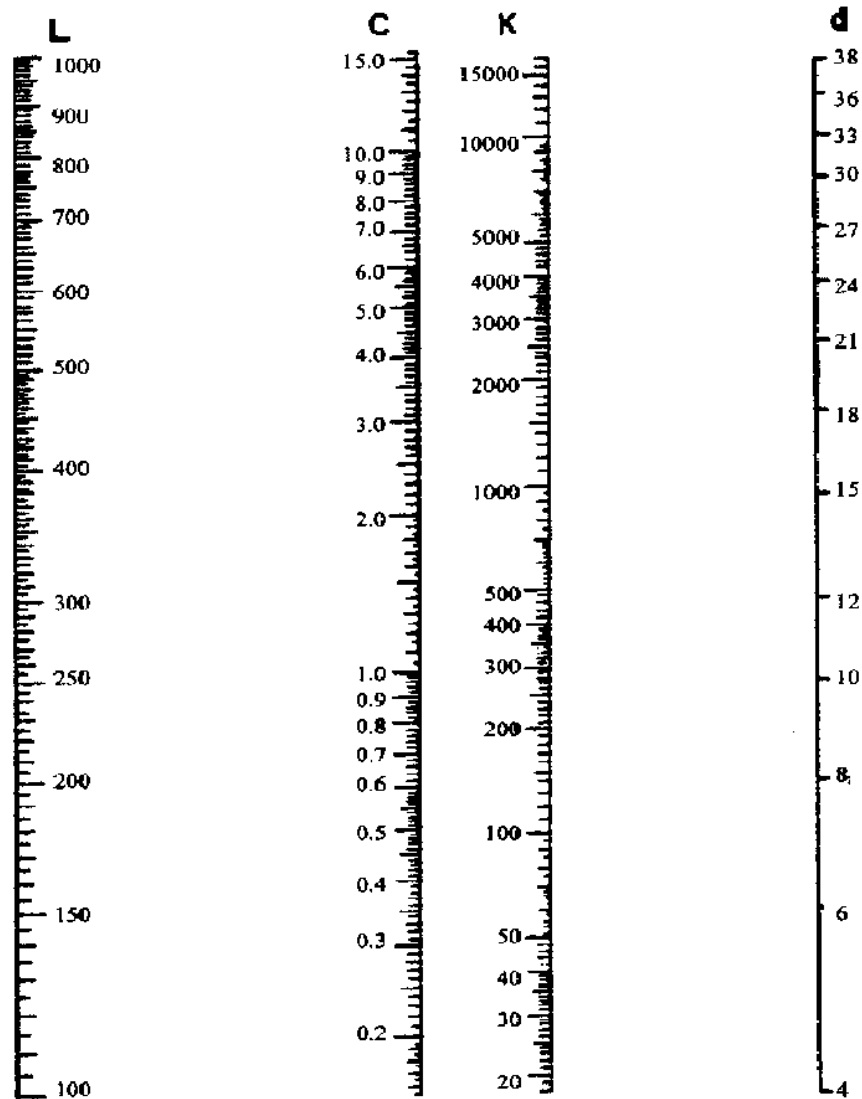


TABLE 1

The nomograph shown on this page may be used to compute the specification time even if several different pipe diameters are included in one test. Draw a straight line connecting the diameter on the 'd' scale with the corresponding length of pipe of that diameter under test on the 'L' scale. Each line will cross the 'K' and 'C' scales. The corresponding values of 'K' and 'C' for each diameter - length combination under test are read and recorded. All the 'K' values are totaled, as are the 'C' values. Total 'K' governs if the total of 'C' is less than 1.0 in which case, total 'K' value equals the time in seconds that the pipeline under test should take before the pressure falls from 3.5 to 2.5 psig. If total 'C' is greater than 1.0, total 'K' is divided by total 'C' to obtain the specification time in seconds.

D. DEFLECTION TESTING

After the pipe has been laid and backfilled, all flexible pipe systems shall be tested for deflection in the presence of ENGINEER. This test shall consist of pulling a mandrel (Go-No Go Device) through the pipe. The maximum deflection allowable shall not exceed five (5) percent of the pipe's internal diameter for final inspection. CONTRACTOR shall conduct the test and shall furnish all necessary test equipment and labor. All pipe sections failing the test shall be removed and replaced at CONTRACTOR's expense.

E. NUMBER OF TESTS

A sufficient number of leakage tests shall be performed to assure ENGINEER that materials and workmanship are acceptable. Defective joints shall be repaired only by use of approved jointing material which is flexible when set and that has a permanent bond to the pipe. Pipe having cracked or broken barrels shall be replaced. The length of sewer line tested per test shall not exceed eight hundred (800) feet.

F. MATERIALS AND EQUIPMENT FOR TESTING

Except as noted in Paragraph B, all labor, equipment and materials (including water) necessary for making the tests of sewer lines shall be furnished by CONTRACTOR.

- G. All tests, except deflection testing as specified under Paragraph D, shall be made after backfill is completed, but prior to any surface restoration or street surfacing. CONTRACTOR shall be responsible for finding and repairing all breaks and leaks revealed by the tests.

PART 4 METHOD OF MEASUREMENT AND BASIS PAYMENT

4.01 METHOD OF MEASUREMENT

A. SEWER MAIN

1. Measurement of sewer mains shall be made in lineal feet of the various sizes and classes, along the centerline of pipe from center to center of manholes.

B. MANHOLES

1. Measurement of manholes shall be made by numerical count each.

C. SERVICE LINES

1. Measurement 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 foot.

4.02

BASIS OF PAYMENT

A. SEWER MAIN

1. Payment for sewer main will be made at the contract unit price bid per lineal foot of the various sizes and classes called for, which price shall include furnishing and installing pipe; trench excavation and backfill, furnishing and placing Type 1 Pipe Bedding; specials required for connection to manholes; testing and all other work necessary or incidental for completion of the item. Trench excavation, backfill, and related work will be paid for under separate items.

B. MANHOLES

1. Payment for manholes will be made at the Contract Unit Price bid each; which price shall include furnishing and installing the manhole and all additional excavation, backfill, manhole ring, and cover required for the installation and completion of the item.

C. SERVICE LINES

1. Payment for sewer services will be made for each of the following bid items as are included in any particular contract:
 - a. Trench excavation and backfill.
 - b. “(Size) (Class) Sewer Service Pipe in Place,” per linear foot.
 - c. Tee or wye (Size) per each.
2. The unit contract prices shall be payment in full for all labor, materials, tools, and other necessary things as may be required to complete the items of work in accordance with the Drawings and the specifications.

END OF SECTION

SECTION 02725 — STORM DRAINING AND CULVERTS

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of construction of drainage culverts and storm drains, including manholes, inlets and other appurtenant structures, complete.

1.02 REFERENCES

- A. Where reference is made to an ASTM, ANSI or AASHTO designation, it shall be the latest revision at the time of call for Bids, except as noted on the Drawings or in the Special Provisions.

1.03 QUALITY ASSURANCE

A. CERTIFICATION BY MANUFACTURER

1. CONTRACTOR shall furnish certification by the manufacturer of the pipe to be furnished on this project, certifying that the pipe complies with the applicable specifications, when required by ENGINEER. Required certification shall accompany each delivery of material.
2. 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.
3. Type of joint, class, thickness designation, casting, lining, marking, testing, etc., shall be specified.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All storm drain and culvert piping shall be as called out in the Contract Documents and shall be in accordance with materials and testing as specified in this section. Pipe sizes and strength classifications shall be as shown on the Drawings and/or as listed in the Special Provisions.

B. CORRUGATED STEEL PIPE

1. Corrugated steel pipe and coupling bands for culverts shall meet the requirements of AASHTO M-36 for the specified sectional dimensions.

C. CONCRETE PIPE

1. Pipe for Storm Drains and Culverts shall be reinforced concrete pipe conforming to ASTM C-76 or non-reinforced concrete pipe conforming to ASTM C-14. Joints for concrete pipe shall be rubber gasket type conforming to ASTM C-443 or as otherwise specified by ENGINEER. Non-reinforced pipe shall use only the ASTM C-443 type joint.

D. CORRUGATED ALUMINUM ALLOY CULVERT PIPE

1. This pipe shall conform to the requirements of AASHTO M-196 and AASHTO M-197.
 - a. Corrugations for pipe designated as 2-2/3 x 1/2 inch shall conform to the requirements of AASHTO M-196.
 - b. Corrugations for pipe designated as three (3) x one (1) inch shall conform to the requirements of AASHTO M-196.

E. HIGH DENSITY POLYETHYLENE (HDPE) PIPE

1. This pipe shall conform to AASHTO M-252 or ASHTO M-294, Specifications for corrugated Polyethylene Pipe three (3) to ten (10) inch and twelve (12) to thirty-six (36) inch respectively.
2. Installation shall be in accordance with ASTM D-2321, Standard Practice for Underground Installation of Thermoplastic Sewer Pipe.

F. MANHOLES

1. Manholes shall be constructed of precast concrete materials with frames and covers in accordance with details shown on the Drawings.

G. RINGS AND COVERS

1. Rings and covers shall be in accordance with OWNER's Standards. Covers shall be non-ventilated type unless called out otherwise on the plans.

H. PRECAST CONCRETE RINGS

1. Adjusting rings may be used for adjusting the manhole top elevation to coincide with existing ground elevations, except the total height of adjusting rings used per manhole shall not exceed twelve (12) inches. Adjusting rings shall be reinforced with the same percentage of steel as the riser and top, and shall be supplied with nonslip lugs to match grooves in the precast manhole top.

2. Precast Concrete Rings for manholes shall conform to ASTM C-478, "Precast Reinforced Concrete Manhole Risers and Tops".

I. STEPS

1. When required, non-corrosive steps of rubber encased steel, aluminum, or nylon shall be used. Steps shall withstand vertical loads of four hundred (400) pounds and pull-out resistance of 1,000 pounds.

J. CONCRETE BASE

1. Concrete bases shall be precast or poured in the field on undisturbed earth. Concrete shall conform to Section 03304, PORTLAND CEMENT CONCRETE.

K. INLETS AND CATCH BASINS

1. Inlet frames and gratings shall be standard cast iron frames and gratings of the design shown on the Drawings or as specified in the Special Provisions.

L. SMOOTH INTERIOR, CORRUGATED POLYETHYLENE PIPE

1. This pipe shall conform to "AASHTO M-294 Type S" and as such shall be acceptable for storm and culvert applications when installed according to manufacturer's specifications.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. RESPONSIBILITY FOR MATERIAL

1. CONTRACTOR shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include furnishing all material and labor required for the replacement of installed material discovered defective prior to final acceptance of the work or during the guarantee period.
2. CONTRACTOR shall be responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.

B. HANDLING OF PIPE

1. All pipe furnished by CONTRACTOR shall be delivered and distributed at the site by CONTRACTOR. Pipe, fittings and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances

shall materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

2. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. The interior of all pipe and other accessories shall be kept free from dirt and foreign matter at all times.
3. Pipe shall be handled so that no coating or lining will be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by CONTRACTOR at his expense in a manner satisfactory to ENGINEER.

C. LAYING PIPE

1. All pipe shall be laid and maintained to the required lines and grades with fittings, tees and manholes at the required locations.
2. Proper tools and equipment satisfactory to ENGINEER shall be used by CONTRACTOR for the safe and convenient prosecution of the work. All pipe and fittings shall be carefully lowered into the trench in such a manner as to prevent damage to pipe materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.
3. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a plug or other means approved by ENGINEER. CONTRACTOR shall clean and remove all sand, gravel, concrete and cement grout that has entered the lines in the process of construction.
4. The bottom of trench shall be shaped to fit the bottom quadrant of the pipe, with holes for joints just large enough to permit assembly.

D. TOLERANCES

The sewers shall be installed within one (1) inch for grade and shall not be off more than two (2) inches for alignment.

E. STORM SEWERS CROSSING WATER MAINS AND SANITARY SEWERS

1. NORMAL CONDITIONS - Storm sewers crossing water mains or sanitary sewer mains shall be laid above or below these mains to provide a vertical separation of at least 18 inches between the bottom of the upper main and the top of the lower main.

2. UNUSUAL CONDITIONS - When local conditions prevent a vertical separation of at least eighteen (18) inches, storm sewer mains passing under or over water mains or sewer mains shall be protected by providing:
 - a. Adequate structural support for the mains to prevent excessive deflection of joints and settling on and breaking the lower main; and
 - b. That the full-length of main be centered at the point of crossing so that the joints will be equidistant and as far as possible from the other main.
 - c. That the water main shall be protected by a suitable casing pipe or other protection.

3.02 MANHOLE INSTALLATION

- A. Manholes shall be constructed to the general dimensions shown. Invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base or may be half-pipe laid in concrete. The floor of the manhole outside the channel shall be smooth and shall slope toward the channel not less than one (1) inch per foot, nor more than two (2) inches per foot.
- B. All connections between wall sections or between sewer pipe and manhole walls shall be joined with a watertight seal.
- C. Manhole construction shall be not greater than one manhole distant behind sewer construction, unless approved by ENGINEER.

3.03 INLETS AND CATCH BASINS

- A. Inlets and catch basins shall be constructed as shown on the Plans for the type designated.
- B. Inlet structures shall be constructed to the line, cross section and dimensions shown. Concrete and reinforcing steel shall conform to Section 03304, PORTLAND CEMENT CONCRETE and Section 03200, CONCRETE REINFORCEMENT. Inlet structures may be precast or cast-in-place.

3.04**TESTING**

A. LIGHT TEST

After the trench has been backfilled, a light test shall be made between manholes to check alignment and grade for displacement of pipe. Except for curved alignments shown on the plans, the completed pipeline shall be such that a true circle of light can be seen from one manhole to the next. If alignment or grade is other than specified and displacement of pipe is found, CONTRACTOR shall remedy such defects at his own expense.

B. LEAKAGE TEST

Unless specified in the Special Provisions, a leakage test will not be required. However, this does not preclude the fact that obvious and concentrated leaks (such as open joints, pinched gaskets, cracked barrels or bells, etc.) will not be allowed.

PART 4**METHOD OF MEASUREMENT AND BASIS OF PAYMENT****4.01****METHOD OF MEASUREMENT**

- A. Measurement of storm drain pipe shall be made in lineal feet of the various sizes and classes along the centerline of pipe from center to center of manholes, or center of inlet to center of manhole.
- B. Measurement of culvert piping shall be made in lineal feet of the various sizes and classes, along the centerline of pipe for the length of pipe installed.
- C. Storm Drain Inlets shall be measured by the number of drain inlets installed, complete in place.
- D. Measurement of manholes shall be made by numerical count each.

4.02**BASIS OF PAYMENT**

- A. The following items shall constitute pay items for the work covered under this Section of the Specifications. Payment for these items shall be full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.
- B. Payment for storm drain pipe will be made at the contract unit price bid per lineal foot of the various sizes and classes called for, which price shall include furnishing and installing pipe; furnishing and placing Type 1 pipe bedding; specials required for connection to manholes and inlets; testing and all other work necessary or incidental for completion of the item.

- C. Payment for culvert piping will be made at the contract unit price per lineal foot, which price shall include furnishing and installing pipe, including any specials and all other work necessary or incidental for completion of the item. Flared end sections shall be paid for at unit price bid per each.
- D. Payment for manholes will be made at the Contract Unit Price bid each; price shall include foundation, manhole, ring, cover, ladder steps, backfill, and cover necessary for the installation and completion of item.

END OF SECTION

SECTION 02731 — PRESSURE SEWER LINES AND FORCE MAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe and fittings for pressure sewer lines, raw water lines, and force mains.
- B. Valves, thrust blocks, and anchor blocks.

1.02 RELATED SECTIONS

- A. Apply other sections of specifications to the extent required for proper performance of this work.
- B. Section 02207 - Aggregate Materials.
- C. Section 02225 - Trenching.
- D. Section 02732 - Gravity Sanitary Sewerage Systems.
- E. Section 03419 - Structural Precast Concrete Units.
- F. Section 03315 - Non-Structural Concrete.
- G. Section 09940 - Painting.

1.03 REFERENCES

- A. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other liquids.
- B. ANSI/AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other liquids.
- C. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
- D. ANSI/AWWA C115 - Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
- E. ANSI/AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings.
- F. ANSI/AWWA C150 - Thickness Design of Ductile-Iron Pipe.
- G. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.

- H. ANSI/AWWA C153 - Ductile Iron Compact Fittings, 3-inch through 16-inch, for Water and Other Liquids.
- I. ANSI/AWWA C219 - Bolted, Sleeve-type Couplings for Plain-end Pipe.
- J. ANSI/AWWA C500 - Gate Valves, 3 through 48 inch NPS, for Water and Sewage Systems.
- K. ANSI/AWWA C 504 - Rubber Seated Butterfly Valves.
- L. ANSI/AWWA C508 - Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
- M. ANSI/AWWA C509 - Resilient Seated Gate Valves, 3-inch through 12-inch NPS, for Water and Sewage Systems.
- N. ANSI/AWWA C520 – Knife Gate Valves, Sizes 2 inch through 96 inch.
- O. ANSI/AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
- P. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
- Q. ANSI/AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- R. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.
- S. ANSI/AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, ½ inch (13 mm) through 3 inch (76 mm), for Water Service.
- T. ANSI/AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 inch through 48 inch (350 mm through 1200 mm), for Water Transmission and Distribution.
- U. ANSI/AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 inch (100 mm) through 63 inch (1575 mm), for Water Distribution and Transmission.
- V. ANSI/AWWA C907 – Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings - 4-inch through 12-inch.
- W. ASTM D1599 - Test Method for Short Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings.
- X. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- Y. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

- Z. ASTM D2774 - Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
- AA. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- BB. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
- CC. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- DD. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- EE. ASTM F2164 Standard Practice for Field Leak Testing of Polyethylene (PE) and Cross linked Polyethylene (PEX) Pressure Pipe Systems Using Hydrostatic Pressure

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Manufacturer's Certificate: Certify that pipe manufacturer is familiar with service requirements, specifications, and installation methods and that the pipe supplied will perform satisfactorily.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Accurately record actual locations of piping mains, valves, and connections.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.

PART 2 PRODUCTS

2.01 PIPE

- A. Ductile Iron Pipe:
 - 1. Pipe:
 - a. ANSI/AWWA C 115, C 116 - Epoxy Lined, and C 151; flanged or mechanical joint, epoxy lined, or alternatives as shown on drawings.
 - b. MJ or Flanged joints.

2. Fittings:
 - a. ANSI/AWWA C 110 Ductile iron, standard thickness, flanged or mechanical joint, epoxy lined, or alternatives shown on drawings.
 - b. ANSI/AWWA C 153 Ductile iron, standard thickness, mechanical joint, epoxy lined, or alternatives shown on drawings.
 3. Pipe Joints: ANSI/AWWA C 111, rubber gasket.
 4. Jackets: ANSI/AWWA C 105, polyethylene encasement.
 5. Couplings: ANSI/AWWA C 219, Ductile Iron, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
 6. Epoxy Lining for DIP shall be two-component epoxy lining system for sewage, such as coal tar epoxy, which combines corrosion resistant characteristics of coal tar pitch with those of epoxy resin. Epoxy lining shall be factory applied.
- B. PVC Pipe (4-inch dia. and larger):
1. Pipe: ANSI/AWWA C 900, C 905.
 2. Fittings:
 - a. ANSI/AWWA C 110-Ductile iron, standard thickness, mechanical joint, epoxy lined, or alternatives shown on drawings.
 - b. ANSI/AWWA C 153 Ductile iron, standard thickness, mechanical joint, epoxy lined, or alternatives shown on drawings.
 3. Pipe Joints: ASTM D 3139 compression gasket ring.
 4. Trace Wire: Insulated ten (10) gage copper, suitable for direct bury.
 5. Burial Ribbon: 3-inch wide, 4-mil thickness, low-density polyethylene plastic film, blue with "SEWER" printed in black letters, suitable for direct bury.
- C. PVC Pipe (smaller than 4-inch dia.):
1. Pipe: ASTM D 2241, ASTM 1784, Grade 1 (12454-B)
Pressure Rating:

<u>System Design Pressure Class</u>	vs.	<u>De-rated PVC</u>
for Class 100 psi use		Class 160 psi SDR 26
for Class 150 psi use		Class 200 psi SDR 21

for Class 200 psi use

Class 250 psi SDR 17

2. Fittings:

- a. ANSI/AWWA C 110-Ductile iron, standard thickness, mechanical joint, epoxy lined, or alternatives shown on drawings.
- b. ANSI/AWWA C 153 Ductile iron, standard thickness, mechanical joint, epoxy lined, or alternatives shown on drawings.
- c. One piece.
- d. Class 200.

3. Pipe Joints: ASTM D 3139 compression gasket ring.

4. Trace Wire: Insulated ten (10) gage copper suitable for direct bury.

5. Burial Ribbon: 3-inch wide, 4-mil thickness, low-density polyethylene plastic film, blue with "SEWER" printed in black letters, suitable for direct bury.

D. Polyethylene Pipe (4-inch dia. and larger):

- 1. ANSI/AWWA C 906, Table 3 for 4" diameter.
- 2. Iron Pipe Size.
- 3. Trace Wire: Insulated ten (10) gage copper, suitable for direct bury.
- 4. Burial Ribbon: 3-inch wide, 4-mil thickness, low-density polyethylene plastic film, blue with "SEWER" printed in black letters, suitable for direct bury.

E. Polyethylene Pipe (2-inch and 3-inch dia.):

- 1. ANSI/AWWA C 901, Table 5.
- 2. Iron Pipe Size (IPS).
- 3. Trace Wire: Insulated 10 gage copper, suitable for direct bury.
- 4. Burial Ribbon: 3-inch wide, 4-mil thickness, low-density polyethylene plastic film, blue with "SEWER" printed in black letters, suitable for direct bury.

F. Polyethylene Pipe (smaller than 2-inch dia.):

- 1. ANSI/AWWA C 901, Table 7.
- 2. Copper Tubing O.D. (CTS).

3. Trace Wire: Insulated ten (10) gage copper, suitable for direct bury.
 4. Burial Ribbon: 3-inch wide, 4-mil thickness, low-density polyethylene plastic film, blue with "SEWER" printed in black letters, suitable for direct bury.
- G. Class of Pipe: As shown on drawings.
- H. Joints: As shown on drawings.
- I. Insulation:
1. Field applied 1-inch foam.
 2. Suitable for buried service.
 3. Continuous over all pipe and fittings.

2.02

GATE VALVES

- A. Cast iron body, bronze mounted, resilient-wedge, non-rising stem, open counter clockwise.
- B. Stem seals: Double "O" ring designed so that seal above stem collar can be replaced with valve under pressure in full open position.
- C. 2-inch valves: Conform to ANSI/AWWA C 500 or C 509, as approved by ENGINEER.
- D. 3-inch through 20-inch valves: Conform to ANSI/AWWA C 509.
- E. Valves for underground, direct-bury installation:
 1. Mechanical joint ends with transition gaskets if necessary to allow connection to pipe.
 2. Furnish with 2-inch square wrench nut for key operation.
 3. Furnish with valve box.
 4. If bury depth is over six (6) feet, provide bolt-on extension stem to raise wrench nut to within 1.5 feet of ground surface.
 5. Provide one (1) tee-operating wrench five (5) feet long.
- F. Valves for inside installation:
 1. Flanged ends.
 2. Handwheel operator unless shown otherwise on drawings.

- 3. Actuators as shown on drawings.
- G. Epoxy polyamide interior coating conforming to AWWA C 550, 8-mil.
- H. Buried valves - 8-mil coal-tar epoxy exterior coating.

2.03

AWWA BUTTERFLY VALVES - BURIED OR VAULT SERVICE

- A. Cast Iron body ASTM A 126, Class B with ANSI B 16.1 flange drilling.
- B. Conform to AWWA C 504.
- C. Aluminum bronze, ASTM A 148-952, or ductile iron, ASTM A 536, Grade 65-45-12, disc with 316 SS or monel edge.
- D. SS 18-8 series one piece shaft connected to disc with torque plug.
- E. Field replaceable synthetic rubber valve seats located on body only. ASTM D 429, method B.
- F. Self-lubricating, corrosion-resistant, sleeve type bearings designed for vertical and horizontal shaft loadings.
- G. Self-adjusting packing, replaceable without removing actuator.
- H. Leak tested and proof of compliance with AWWA C 504, Section 5.5.
- I. Valves for underground, direct-bury installation:
 - 1. Mechanical joint ends with transition gaskets if necessary to allow connection to pipe.
 - 2. Furnish with 2-inch square wrench nut for key operation.
 - 3. Furnish with valve box.
 - 4. If bury depth is over six (6) feet, provide bolt-on extension stem to raise wrench nut to within 1.5 feet of ground surface.
 - 5. Provide one (1) tee-operating wrench five (5) feet long.
- J. Valves for inside installation:
 - 1. Flanged ends.
 - 2. Actuators as shown on drawings.
- K. Epoxy polyamide interior coating conforming to AWWA C550, 8-mil.

- L. Buried valves - 8 mil coal-tar epoxy exterior coating.

2.04 LUGGED BUTTERFLY VALVES - SERVICE INSIDE BUILDINGS

- A. MSS SP-67, rated at one hundred seventy-five (175) psi fully-lugged, cast iron body conforming to ASTM A 126, Class B.
- B. Field replaceable EPDM seats.
- C. Aluminum bronze disc.
- D. One piece stainless steel stem.
- E. Upper and lower SS lined reinforced Teflon inboard stem bearings and bi-directional stem packing.
- F. Actuators as shown on drawings.
- G. Factory leak tested to one hundred ninety-five (195) psi.
- H. Epoxy polyamide interior coating conforming to AWWA C550, 8-mil.
- I. Keystone Figure AR2 or equal.

2.05 PLUG VALVES

- A. Full round opening permanently lubricated plug type, rubber seat with no obstructions to flow.
- B. Wall thickness in compliance with AWWA C504.
- C. Cast iron body, ASTM A 126, Class B.
- D. Flanged ANSI, Class 125, ANSI B16.1.
- E. SS bearings, top and bottom, permanently lubricated.
- F. Balanced plug, ASTM A-126, Class B or ASTM A-436 (Ni-Resist) or ductile iron ASTM A 536.
- G. Epoxy polyamide interior coating conforming to AWWA C 550, 8-mil.
- H. Buried valves – 8-mil coal-tar epoxy exterior coating.
- I. Welded nickel seat.
- J. 150-pound valve rating.

- K. Self-adjusting, wear compensating, packing replaceable without removing bonnet or plug.
- L. Actuator fully isolated from line media.
- M. Leak tested.

2.06 AWWA CHECK VALVES - VAULT SERVICE

- A. Conform to ANSI/AWWA C 508.
- B. Cast iron body.
- C. Outside lever arm and counter weight.
- D. Flanged ANSI, Class 125.
- E. Epoxy polyamide interior coating conforming to AWWA C 550, 8-mil.

2.07 WAFER CHECK VALVES - SERVICE INSIDE BUILDINGS

- A. External spring.
- B. Rating - 125 pound ANSI.
- C. Cast iron body, ASTM A 126, Class B.
- D. 316 SS disc and arm.
- E. Bronze bushings.
- F. EPDM seat.
- G. 316 SS spring.
- H. EPDM shaft seal.

2.08 VALVE BOXES

- A. Cast iron, 5-1/4 inches diameter.
- B. Adjustable screw type of sufficient length for pipe bury required.
- C. Cast iron cover with arrow indicating direction of opening.

2.09 DIAPHRAGM VALVES

- A. Flanged cast iron, ASTM A 126.
- B. Straightway body, full uniform port.

- C. Liner: Neoprene rubber.
- D. Bonnet: Ductile iron, ASTM A 395.
- E. Diaphragm: Natural rubber.

2.10 VALVE ACTUATORS

- A. Electric Actuators for Diaphragm Valves:
 - 1. Limitorque L 120-10.
 - 2. Three (3) phase, 208 Volt.
 - 3. Mounted and tested.
 - 4. Controller: Keystone LC-2, 4-20 mA input, 4-20 mA output, self-tuning option. control module.
 - 5. Gear Operators - Manufacturer's standard.
- B. Lever Operators - Manufacturer's standard.

2.11 JOINT RETAINERS

- A. Manufacturers: EBAA Iron Sales, Inc. Series 1600 Restraint Harness or 2000 PV Mechanical Joint Restraint or approved equal.
- B. Cast from ductile iron.
- C. Provide a sufficient number of ductile tie bolts to restrain working and test pressures.

2.12 FROST PROTECTION

- A. Comply with details shown on drawings.
- B. 2-inch thick rigid Styrofoam insulation board ("Blue Board").

2.13 ACCESSORIES

- A. Concrete for Thrust Blocks, Anchor Blocks, and Gate Valve Surface Pads: Class B.
- B. Polyethylene Wrap – 8-mil minimum thickness.

2.14 PIPE EMBEDMENT MATERIAL

- A. As specified in Section 02207 - Aggregate and Backfill Materials.

B. Bedding and Haunching Material:

1. Type A, B, or C, for HDPE and DIP, unless otherwise indicated on
2. Drawings.
3. Type C, for PVC and PVCO, or as approved by ENGINEER.

C. Initial Backfill Material:

1. Type A, unless otherwise indicated on Drawings.

PART 3 EXECUTION

3.01 PREPARATION

A. Excavate trench in accordance with Section 02225.

B. Remove scale and dirt on inside of pipe before assembly.

3.02 SEPARATION REQUIREMENTS OF POTABLE WATER LINES AND SEWERS, STORM DRAINS, OR IRRIGATION LINES

A. Definitions:

1. Separation requirements shall apply to sanitary sewer lines, storm drains (storm sewers), raw water, and irrigation lines and manholes or structures associated with these lines.
2. Within this section, "sewer line" shall mean any of the lines listed above and "sewer manhole" shall mean any of the structures associated with the lines listed above.

B. Parallel Installation:

1. Lay water lines at least ten (10) feet horizontally from any sewer line measured edge to edge of pipe.
2. No water lines shall pass through or come into contact with any part of a sewer manhole.
3. When a horizontal separation of ten (10) feet is not possible, maintain bottom of water line at least eighteen (18) inches above the top of the sewer line.
4. When horizontal separation of ten (10) feet and vertical separation of eighteen (18) inches is not possible, use one of the following methods:

- a. Construct sewer line of materials and with joints that are equivalent to water main standards of construction and pressure test prior to backfilling.
- b. Place water or sewer line in a separate casing pipe. Provide adequate structural support for casing to prevent settling and deflection of joints.
- c. Use cement-treated backfill as outlined below.

C. Water Line Crossing Above Sewer Line:

- 1. Maintain vertical separation of at least eighteen (18) inches between bottom of water line and the top of sewer line.
- 2. If a vertical separation of eighteen (18) inches is not possible, use one of the following methods:
 - a. Place sewer line in a separate casing pipe. Joints in sewers at crossing shall be located at least ten (10) feet from water lines.
 - b. Use cement-treated backfill as outlined below.

D. Water Line Crossing Below Sewer Line:

- 1. Use one of the following methods:
 - a. Place sewer line in a separate casing pipe. Provide adequate structural support for casing to prevent settling and deflection of joints. Center the length of sewer pipe at point of crossing, so that joints will be equal distance and as far as possible from water line.
 - b. Use cement-treated backfill as outlined below.

E. Cement-treated Backfill:

- 1. Place cement-treated backfill, in lieu of pipe casing specified in Paragraphs B, C, and D, if approved by ENGINEER.
- 2. Place cement-treated backfill on undisturbed trench bottom and extend to two (2) inches above upper utility for ten (10) feet on each side of the pipe intersection.
- 3. Cement-treated backfill to conform to Section 02207.
- 4. Place cement-treated backfill as appropriate to maintain utility lines and grade.

3.03

PIPE EMBEDMENT

- A. Place pipe embedment material in accordance with Section 02225.

3.04**PIPE**

- A. Install pipe to provide depth of cover indicated on drawings.
- B. Install PVC Pipe to ANSI/AWWA C 605.
- C. Install HDPE Pipe to ASTM D 2774.
- D. Install ductile iron piping and fittings to ANSI/AWWA C 600.
- E. Route pipe in straight line unless indicated otherwise on drawings.
- F. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- G. Form and place concrete for thrust blocks at each fitting, or install joint retainers as indicated on drawings.
- H. Backfill trench in accordance with Section 02225.
- I. Install piping to conserve building space and not interfere with use of space.
- J. Provide access to valves and fittings.
- K. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09900.
- M. Install valve upright or horizontal, not inverted.
- N. Install pipe supports as indicated on drawings.
- O. Set buried valves on solid bearing.
- P. Center and plumb valve box over valve. Set box cover flush with grade.
- Q. Conform to manufacturer's recommendations for installing pipe, valves and fittings.

3.05**PIPE INSTALLED FROM TOP OF TRENCH: PIPE MAY BE JOINTED ON THE TRENCH BANK AND LOWERED INTO THE TRENCH, IF THE FOLLOWING REQUIREMENTS ARE MET:**

- A. Comply with Parts 3.3 and 3.4.
- B. Use equipment capable of centering pipe over trench as it is being lowered into place to prevent pipe from contacting trench wall.

- C. Maintain the string of pipe being handled under sufficient compressive force to prevent joints from separating.
- D. Use “free-flowing” pipe embedment material.

3.06 TRACE WIRE

- A. Place in trench on top of all non-metallic piping.
- B. Underground Connections:
 - 1. Use crimp connector with copper sleeve joint.
 - 2. Tape or cover to maintain integrity of insulation.
- C. Provide continuity between terminals.
- D. Install terminal at all manholes, air/vac valves, clean-outs, and at intermediate locations along pipeline to provide maximum spacing between terminals of 2,000 feet.

3.07 BURIAL RIBBON

- A. Place on trench backfill two (2) feet above top of pipe, for all force main locations.

3.08 VALVES

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade. Pour concrete surface pad flush with finished grade.
- C. Wrap with polyethylene.
- D. Form and place concrete and rebar for anchor blocks at each valve.

3.09 FITTINGS

- A. Conform to Manufacturer's recommendations.
- B. Wrap cast iron or ductile iron fittings in polyethylene.
- C. Form and pour concrete for thrust blocks at each fitting.

3.10 THRUST BLOCKS

- A. Dampen soil or place polyethylene in trench.
- B. Pour thrust block.

- C. Cover thrust block with polyethylene.
- D. For Immediate Backfilling:
 - 1. After thirty (30) minutes, carefully place 1.5 feet of backfill without distorting concrete.
 - 2. Complete backfill and compaction within sixty (60) minutes of starting thrust block placement.

3.11 HYDROSTATIC TESTING

- A. Pressure Test: After pipe has been laid, subject all pipe or any valved section thereof to a hydrostatic pressure test.
 - 1. Test Pressure Restrictions:
 - a. Be not less than 1.25 times the system maximum working pressure at the highest point in the test section.
 - b. Not to exceed pipe or thrust restraint design pressures or pipe pressure class.
 - c. Not to exceed twice the rated pressure of valve or hydrants when they form the boundary of the test section.
 - d. Not to exceed the rated pressure of resilient-seated gate valves when they form boundary of test section.
 - 2. Air Removal:
 - a. Before applying test pressure, expel all air from test section.
 - b. If permanent air vents are not located at all high points, install corporation stops to vent the air.
 - 3. Pressurization:
 - a. Slowly fill each valved section of pipe with water.
 - b. The test pressure shall not be less than 1.25 the designed maximum working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the sustained working pressure at the lowest elevation of the test section.
 - c. Maintain test pressure for a minimum of two hours.

- d. Examine all exposed pipe, fittings, valves, hydrants, and joints and correct any visible leakage.
- e. A pressure loss of more than five (5) psi constitutes failure of the test. Make necessary repairs and retest at no cost to Owner.

B. Leakage Test:

- 1. Conduct concurrently with pressure test.
- 2. Leakage Defined: The quantity of water that must be supplied to a valved section of pipe to maintain pressure within five (5) psi of specified test pressure.
- 3. Allowable Leakage – From AWWA C600 and C905: Not to exceed that determined by the following formula:

$$L = \frac{S * D * P^{0.5}}{148000}$$

L = Allowable leakage, in gallons per hour

S = Length of pipeline tested, in feet

D = Nominal pipe diameter, in inches

P = Average test pressure, in pounds per square inch (psi) gage

3.12 HYDROSTATIC TESTING - POLYETHYLENE PIPE

- A. Bleed off any trapped air and then raise the hydrostatic pressure to a pressure that is 1.5 times the system maximum working pressure at the highest elevation in the test section. Do not exceed the rated pressure of gate valves when they form boundary of test section.
- B. To compensate for initial expansion of the pipe under test, add sufficient makeup water to the system at hourly intervals for three (3) hours to return to the test pressure.
- C. Four (4) hours after initial pressurization, begin actual pressure test. Run test for three (3) hours.
- D. Re-pressure line as often as needed to maintain pressure within five (5) psi of specified test pressure.
- E. If the amount of makeup water exceeds that amount as determined by equation under Section 02731, Part 3.11 B. 3. plus the allowance for expansion, the test failed. Make necessary repairs and retest.
- F. Allowance for expansion, U.S. Gallons/100 feet of pipe according to ASTM 2164:

Nominal Pipe Dia. Inches	1-Hour Test	2-Hour Test	3-Hour Test
2	0.05	0.10	0.15
3	0.10	0.15	0.20
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.00	1.50
10	0.70	1.30	2.10
12	1.10	2.30	3.40
14	1.40	2.80	4.20
16	1.70	3.30	5.00
18	2.00	4.30	6.50

- G. If the test is not completed in 8 hours, allow the test section to "relax" for eight (8) hours before retesting.

PART 4 METHOD OF MEASUREMENT AND BASIS PAYMENT

4.01 METHOD OF MEASUREMENT

A. FORCE MAIN

1. Measurement of force mains shall be made in lineal feet of the various sizes and classes, along the centerline of pipe through all valves, fittings, and appurtenances.

B. VALVES

1. Measurement of force main valves shall be made by numerical count of the sizes and types of valves listed in the Proposal.

C. FITTINGS

1. Measurement of force main fittings will be by numerical count of the various types and sizes listed in the Proposal.

D. THRUST BLOCKS

1. Measurement of valve thrust blocks shall be made by numerical count of each size type listed in the bid schedule actually installed.

E. PIPE INSULATION

1. Measurement of pipe insulation shall be made in linear feet along the centerline of the installed insulation.

4.02 BASIS OF PAYMENT

A. FORCE MAIN

1. Payment for force main will be made at the contract unit price bid per lineal foot of the various sizes and classes called for, which price shall include furnishing and installing pipe; furnishing and placing bedding; testing and all other work necessary or incidental for completion of the item. Trench excavation, backfill, and related work will be paid for under separate items.

B. VALVES

1. Payment for force main valves will be made at the Contract Unit Price bid each; which price shall include furnishing and installing the valve and valve box, all additional excavation, backfill, and special compaction required for the installation, and all other work necessary or incidental for completion of the item.

C. FITTINGS

1. Payment for fittings will be made at the contract unit price bid for each fitting, which price shall include furnishing and installing the fittings as required, thrust blocking and any other work necessary or incidental for completion of the item.

D. THRUST BLOCKS

1. Payment for this item will be made at the Contract Unit Price bid each; which price shall include all additional excavation, installation (including all bolts, strapping and concrete), backfill and compaction.

E. PIPE INSULATION

1. Payment for pipe insulation will be made at the contract unit price per linear feet of insulation, which price shall constitute full compensation for furnishing all labor, equipment, material, transportation, and incidentals necessary to install the pipe insulation as described herein and shown on the drawings.

END OF SECTION

SECTION 02776 —CONCRETE SIDEWALKS, DRIVEWAY APPROACHES, CURB TURN FILLETS, VALLEY GUTTERS AND MISCELLANEOUS NEW CONCRETE CONSTRUCTION

PART 1 GENERAL

1.01 SUMMARY

- A. Concrete sidewalk and driveway approaches, curb turn fillets, valley gutters, new monument boxes and other miscellaneous new concrete construction shall consist of air-entrained Portland Cement Concrete constructed in accordance with these specifications. This work shall be in reasonably close conformity with the lines and grades, thicknesses, and typical cross sections shown on the plans or established by the ENGINEER. See Standard Drawing No. 02776-01.

PART 2 PRODUCTS

2.01 MATERIALS

- A. PORTLAND CEMENT CONCRETE - Air-entrained Portland Cement Concrete shall conform to the requirements of Section 03304, PORTLAND CEMENT CONCRETE. Except for sidewalks, all items shall be Class 4000.
- B. REINFORCING STEEL - Reinforcing steel shall conform to the requirements of Section 03200, CONCRETE REINFORCEMENT.
- C. PREFORMED EXPANSION JOINT MATERIAL - Joint material shall comply with the requirements of AASHTO M-213, ASTM D-994, ASTM D-1751, or ASTM D-1752.

PART 3 EXECUTION

3.01 GENERAL

- A. Sidewalks and driveway approaches, either new or replacement, valley gutters and curb turn fillets shall be constructed at the locations shown on the plans and where directed by the ENGINEER, and shall be in accordance with these specifications and plans.
- B. The quantity of driveway approaches, concrete driveway replacement and concrete sidewalk replacement shown in the Proposal is an estimate and may be increased or decreased without an adjustment in unit prices as these items shall be considered "minor items."

3.02 SUBGRADE AND BASE COARSE PREPARATION

- A. The subgrade shall be excavated or filled with suitable material to the required grades and lines.
- B. All soft, yielding and otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted and extended a minimum of 1 foot outside the form lines.
- C. The subgrade shall be ninety-five (95) percent of maximum dry density as determined by AASHTO T-180 Modified Proctor Density.
- D. When required on the plans base course will be installed to the required grade in accordance with Section 02231.

3.03 ERECTING FORMS

- A. Forms, wood or steel, shall be staked securely in place, true to line and grade.
- B. 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.
- C. Forms shall be clean and well-oiled prior to setting in place.
- D. When set, the top of the form shall not depart from grade more than 1/4 inch when checked with a 10-foot straightedge. The alignment shall not vary more than 1/2 inch in ten (10) feet.
- E. 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.

3.04 PLACING AND FINISHING CONCRETE

- A. The subgrade or base course shall be properly compacted and brought to specified grade before placing concrete.
- B. The subgrade or base course shall be thoroughly dampened immediately prior to the placement of the concrete.
- C. Concrete shall be spaded and tamped thoroughly into the forms to provide a dense, compacted concrete free of rock pockets.
- D. The exposed surfaces shall be floated, finished and broomed.
 - 1. The surface of concrete shall be finished true to the lines and grades shown on the plans.

2. Concrete shall be worked until the coarse aggregate is forced down into the body of the concrete and no coarse aggregate is exposed. The surface shall then be floated with a wooden float to a smooth and uniform surface.
 3. When the concrete has hardened sufficiently, the surface shall be given a broom finish. The broom shall be of an approved type. The strokes shall be square across the concrete from edge to edge with adjacent strokes overlapped. Strokes shall be made without tearing the concrete. The broomed finish shall produce regular corrugations not over 1/8 inch in depth.
 4. Concrete that is adjacent to forms and formed joints shall be edged with a suitable edging tool to the dimensions shown on the plans.
- E. 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.

3.05 STRIPPING FORMS

- A. Forms may be removed at such time as the concrete is sufficiently set that removal will be without danger of chipping or spalling.
1. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with curing compound.
 2. All forms shall be cleaned, oiled and be examined for defects before they are used again.

3.06 PROTECTION

- A. The CONTRACTOR shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper or plastic sheeting.
- B. When concrete is being placed in cold weather and temperature may be expected to drop below 35°F, suitable protection shall be provided to keep the concrete from freezing until it is at least seventy-two (72) hours old. Concrete damaged by freezing shall be removed and replaced at the CONTRACTOR'S expense.

3.07 CURING

- A. Curing shall be in accordance with Section 03370, CONCRETE CURING.

3.08 JOINTS

- A. Preformed Expansion Joints shall be installed at the locations shown in the standard details.
- B. Contraction joints shall be provided between expansion joints at the intervals noted in the standard details. Joints in new construction shall match joints in adjacent existing concrete.

3.09 BACKFILL

- A. In areas where lawns exist or as shown on the plans, the top four (4) inches of backfill bringing its level up to the top of the sidewalk or driveway shall be black loam or good topsoil which is suitable for the growth of lawns.
 - 1. It shall be placed out from the sidewalk or driveway a sufficient distance and in amount to replace turf or lawn removed during installation.
 - 2. Backfill shall be completed by grading to match the existing lawn.
- B. Where lawns do not exist, the top four (4) inches of backfill shall be impervious dirt and shall be placed to conform to the typical sections shown on the plans.
- C. Backfill shall be compacted to a density equal to the adjacent materials. It shall be leveled off to a neat and free draining surface.

3.10 TOLERANCES

- A. The work shall be performed in a manner which results in the item being constructed true to line and grade, uniform in appearance and structurally sound.
- B. Items found with unsightly bulges, ridges, low spots or other defects shall be removed and replaced at the CONTRACTOR's expense if the ENGINEER considers them to be irreparable.
- C. When checked with a 10-foot straightedge, grade shall not deviate by more than 1/4 inch and alignment shall not vary by more than 1/2 inch.
- D. Final elevation shall not depart from plan elevation by more than 1/2 inch.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. CURB TURN FILLETS - This item shall be measured by the square foot, in plan view, of curb turn fillets constructed, complete in place, including curb.

- B. CONCRETE VALLEY GUTTERS - This item shall be measured by the square foot.
- C. NEW CONCRETE SIDEWALK - This item shall be measured by the square foot.
- D. SURVEY MONUMENTS - This item shall be measured and paid for by the number of monuments constructed where shown on the plans at the contract unit price bid for "Install Monuments".

4.02

BASIS OF PAYMENT

- A. CURB TURN FILLETS - Payment shall constitute full compensation for all material, excavation, backfill, curing of concrete, pre-molded mastic material, welded wire mesh, equipment, tools and labor and for the performance of all work and incidentals necessary to complete this item.
- B. CONCRETE VALLEY GUTTERS - Payment shall constitute full compensation for all material, excavation, backfill, curing of concrete, pre-molded mastic material, reinforcing steel, equipment, tools and labor and for the performance of all work and incidentals necessary to complete this item.
- C. NEW CONCRETE SIDEWALK - Payment shall constitute full compensation for all material, excavation, backfill, curing of concrete, pre-molded mastic material, equipment, tools and labor and for the performance of all work and incidentals necessary to complete this item.
- D. SURVEY MONUMENTS - Payment shall constitute full compensation for all materials, excavation, backfill, forming and curing of concrete, equipment, tools and labor and for the performance of all incidentals necessary to complete this item.
- E. Payment shall be made under:

Curb Turn Fillets	square foot
Concrete Valley Gutters	square foot
New Concrete Sidewalk	square foot
Survey Monuments	per each
- F. Payment shall be made at the contract unit price bid for each item multiplied by the number of units installed.

END OF SECTION

SECTION 02805 — RELOCATION STREET SIGNS, UTILITY POLES AND MAILBOXES

PART 1 GENERAL

1.01 SUMMARY

- A. This work shall consist of the removal and/or relocation of street signs, traffic control signs, utility poles, street lights and mailboxes.
- B. Location of street signs and private mailboxes “to be removed”, are approximately only. The survey for curb or sidewalk alignment as a part of actual construction shall be the determining factor as to which of these facilities are to be moved or removed by the CONTRACTOR or others.

PART 2 PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

- A. STREET AND TRAFFIC CONTROL SIGNS. The ENGINEER’s decision to move or relocate street or traffic control signs shall be based on the location of the sign with respect to curb line, sidewalk line and the staked grading limits.
- B. Signs within the staked grading limits whose existing location (both vertically and horizontally) conform to final plan location within a 6-inch tolerance will not be relocated. If no street signs exist then new ones shall be installed.
- C. Signs within the staked grading limits whose existing location does not conform to final plan location tolerance above will be relocated. Signs outside the staked grading limit shall also be relocated to conform to final plan location.
- D. The preservation of the street, stop and other traffic control and direction signs that are to remain in place shall be the responsibility of the CONTRACTOR while the job is under construction. Should any of the signs need to be moved for the CONTRACTOR’s convenience, they shall be removed by the CONTRACTOR, either temporarily reinstalled or stored, and permanently reinstalled when construction or curb and gutter is completed. The CONTRACTOR shall be held liable for any damage to these signs caused by neglect on his part and no extra compensation will be allowed for preserving, removing or replacing stop and other traffic control and direction signs designated to remain in place, but rather this work shall be considered as included in the contract unit prices for the various items of the contract.

- E. Street, stop and other traffic control and direction signs designated to be relocated shall be removed and reinstalled in the locations shown on the Plans or designated by the ENGINEER. The cost of removing, temporarily reinstalling, storing, and permanently reinstalling these signs, will be compensated for at the unit price bid for relocating such signs.
- F. The following procedures will be followed in removing and relocating both signs removed by the CONTRACTOR for his convenience, and signs, designated by the ENGINEER for relocation:
 - 1. After it has been determined which signs shall be relocated at project expense, and which signs the CONTRACTOR will remove and replace for his convenience, the ENGINEER will be notified which street, stop and traffic direction signs are to be removed and reinstalled.
 - 2. Upon receiving the CONTRACTOR's notification, a representative of the OWNER will inspect the signs with the CONTRACTOR to determine the condition of the signs. Signs which require repair will be delivered by the CONTRACTOR to the OWNER. Signs not requiring repair will be removed and reinstalled as specified below. Signs delivered to the OWNER will be repaired and ready for pickup within 48 hours, unless new street signs are required to be ordered from the factory.
 - 3. Where stop signs and traffic direction or control signs are removed, the CONTRACTOR shall place a properly flared barricade in the center of the street, and temporarily install a similar stop sign or traffic direction sign on the barricade. This temporary sign shall remain in place until the CONTRACTOR permanently reinstalls the stop or traffic control signs.
 - 4. Street signs may be installed temporarily upon approval by the ENGINEER.
 - 5. Signs not required or used for temporary installation shall be stored.
 - 6. All stop, traffic direction, street signs or control signs shall be reinstalled in the permanent location shown on the plans or designated by the ENGINEER as soon as possible after the curb or curb and gutter forms have been removed. Signs which have been damaged after removal shall be replaced with new signs at the CONTRACTOR's expense.
- G. All sign locations shall conform to the latest issue of the Manual on Uniform Traffic Control Devices for Streets and Highways published by the U.S. Department of Transportation.

- H. Failure of the CONTRACTOR to permanently reinstall signs within forty-eight (48) hours period after written notice will result in the OWNER reinstalling the sign, and withholding the cost of the work from the CONTRACTOR's estimate.
- I. Private Mailboxes. Private mailboxes within the staked grading limits generally are not shown on the plans. Mailboxes within the staked grading limits designated for relocation by the ENGINEER shall be removed by the CONTRACTOR and temporarily installed outside, but immediately adjacent to the construction limits. Mailboxes shall be reinstalled in accordance with U.S. Post Office regulations.
- J. Power, Street Lights, and Telephone Poles. It shall be the CONTRACTOR's responsibility to coordinate the removal or relocation of utility poles with the utility owner.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Street, stop and traffic control or direction signs designated for relocation shall be measured by the number of street, stop, and traffic control or direction signs relocated.
- B. Private mailboxes designated for relocation shall be measured by the number of mailboxes relocated.

4.02 BASIS OF PAYMENT

- A. Payment for street stop and traffic control and direction signs designated for relocation shall be paid for at the unit price measured as relocated. Those signs or devices moved by the CONTRACTOR for his convenience shall be reinstalled at no cost to the OWNER.
- B. Payment for private mailboxes relocated shall be paid for at the unit price bid multiplied by the number of units measured as relocated.
- C. Private Mailboxes. Existing private mailboxes removed by the CONTRACTOR for his convenience shall be reinstalled at no cost to the OWNER.
- D. Payment for the above items shall constitute full compensation for all materials, excavation, temporary reinstallation, forming and curing of concrete equipment, tools and labor and for the performance of all work and incidentals necessary to complete the item.

END OF SECTION

SECTION 02895 — ENGINEERING FABRIC

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers materials and work associated with providing engineering fabric for drainage and filtration, erosion control, separation and stabilization, embankment, and retaining wall reinforcement, and asphalt paving. The fabrics covered in this section shall be woven or non-woven fabric consisting only of long chain polymeric filaments or yarns such as polyethylene, polyester, polyamide, or polyvinylidene-chloride formed into a stable network such that the filaments or yarns retain their relative positions to each other.

1.02 SUBMITTALS

- A. Submit for approval name of fabric and installation procedures.

1.03 QUALITY ASSURANCE

- A. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions. All test methods shall be in accordance with latest ASTM procedures.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fabric shall meet the following minimum performance and strength requirements listed in Table No. 1 during its service life.

GEOTEXTILE (FABRIC) AND IMPERMEABLE PLASTIC MEMBRANE SPECIFICATIONS								
Fabric and Membrane Requirements (Minimum Roll Average)								
					Separation & Stabilization			
Fabric and Membrane Property	Test Method	Drainage & Filtration	Erosion Control	Silt Fence	Woven	Non-Woven	Embankment & Retaining Wall Reinforcement	Impermeable Plastic Membrane
PERFORMANCE CRITERIA DURING SERVICE LIFE								
Equivalent or Apparent Opening Size, US Standard Sieve	ASTM D 4751	40-100	40-140	20-50	40-100	40-100	40-100	--
Thickness, Mils	ASTM D 1777	--	--	--	--	--	--	12
Permittivity, Sec-1	ASTM D 4491	0.2	0.1	0.01	0.01	0.05	0.01	<10 ⁻⁷ cm/sec (6)
Retention Efficiency, %	VTM-51-79(1)	--	--	75	--	--	--	--

STRENGTH REQUIREMENTS								
Wide Width Strip Tensile Strength, lbs./in.	ASTM D 4595(2)	40	65	65	130	65	200	80
Elongation at Failure, %	ASTM D 4595(2)	40 Min.	20 Min.	20 Min.	20 Min.	40 Min.	35 Max.	20 Min.
Burst Strength, psi	ASTM D 3786 (Diaphragm Method)	130	210	250	290	210	430	--
Trapezoid Tear Strength, lbs.	ASTM D 4533 (Any Direction)	25	40	50	50	40	75	50
Puncture Strength, lbs.	ASTM D 4733(3)	25	50	50	75	50	110	60
Seam Strength, lb./in.	ASTM D 4884	40	65	65	130	65	200	--
ENVIRONMENTAL REQUIREMENTS								
Mildew/Rot Resistance, %	AATCC 30 1988(5)	100	100	100	100	100	100	100
Insect/Rodent Resistance, %	AATCC 24 1985 (5)	100	100	100	100	100	100	100
Ultraviolet Resistance, % Strength Retention	ASTM D 4355	(4)	90	70	(4)	(4)	(4)	(4)

WDT - Standard Specifications for Road and Bridge Construction - 1993.

1. Virginia Department of Highways and Transportation test method.
2. 8" wide X 4" (200 X 100 mm) length specimen tested at a strain rate of 10% (0.4 in.) (10 mm) per minute.
3. Using 5/16" (8 mm) diameter flat tipped steel cylinder centered with ring clamp.
4. Non-stabilized or low susceptible geotextiles should not be exposed to ultraviolet radiation for more than 5 days.
5. American Association of Textile Chemists and Colorists test procedures.
6. Permeability Coefficient (ASTM D 4491)

NOTE: Values are omitted where the requirement does not apply to the end use application or is sufficiently addressed by a related property.

PART 3 EXECUTION

3.01 PACKAGING AND ON SITE STORAGE

- A. Engineering fabric shall be uniformly rolled onto a cardboard core, and shall be wrapped in plastic to protect the material from moisture and damage during shipment. Protective wrapping shall be left on the fabric until installation. The product must not be allowed to get wet prior to installation to prevent weakening of the cardboard core. Rolls shall be externally tagged for easy field identification. External tagging shall include the following: 1) Name of Manufacturer; 2) Product type; 3) Product grade; 4) Lot number; and, 5) Physical dimensions.

3.02 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Engineering fabric shall be measured by the square yard excluding overlaps and seam allowances.

4.02

BASIS OF PAYMENT

- A. Engineering fabric shall be paid for at bid schedule unit prices in place. Price quoted for fabric shall include all installation charges for placing fabric as shown on drawings. CONTRACTOR shall be responsible for any damage that occurs to the fabric during installation and will replace the damaged fabric at no additional cost.

END OF SECTION

SECTION 02900 — LANDSCAPING

PART 1 GENERAL

1.01 SUMMARY

- A. Provide topsoil and lawns.
- B. Provide trees and shrubs.
- C. Provide soil amendments and fertilizer.
- D. Provide seeding and mulching.

1.02 SUBMITTALS

- A. Submit for approval product and maintenance data, and dryland seed mixture.

1.03 QUALITY ASSURANCE

- A. Trees and shrubs shall be nursery-grown, with botanical and common names of plants true to the approved names given in the latest edition of "Hortus," and shall meet the requirements of American Standard for Nursery Stock adopted by the American Association of Nurserymen. Plants shall be sound, healthy, vigorous, symmetrically proportioned, well-branched, densely foliated when in leaf, free of diseases and insect pests, eggs, larvae, and have well-developed root systems.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver fertilizer in unopened containers bearing the manufacturer's statement of analysis.
- B. Adequately protect root balls at all times from sun, drying winds and frost. Do not prune plants prior to delivery. If balled and burlapped plants are not installed immediately upon delivery, set on the ground and protect well with moist soil or wet mulch.
- C. Deliver, store and handle other materials in accordance with manufacturer's instructions.

1.05 WARRANTY

- A. Warrant trees and shrubs for a period of one (1) year after Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from OWNER's neglect, abuse by others, or natural phenomena. Replace

unsatisfactory plant material at end of warranty period. One replacement is required.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Obtain from local source(s) having similar soil characteristics to that at the site. Obtain from well-drained site(s) where topsoil occurs in a depth of not less than four (4) inches. Do not obtain from bogs or marshes. Topsoil shall be fertile, friable, natural loam, reasonably free of subsoil, clay lumps, brush, weeds, litter, roots, stumps, stones larger than two (2) inches in any dimension, or any other material which would inhibit the germination of seeds or the growth of the cover crop.
- B. Lawns, seed: New crop seed mixture, composed principally of common Kentucky Bluegrass, or as approved. Other acceptable varieties include Merion, Baron and Fylking.
- C. Lawns, sod: Vigorous, viable, strongly rooted sod, not dormant or less than two (2) years old, free of weeds and undesirable native grasses, insect infestations and fungus, and machine cut to a pad thickness of one (1) inch + 1/4 inch. Sod shall be composed principally of Kentucky Bluegrass (*Poa pratensis*), testing 99.9 percent pure, or as approved. Other acceptable varieties include Tall Fescue and Brome.
- D. Trees and shrubs: See schedule on Drawings.
- E. Soil amendments: Organic matter such as pine needles, leaf mold, or peat.
 - 1. Shredded peat moss shall be commercial grade of either sphagnum moss, reed, or sedge peat, taken from fresh water site, free of lumps, roots and stones, with texture and pH range suitable for intended use.
 - 2. Well-rotted and shredded manure.
 - 3. Treble superphosphate.
- F. Fertilizer: Commercial grade of neutral character, with some elements derived from organic sources.
 - 1. Lawns: Farm-type, such as 18-46-0, applied at five (5) pounds per 1000 square feet of lawn area, or 16-20-0, at seven (7) pounds per 1000 square feet. Provide nitrogen in a form that will be available to lawns during initial growth period. Established lawns shall not receive more than 1.5 pounds of soluble nitrogen per 1000 square feet, applied four (4) times annually.

2. Trees and shrubs: Not less than five (5) percent total nitrogen, ten (10) percent available phosphoric acid, and five (5) percent soluble potash.
 3. Dryland seeding: Not less than a 2:1:1 ratio of nitrogen, phosphorous and potassium.
- G. Dryland seed: The following is only a suggestion and may not be applicable or available statewide. Consult the local Soil Conservation Service for appropriate seed species and application rates.

Grass Species	P.L.S. LBS./AC
Bottlebrush Squirreltail	0.75
Canby Bluegrass, Canbar	0.75
Indian Ricegrass, Nespar	2.50
Streambank Wheatgrass, Sodar	4.00
Western Wheatgrass, Rosana	5.00

These types and percentages may vary. Mixture may be available commercially as "Dryland Pasture Mix."

H. Mulch

1. Trees and shrubs: Well-aged fibrous or shredded bark, old sawdust, pine needles, or leaf mold.
2. Dryland seeding: Certified weed free small grain straw or native hay.
3. Pigmented wood cellulose fibers or paper pulp for hydraulic seeding. Mulch shall form a blotter-like ground cover with moisture absorption and percolation properties, and the ability to cover and hold the seed in contact with the topsoil, yet not inhibit the penetration of seedlings through it.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Topsoil: Spread topsoil to a uniform depth of 6 inches over all areas scheduled to receive lawns. Fertilize proposed lawns at rate specified herein. Fine grade areas to a firm even surface, free from lumps or stones. Installation of sod may be done immediately after fine grading, provided the bed is in good condition and not muddy or hard. If it is hard, scarify to a friable condition again.
- B. Lawns, seed
1. If soils are predominantly clayey or sandy, peat moss or manure shall be spread uniformly at a rate of three (3) cubic yards per 1000 square feet, and worked into the soil.

2. Apply superphosphate at a rate of ten (10) pounds per 1000 square feet.
3. Apply seed, at rate of two (2) pounds per 1000 square feet, using a drop (band) type spreader. Divide seed into two halves and distribute one half in the north-south direction, and the other half from east to west.
4. Rake seed into the soil and commence light watering, at least four (4) times per day for two (2) weeks, or until seed germinates.

C. Lawns, sod

1. Lay sod parallel to the direction of the slope and in a manner permitting butt joints to alternate. Fit sod pieces tightly together so that no joint is visible and tamp sod firmly and evenly by hand.
2. Roll sod with a 150-pound roller to level and seal seams. After rolling, water sod until water soaks through into topsoil to a depth of not more than three (3) inches.
3. Water, weed and replace sod, if required, until Substantial Completion. Erect and maintain temporary protection devices where deemed necessary.
4. Mow sod at least twice before Substantial Completion. At the time of the first mowing, set mower blades to produce 2-1/2-inch mowed height.

D. Trees and shrubs

1. Mark planting area for tree and shrub pits that is five (5) times the diameter of the root ball. Do not proceed with planting until the bed and pit locations are approved by the ENGINEER.
2. Loosen soil with rototiller or shovels to a depth of twelve (12) inches. Add organic matter, distributed uniformly within planting bed.
3. In the center of the prepared area, excavate a shallow hole for the root ball, so that it sits on solid subsoil. Apply fertilizer directly to bottom of pit.
4. Set plant in center of pit, plumb and straight, and at such a level that, after settlement, the top of the root collar is even with adjacent finished grade. Remove burlap, ropes, and all wire. Gently pack soil around plant and lightly water, to promote further soil consolidation.
5. Apply two (2) inches thick layer of mulch.
6. Prune each plant with clean, sharp tools to remove suckers, and broken, badly bruised or dead branches. Wrap tree trunks with TUBEX, or equivalent translucent material.

7. Guy trees with two (2) wires anchored securely to steel posts, directly opposite each other, not less than five (5) feet from the trunk. Protect the tree from direct contact with the wires. Remove posts and wires after one year.
 8. Commence watering and maintenance of plantings until Substantial Completion.
 9. Correct defective work as soon as it becomes apparent and as weather and season permit.
- E. Seeding: Broadcasting will not be allowed.
1. Prior to seeding, areas that have become muddy or hard shall be scarified to a depth of four (4) inches, and left in a friable condition. Fertilize at a rate of forty (40) pounds of available nitrogen per acre.
 2. Drilling: Drills shall be set for uniform rows with spacing not to exceed eight (8) inches, and depth for the type of seed being drilled, for a distribution rate of twenty (20) pounds per acre, or as recommended by the local Soil Conservation Service.
 3. Dry mulching: Spread mulch uniformly over the seeded area at a rate of two (2) tons per acre. Anchor mulch in the soil with a smooth or serrated coulter disc.
 4. Hydraulic methods: Use equipment designed for such work. Seed and water shall be uniformly applied to the areas scheduled to be seeded. Fertilizer, water and approximately one (1) ton per acre of hydraulic mulch shall be homogeneously mixed and uniformly applied to seeded areas.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Measurement shall not become necessary if landscaping is bid as lump sum.
- B. If unit prices are called for in the Bid Schedule measurement of each item will be made as the number of units used or installed.

4.02 BASIS OF PAYMENT

- A. Payment for landscaping shall be lump sum, unless otherwise noted in the contract.
- B. When unit prices are called for in the Bid Schedule payment shall be made at unit prices for each of the various items multiplied by the number of units installed or incorporated in the work.

END OF SECTION

SECTION 02915 — UNIT PAVERS

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish and place base course, setting bed and interlocking concrete unit pavers, at the following locations, in the quality, shape, thickness and color specified. Coordinate with work of other sections.
1. Driveways and streets.
 2. Walkways and plazas.

1.02 SUBMITTALS

- A. Submit for approval samples, and manufacturer's product data, installation instructions, and maintenance data. Prepare for approval 4-foot by 4-foot mock-ups. Provide a pallet of extra stock at Substantial Completion.

1.03 QUALITY ASSURANCE

- A. Comply with applicable sections of these specifications for base coarse and setting bed preparation, and with ASTM C936 - "Standard Specification for Solid Concrete Interlocking Paving Units." Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, store, and install pavers in accordance with manufacturer's printed instructions and approved submittals.
- B. Manufacturer and Installer shall each provide a 2-year written guarantee from the date of Substantial Completion.
- C. Randomly select five pavers for testing in accordance with ASTM Standard C-140, to verify the average compressive strength is no less than 8,000 psi, with no individual paver less than 7,200 psi. Submit test results to ENGINEER.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Brick pavers, ASTM C902, frost-resistant type:
1. Heavy-duty type for vehicular traffic.
 2. Intermediate-duty type for pedestrian traffic.

- B. Concrete pavers: Solid units with interlocking design, such as UNI-Stone, by Pavestone Co., Phoenix, Arizona. Pavers shall be 3-1/8-inch thick. Color shall be Terra Cotta.
- C. Asphalt block pavers: Solid asphalt cement units.
- D. Setting bed: Well-graded, clean, washed sand with one hundred (100) percent passing a 3/8-inch sieve, and a maximum of three (3) percent passing a No. 200 sieve.
- E. Bituminous setting bed with neoprene mastic with sand filled joints.
- F. Mortar setting bed over concrete slab with pigmented grout at joints. Provide control and expansion joints.
- G. Base coarse: Comply with Section 02231 of these specifications.
- H. Joints: Clean masonry type sand containing at least thirty (30) percent of 1/8-inch particles.

PART 3 EXECUTION

3.01 PREPARATION

- A. The base coarse shall be shaped to grade and cross-section, and compacted as specified in Section 02210, to a uniform depth of six (6) inches, held 4-1/8 inches below finish grade.
- B. Spread and screed the setting bed sand evenly over the prepared base coarse to a uniform compacted depth of 1-1/4 inches. Do not disturb this coarse once the desired elevation is achieved.

3.02 PLACEMENT

- A. Place the pavers in a Herringbone pattern with nominal joint width of 1/8 inch between adjacent pavers, with no joint exceeding 1/4 inch. Alternately select pavers from at least three (3) pallets, working from top to bottom in each pallet stack. Use a double-headed breaker or masonry saw for cutting pavers.
- B. Pavers shall be seated into the sand bedding coarse with a plate vibrator capable of 3,000 to 5,000 pounds compaction force with the surface clean and the joints open.
- C. After vibration, spread masonry type sand over the surface, allow to dry, and vibrate so as to completely fill the joints. Surplus material shall be swept from the surface after joints are completely filled with sand.
- D. Remove and replace any damaged pavers. Clean and protect work from damage.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unit Pavers shall be measured for payment by the square foot.

4.02 BASIS OF PAYMENT

- A. Basis of payment shall include paver, setting bed, base coarse, joint filler and all materials and labor to complete the installation.
- B. Payment shall be made at the contract unit price bid multiplied by the number of units (square feet) placed.

END OF SECTION

SECTION 03100 — CONCRETE FRAMEWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Formwork for cast-in-place concrete
- B. Openings in formwork for other affected work
- C. Form accessories such as snap ties, bracing, etc.
- D. Stripping formwork

1.02 SUBMITTALS

- A. Shop Drawings: Fabrication and erection drawings of forms for specific finished concrete surfaces, as indicated. Show general construction of forms, jointing, special joints or reveals, location and pattern of form tie placement, and other items affecting exposed concrete visibility.
- B. Form Release Agent: Where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent submit manufacturer's instructions for use of agent.

1.03 QUALITY ASSURANCE

- A. Design, engineering, and construction of formwork are the CONTRACTOR's responsibility.
- B. Standards: Comply with all pertinent provisions of the ACI 347.
- C. Qualification of Workmen: Provide at least one (1) person who shall be present at all times during the work of this Section and who shall be thoroughly familiar with the type of materials being installed, the reference standards, and the requirements of this work.
- D. Design Forms
 - 1. With sufficient strength to maintain finished tolerances indicated in Section 03345, to support loads, pressures, and allowable stresses as outlined in ACI 347.
 - 2. To permit easy removal.
 - 3. For required finishes.

E. Product Handling

1. Take all means necessary to protect formwork materials before, during, and after installation and to protect the installed work of other trades. In the event of damage, immediately make all repairs and replacements necessary to the approval of the ENGINEER and at no additional cost to the OWNER.

1.04 DEFINITIONS

- A. Shoring: The activity to support formwork.
- B. Re-shoring: The activity to reduce the amount of formwork supporting concrete elements. As concrete sets and strength increases, less need for formwork occurs gradually until concrete becomes free standing.

1.05 REFERENCES

- A. ACI 347: Recommended Practice for Concrete Formwork.

1.06 JOB CONDITIONS

- A. For reference purposes, establish and maintain sufficient control points and bench marks to check tolerances. Maintain in an undisturbed condition and until final completion and acceptance of Work.
- B. Regardless of tolerances specified, allow no portion of Work to extend beyond legal boundaries.

1.07 FIELD SAMPLES

- A. Prepare field samples and submit in accordance with Section 01340.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Construct formwork for concrete concealed from view with plywood sawn boards of sound grade or steel forms as approved by the ENGINEER.
- B. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without excessive and objectionable bow or deflection.
- C. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surface.

2.02**FORMWORK ACCESSORIES**

A. Form ties and spreaders

1. Provide factory-fabricated, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
2. Provide ties so that portion remaining within concrete after removal of exterior parts is at least 1-1/2 inches from the outer concrete surface. Provide form ties that will not leave a hole larger than 1-inch diameter in the concrete surface. The portion of the tie remaining in the concrete after removal of the exterior parts shall not project beyond surface of the concrete.
3. Wire ties will be permitted where surfaces on either side of a formed member will not be exposed to view or painted. Projecting ends of wire ties shall be cut off flush with the concrete surfaces. Job fabricated ties will not be acceptable.

B. Pre-molded Expansion Joint Filler: Unless indicated otherwise, provide Type F1, in accordance with Section 03251.**C. Form Release Agent**

1. Provide commercial formulation form release agent compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
2. Surplus oil on forms and form oil on reinforcing steel and construction joints shall be removed before concrete is placed.

D. Fillets for Chamfered Corners: Wood strips 3/4-inch x 3/4-inch size; maximum possible length.**2.03****DESIGN OF FORMWORK**

A. General

1. Design, erect, support, brace, and maintain formwork so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure.
2. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose.

3. Construct formwork so that concrete members and structures are of correct size, shape, alignment elevation, and position.
4. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperatures, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
5. Support form facing materials by structural members spaced sufficiently close to prevent objectionable deflection.
6. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities, and within allowable tolerances.
7. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the substrata and conditions under which work of this Section is to be performed, and correct unsatisfactory conditions which would prevent proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 FORM CONSTRUCTION

- A. Construct forms complying with ACI 347, to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grade, level, and plumb work in finished structures.
- B. Provide for openings, offsets, keyways, recesses, moldings, reglets, chamfers, blocking, screed, bulkheads, anchorages, inserts, and other features required. Use selected materials to obtain required finishes.
- C. Forms for openings and construction which accommodates installation by other trades whose materials and products must be fabricated before the opportunity exists to verify the measurements of adjacent construction which affects such installations, shall be accurately sized and located as dimensioned on the Drawings. In the event that deviation from the Drawing dimensions results in problems in the field, the CONTRACTOR shall be responsible for resolution of the conditions as approved by the ENGINEER without additional expense to the OWNER.

- D. Fabrication: Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.
- E. Provision for other trades: Provide openings in concrete formwork to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Accurately place and securely support items to be built into forms.
- F. Cleaning: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before concrete is placed.

3.03 FORM COATINGS

- A. Coat form contact surfaces with form-coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces which will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.

3.04 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto.
- B. Edge forms and screed strips for slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

3.05 REMOVAL OF FORMS

- A. Forms shall be removed in a manner to insure complete safety of the structure. Forms shall not be removed until concrete has sufficient strength to carry its own weight and the loads upon it with safety. Due to weather conditions or for other reasons, the forms shall remain in place for longer periods than stated above, when directed by the ENGINEER.
- B. Do not pry against face of concrete. Use only wooded wedges.
- C. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.

- D. Formwork for columns, walls, sides of beams, and other members not supporting the weight of concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal.
- E. Where no re-shoring is planned, leave forms and Shoring used to support weight of concrete in beams, slabs, and other concrete members in place until concrete has attained its specified strength.
- F. Where re-shoring is planned, supporting formwork may be removed when concrete has reached seventy (70) percent of specified strength, provided re-shoring is installed immediately.

3.06

RE-SHORING

- A. When re-shoring is permitted or required, plan operations in advance and obtain approval.
- B. During re-shoring, do not subject concrete in beam, slab, column, or any other structural member to combined dead and construction loads and live loads in excess of loads permitted for developed concrete strength at time of re-shoring.
- C. Place re-shoring as soon as practical after stripping operations are complete, but in no case later than end of working day on which stripping occurs.
- D. Tighten re-shoring to carry required loads without overstressing.
- E. Leave re-shoring in place until the concrete being supported has reached its specified strength.
- F. For floors supporting shoring under newly placed concrete, level original supporting shoring or re-shoring.
 - 1. Re-shoring system shall have a capacity to resist anticipated loads in all cases equal to at least one-half (1/2) the capacity of the shoring system.
 - 2. Unless otherwise specified, locate re-shoring directly under shoring.
 - 3. In multistory buildings, extend re-shoring through a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads in such a manner that design loads of floors and support shoring are not exceeded.
- G. Design, engineering, and construction of shoring and re-shoring are the responsibility of the CONTRACTOR.

3.07 REMOVAL STRENGTH

- A. When removal of formwork or re-shoring is based on concrete reaching a specified strength, it shall be assumed that concrete has reached this strength when either of the following conditions have been met:
 - 1. When test cylinders, field cured along with the concrete they represent, have reached the specified strength.
 - 2. When concrete has been cured in accordance with provisions of Section 03370 for the same length of time as the site-cured cylinders which reached specified strength. Determine the length of time the concrete has been cured in the structure by cumulative number of days or fractions thereof, not necessarily consecutive, during which the air temperature is above 50°F and concrete has been damp or sealed from evaporation and loss of moisture.

3.08 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork. When forms are re-used for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.

3.09 FIELD QUALITY CONTROL

- A. Before commencing a placement, verify connections, form alignment, ties, inserts, and shoring are placed and secure.
- B. Observe formwork continuously while concrete is being placed to verify that the forms are plumb and there are no deviations from desired elevation, alignment, or camber.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

4.02**BASIS OF PAYMENT**

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 03200 — CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Reinforcing steel bars, wire fabric, or rod mats for cast-in-place concrete.
- B. Support chairs, bolsters, bar supports, and spacers for supporting reinforcement.
- C. Fiber reinforced concrete.

1.02 REFERENCES

- A. AASHTO M 254: Standard Specification for Corrosion Resistant Coated Dowel Bars.
- B. ACI 301: Specifications for Structural Concrete for Buildings.
- C. ACI 315: Details and Detailing of Concrete for Buildings.
- D. ASTM A 82: Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- E. ASTM A 185: Standard Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
- F. ASTM A 615: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- G. ASTM A 706: Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
- H. AWS D1.1: Structural Welding Code Steel.
- I. AWS D1.4: Structural Welding Code Reinforcing Steel.
- J. CRSI Document: Manual of Standard Practice.

1.03 SUBMITTALS

- A. Manufacturer's Certificate: Submit mill test certificates of supplied concrete reinforcement, indicating physical and chemical analysis.
- B. Welder's certification.
- C. Shop Drawings.

1. Indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.
2. When required, Shop Drawings shall be prepared under the direction of a Wyoming licensed professional engineer acceptable to the agency having jurisdiction.

1.04 PRODUCT HANDLING

- A. Delivery: Deliver reinforcement to the job site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Take all means necessary to protect reinforcement materials before, during, and after installation and to protect the installed work of other trades. Store all reinforcement materials in a manner to prevent excessive rusting and fouling with grease, dirt, and other bond-breaking coatings. Take all necessary precautions to maintain identification after bundles are broken. In the event of damage or errors, immediately make all repairs or replacements necessary and at no additional cost to the OWNER.

1.05 FIBER REINFORCED CONCRETE

- A. Submit one (1) copy of manufacturer's printed product data, clearly marked, indicating proposed fibrous concrete reinforcement materials. Printed data should state 1.5 pounds of fiber to be added to each cubic yard of each type of concrete.
- B. Submit one (1) copy of a manufacturer's printed batching and mixing instructions.
- C. Submit one (1) copy of a certificate prepared by the Concrete supplier stating that the approved fibrous concrete reinforcement materials at the rate of 1.5 pounds per cubic yard were added to each batch of concrete delivered to the project site. Each certificate shall be accompanied by one (1) copy of each batch delivery ticket indicating amount of fibrous concrete reinforcement material added to each batch of concrete.

PART 2 PRODUCTS

2.01 CONCRETE REINFORCEMENT MATERIALS

- A. Reinforcing Steel: In accordance with ASTM A 615 deformed bars, grade, and type as indicated, including supplementary requirements S1, either uncoated or as indicated. When no grade is indicated, use 60-ksi yield grade steel. Use ASTM A 706 steel if welding is indicated or allowed.

- B. Welded Steel Wire Fabric: In accordance with ASTM A 185 plain type; in flat sheets or coiled rolls either uncoated or as indicated.
- C. Stirrup Steel: In accordance with ASTM A 82.
- D. Plain Dowel Bars for Expansion Joints: In accordance with ASTM A 615, 60-ksi yield grade steel.
 - 1. Epoxy coated in roadway pavements.
 - 2. Provide metal dowel cap at one end of dowel to permit longitudinal movement of dowel within concrete section. Design caps with one end closed.
 - 3. Provide for movement equal to joint width plus one-half (1/2) inch.
 - 4. For load transfer bars, paint with one (1) coat of paint conforming to AASHTO M 254 and coat half with grease.
- E. Fibrous Concrete Reinforcement Material
 - 1. One hundred (100) percent virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement. Volume per cubic yard shall equal a minimum of 0.1 percent (1.5 pounds).
 - 2. Fibrous concrete reinforcement (fibermesh) shall be as manufactured by Fibermesh Company, 4019 Industry Drive, Chattanooga, TN 37416; Grade MD or equal.
 - 3. Physical Characteristics:
 - a. Specific gravity: 0.91
 - b. Tensile strength: 50 to 110 ksi (345 to 759 MPa).
 - c. Fiber length: graded per manufacturer; or, as specified by project engineer.
 - 4. Fibrous concrete reinforcement materials provided in this Section shall produce concrete conforming to the requirements for each type and class of concrete required, as indicated on the drawings and specified in section 501 WPWSS where the concrete is tested in accordance with ASTM C-94 and ASTM C-1116 Type III 4.1.3 and ASTM C-116 (Ref: ASTM C-1018) Performance Level I5 outlined in Section 21 Note 17.

2.02 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16-gage steel wire shall be plain, cold-drawn and shall comply with ASTM A 82.
- B. B. Supports for reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place:
 - 1. Use wire bar type supports complying with CRSI recommendations unless otherwise indicated. Do not use wood, brick, and other unacceptable materials.
 - 2. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot-dip galvanized or plastic protected legs.

2.03 FABRICATION

- A. Fabricate reinforcement in accordance with ACI 315, providing for the concrete cover specified in Section 03304.
- B. Locate reinforcing splices not indicated on drawings at points of minimum stress. Indicate location of splices on Shop Drawings.
- C. Weld reinforcing bars in accordance With AWS D1.4.
- D. Unacceptable materials: Reinforcement with any of the following defects will not be permitted in the Work:
 - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
 - 2. Bends or kinks not indicated on Drawings or final Shop Drawings.
 - 3. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 EXECUTION

3.01 PLACING

- A. All reinforcement to be free of loose mill scale, loose or thick rust, dirt, paint, oil or grease.
- B. Place all reinforcement in the exact position indicated. With tie wire, tie bars together at all intersections.

- C. Maintain the distance from vertical forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices. Placing and fastening of reinforcement in each section of the Work must be approved before concrete is placed.
- D. Overlap sheets of metal mesh one square plus six (6) inches to maintain a uniform strength. Securely fasten at the ends, edges, and supports to maintain clearances.

3.02 SPLICING

- A. Furnish all reinforcement in the full lengths indicated unless otherwise permitted. Splicing of bars, except where indicated is not permitted without written approval. Stagger splices where possible.
- B. Unless indicated otherwise, overlap reinforcing bars a minimum of thirty (30) diameters to make the splice. In lapped splices, place the bars and wire to maintain the minimum distance for clear spacing to the surface of the concrete.
- C. Do not use lap splices on bars greater in diameter than No. 11 unless approved.
- D. Weld reinforcing steel only if indicated or if authorized in writing. Weld in conformance to AWS D1.4.
- E. Do not bend reinforcement after embedding in hardened concrete.
- F. Do not permit reinforcement or other embedded metal items bonded to the concrete, to extend continuously through any expansion joint, except dowels in floors bonded on only one side of joints.

3.03 PLACING EMBEDDED ITEMS

- A. Place all sleeves, inserts, anchors, and embedded items prior to concrete placement. Temporarily fill voids in embedded items to prevent entry of concrete.
- B. Give all trades whose work is related to the concrete Section ample notice and opportunity to introduce or finish embedded items before concrete placement.

3.04 CONSTRUCTION METHODS FOR FIBER REINFORCED CONCRETE

- A. Add fibrous concrete reinforcement to concrete materials at the time concrete is batched in amounts in accord with approved submittals for each type of concrete required.
- B. Mix batched concrete in strict accord with fibrous concrete reinforcement manufacturer's instructions and recommendations for uniform and complete dispersion.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. The cost of the fibrous concrete reinforcing is to be included as a part of the appropriate item in which it is being used. There will be no separate measurement or payment for this item.
- B. Reinforcing steel will be measured by the pound, based on the theoretical number of pounds, excluding splice bars to replace test samples, complete in place as shown on plans or placed as ordered.
- C. The quantities of materials furnished and placed shall be based upon the calculated weights of the reinforcing steel actually placed in accordance with these specifications. No deductions will be made for any bends except for hooks. The length of the bar to be added to out-to-out dimensions of hooked bars will be shown on the plans. The weights calculated shall be based upon the following table:

Metric Designation	Size	Weight per L.F. in		Metric Designation	Size	Weight per L.F. in	
		lbs.	kg/m			lbs.	kg/m
				25	#8	2,670	3,973
10	#3	0.376	0.559	30	#9	3,400	5,059
10	#4	0.668	0.994	35	#10	4,303	6,403
10	#5	1,043	1,552	35	#11	5,313	7,906
15	#6	1,502	2,235	45	#14	7,650	11,383
20	#7	2,044	3,041	55	#16	13,600	20,237

- D. The weights estimated for spiral spacers will be based on three-quarter (3/4) pound per linear foot. The weight of the spiral will be computed using the core diameter shown on the plans. Wire mesh, when included as a pay item, will be based on the weights shown on the plans for the type of mesh designated.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of reinforcing steel will be paid for at the contract unit price per pound complete in place. No allowance will be made for clips, wires, or other material used for fastening reinforcement in place.

Payment will be made under:

PAY ITEM
Reinforcing Steel

PAY PER UNIT
Lb.

END OF SECTION

SECTION 03251 — EXPANSION AND CONTRACTION JOINTS

PART 1 GENERAL

1.01 SUMMARY

- A. Joints and joint sealants in horizontal traffic surfaces for cast-in-place concrete sidewalks, curb, gutter, and pavement slabs.

1.02 SUBMITTALS

- A. Manufacturer's certification that product was manufactured, tested, and supplied in accordance with source quality control requirements specified herein, together with a report of the test results and the date each test was completed.
- B. Manufacturer's instruction for joint preparation, type of cleaning, and installation.
- C. Manufacturer's Product Data and Samples for each joint sealant product required.
- D. Safety data sheets.

1.03 REFERENCES

- A. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
- B. ASTM D 545: Standard Methods of Testing Preformed Expansion Joint Filler for Concrete Construction (Non-extruding and Resilient Types).
- C. ASTM D 994: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- D. ASTM D 1056: Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- E. ASTM D 1190: Standard Specification for Concrete Joint Sealer, Hot-Poured Elastic Type.
- F. ASTM D 1191: Standard Method for Testing Concrete Joint Sealers.
- G. ASTM D 1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- H. ASTM D 1752: Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

- I. ASTM D 1850: Standard Specification for Concrete Joint Sealer, Cold-Application Type.
- J. ASTM D 1851: Standard Methods of Testing Concrete Joint Sealers, Cold-Application Type.
- K. ASTM D 2240: Standard Test Method for Rubber Property - Durometer Hardness.
- L. ASTM D 2628: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- M. ASTM D 3405: Standard Specification for Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements.
- N. ASTM D 3406: Standard Specification for Joint Sealant, Hot- Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.
- O. ASTM D 3407: Standard Methods of Testing Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements.
- P. ASTM D 3408: Standard Methods of Testing Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.
- Q. ASTM D 3542: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Bridges.
- R. ASTM D 3569: Standard Specification for Joint Sealant, Hot- Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements.
- S. ASTM D 3581: Standard Specification for Joint Sealant, Hot- Poured, Jet-Fuel-Resistant-Type, for Portland Cement Concrete and Tar-Concrete Pavements.
- T. ASTM D 3582: Standard Methods for Testing Joint Sealant, Hot-Poured, Jet-Fuel-Resistant-Type, for Portland Cement Concrete and Tar-Concrete Pavements.
- U. ASTM D 3583: Standard Methods of Testing Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements, or Joint Sealant, Hot-Applied, Elastomeric, Jet- Fuel-Resistant-Type for Portland Cement Concrete Pavements.
- V. FS SS-S-200: Sealants, Joint, Two Component, Jet-Blast Resistant, Cold-Applied, for Portland Cement Concrete Pavement.

1.04 **QUALITY ASSURANCE**

- A. Obtain joint sealing materials from a single manufacturer for each different product required.

1.05 **DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, cure time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration; or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 **SYSTEM PERFORMANCES**

- A. Pavement joints include longitudinal and transverse expansion joints, contraction joints, construction joints, and crack control joints.
- B. Provide joint sealants that maintain watertight and airtight continuous seals.

PART 2 **PRODUCTS**

2.01 **GENERAL**

- A. Compatibility: Provide joint filler, sealant backings, sealants, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.02 **JOINT VOID - FORMER**

- A. Plastic with a water stop.
- B. 1/4 depth of concrete structural section.

2.03 **JOINT FILLER – SHEET TYPE**

- A. F1 Joint Filler: Bituminous (asphalt or tar) mastic in accordance with ASTM D 994; formed and encased between two (2) layers of bituminous saturated felt or two (2) layers of glass-fiber felt.
- B. B2 Joint Filler: Cane or other cellulosic fiber in accordance with ASTM D 1751; saturated with asphalt.

- C. F3 Joint Filler: Granulated cork in accordance with ASTM D 1751; in an asphalt binder; encased between two (2) layers of asphalt saturated felt or two (2) layers of glass-fiber belt.
- D. F4 Joint Filler: Sponge rubber fully compressible in accordance with ASTM C 1752; with resiliency recovery rate of ninety (90) percent minimum.
- E. F5 Joint Filler: Cork in accordance with ASTM C 1752; impregnated and bound with asphalt; compressible with resiliency recovery rate of ninety (90) percent if not compressed more than fifty (50) percent of original thickness.
- F. F6 Joint Filler: Plastic foam (for cold-applied sealants only) preformed, compressible, resilient, non-waxing, non-extruding strips of flexible, non-gassing plastic foam; non-absorbent to water and gas; thirty (30) pounds per cubic feet density maximum; and of size and shape to control sealant depth and performance.

2.04 JOINT FILLER – BACKER ROD AND TAPE TYPE

- A. Elastomeric Tube (Backer Rod): Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, non-absorbent to water and gas, capable of remaining resilient at temperatures down to -26°F. Provide product with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- B. Tape: Self-adhesive polyethylene bond breaker tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to joint filler materials or joint surfaces at back or bottom of joint.

2.05 JOINT SEALANT - GENERAL

- A. Color of exposed joint sealant indicated, or if not, as selected from manufacturer's standard colors.

2.06 JOINT SEALANT – HOT-APPLIED

- A. HAS1 Sealant: Resilient and adhesive compound type in accordance with ASTM D 3405; for Portland cement concrete or asphalt concrete pavements.
- B. HAS2 Sealant: Thermoplastic type in accordance with ASTM D 3581; jet-fuel resistant without rubber unless indicated otherwise.
- C. HAS3 Sealant: Elastic type in accordance with ASTM D 1190.
- D. HAS4 Sealant: Elastomeric type in accordance with ASTM D 3406; one component, for Portland Cement concrete pavements.

- E. HAS5 Sealant: Elastomeric type in accordance with ASTM D 3569; one component, jet-fuel resistant, for Portland cement concrete pavements.

2.07

JOINT SEALANT – COLD-APPLIED

- A. CAS1 Sealant: Elastomeric type in accordance with ASTM C 920; Chemically curing, for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges and joint substrates indicated; Types S or M; Grade P or NS; Class 25; Use T, NT, M and O.
 - 1. Self-leveling.
 - 2. Shore A Hardness: 40 ± 5 ASTM D 2240.
 - 3. Final cure: Four (4) days maximum.
 - 4. Service range: -10 to 150°F.
- B. CAS2 Sealant: Mastic type in accordance with ASTM D 1850; single or multiple component; for joints having a minimum width of one-half (1/2) inch.
- C. CAS3 Sealant: Coal-tar modified urethane type in accordance with FS SS-S-200; one part, jet fuel resistant; Type H.
- D. CAS4 Sealant: Elastomeric preformed polychloroprene type with lubricant adhesive and indicated movement ratio.
 - 1. For concrete pavement seal; ASTM D 2628.
 - 2. For concrete bridge seals; ASTM D 3542.

2.08

SOURCE QUALITY CONTROL

- A. Preformed Expansion Joint Fillers: Non-extruding and resilient types; ASTM D 545.
- B. Hot-Applied Joint Sealants:
 - 1. Elastic type used in concrete pavements, bridges, other structures; ASTM D 1191.
 - 2. Bituminous type for hydraulic and asphaltic concrete pavements; ASTM D 3407.
 - 3. Elastomeric type of hydraulic concrete pavements; ASTM D 3408.
- C. Jet-Fuel-Resistant Joint Sealant: Hot-applied; ASTM D 3582 and ASTM D 3583.
- D. Cold-Applied Mastic Joint Sealant: In accordance with ASTM D 1851.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not proceed with installation of joint sealants under unfavorable weather conditions.
- B. Install elastomeric sealants when temperature is stable in temperature range recommended by manufacturer for installation.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

3.02 PREPARATION

- A. Clean, prepare, and size joints in accordance with manufacturer's instructions. Remove any loose materials and other foreign matter which might impair adhesion of sealant.
- B. Verify that joint shaping materials and release tapes are compatible with sealant.
- C. Examine joint dimensions and size materials to achieve required width to depth ratio.
- D. Adjust joint depths to allow sealants to perform properly.
- E. Remove moisture on substrate.
- F. Bond Breaker Tape: Install where needed or required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

3.03 JOINTS - GENERAL

- A. Construct all joints as follows.
 - 1. At right angles to top surface of placement.
 - 2. Straight unless indicated otherwise.
 - 3. Before uncontrolled shrinkage cracking takes place.
 - 4. To prevent concrete edge slump.

3.04 EXPANSION JOINTS

- A. Expansion joints shall be in location as shown on drawings or as approved by the ENGINEER. Joints in exterior concrete work shall be placed:

1. Where shown on drawings;
 2. Thirty (32) feet zero (0) inches on center maximum for pavement slabs, or;
 3. One hundred (100) feet on center maximum for sidewalks, curbs, and gutters.
- B. Pre-molded filler strips shall extend full depth of slab.
- C. Isolation joints shall be used in all areas where slabs abut vertical surfaces. Joint material shall be placed on levels called for and in good alignment.
- D. In no case shall the reinforcing or other fixed metal items embedded or bonded into concrete be run continuous through expansion joint.
- E. Finish at joints shall be neatly finished with an edging tool providing a slightly rounded edge on each side of the joint filler material.
- F. Expansion joint material shall be placed in sidewalks, curbs, and gutters at all Points of Curvature, Points of Tangent, and curb turns.

3.05 CONSTRUCTION JOINTS

- A. Construction joints shall be placed in flat slabs in locations as shown on the drawings or as approved by the ENGINEER.
- B. The preformed metal keyway joints shall be set to obtain accurate alignment, grades, level and plumb in the work and shall be furnished the full depth of the slab.
- C. Where a joint is made to a previously placed concrete section, care should be taken to remove all laitance prior to new placement of concrete.
- D. The CONTRACTOR may elect to place concrete on both sides of a construction joint or placing through the joint. When this method is employed, a temporary backer such as a 2x4 shall be provided to stiffen and hold the preformed metal joint in alignment ahead of the work and shall be removed as the work progresses.

3.06 CONTROL JOINTS

- A. Control joints shall be aligned within the curb and gutter, sidewalk, and retaining walls (as applicable) at a maximum spacing of ten (10) linear feet. All components shall be similarly jointed. For sidewalks, control joint spacing shall be no longer than the width of the sidewalk.
- B. Tooled Joint

1. Tooled joints shall be formed by scoring the slab the full depth with a steel trowel along a straight edge in locations as shown on the drawings or, if not shown, not to exceed six hundred twenty-five (625) square feet in area.
2. The joint shall be finished using a joint tool guided by a straight edge leaving a slightly rounded edge on each side of the joint.

C. Sawn Joints

1. Sawn joints shall be sawn into interior concrete floors as indicated on the drawings and at CONTRACTOR's option in place of preformed metal keys.
2. Joints shall be sawn with a power saw designed to saw depth and width as shown on drawings. Hand held saws will not be accepted.
3. Saw cutting shall occur within twelve (12) hours after placement of concrete. The line of the saw shall be straight, true to line, and square.
4. Pourable joint sealant shall be poured into all sawn joints. Installation shall be in strict accordance with manufacturer's specifications which shall include preparation, priming, etc.

3.07

JOINT SEALING

A. Surface Preparation

1. Remove oil, grease, wax, form-release-agents, curing compounds, bitumens, laitance, and old chalking material by sandblast, or water blast as recommended by manufacturer of sealant. Maximum sand blast angle, twenty-five (25) degrees \pm five (5) degrees.
2. Clean and dry with air blast. Do not contaminate air blast with oils or lubricants.
3. Remove frost and moisture in concrete joint substrates before commencing sealing.

B. Installation

1. Ensure that sealants are installed in uniform, continuous ribbons without gaps or air pockets, with complete bonding of joint surfaces on opposite sides.
2. Except as otherwise indicated, fill sealant rabbet flush with surface.
3. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

- C. Depths: Saw cut joints if necessary to provide the required sealant thickness and depth. Install sealant to depths indicated or, if not indicated, as recommended by sealant manufacturer, but within the following general limitations measured at center (thin) section of bead:
 - 1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to seventy-five (75) percent of joint width, but neither more than five-eighths (5/8) inch deep nor less than three-eighths (3/8) inch deep.
 - 2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to fifty (50) percent of joint width, but neither more than one-half (1/2) inch deep nor less than one-quarter (1/4) inch deep.
 - 3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in range of seventy-five (75) percent to one hundred twenty-five (125) percent of joint width.
- D. Spillage: Do not allow poured sealant compound to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces. Clean adjoining surfaces to eliminate evidence of spillage.
- E. Heating: Do not overheat hot-applied sealants.
- F. Edges: Unless indicated otherwise, recess exposed edges of gasket and exposed joint fillers slightly behind adjoining surfaces so compressed units will not protrude from joints.

3.08 CURE AND PROTECTION

- A. Cure sealants and caulking compounds in accordance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.
- B. Follow procedures required for cure and protection of joint sealants during construction period so they will be without deterioration or damage (other than normal wear and weathering) at time of Substantial Completion.

3.09 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses. Use methods and cleaning materials approved by manufacturers of joint sealant and of products in which joints occur.
- B. Remove protective coating and oil from metals with solvent recommended by the sealant manufacturer.

3.10 PROTECTION

- A. Protect joint sealant during and after curing period from contact with contaminating substances or from damage resulting from deterioration or damage at time of Substantial Completion.
- B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work at no additional cost to OWNER.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 03304 — PORTLAND CEMENT CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Portland cement concrete material requirements.
- B. Mix design requirements.
- C. Method of measurement and basis of payment

1.02 SUBMITTALS

- A. Mix Design: Submit each proposed mix design fourteen (14) days prior to use in the Work. Indicate whether mixes have been designed for pumping. Include in the report the following information.
 - 1. Water-cement ratio.
 - 2. Proportion of materials in the mix.
 - 3. Source and type of cement.
 - 4. Analysis of water to be used unless potable.
 - 5. Type and name of admixtures applied. Indicate when accelerating or retarding admixtures are to be used and the resulting change in placement times.
 - 6. Slump, air content, and temperature of samples.
 - 7. Unit weight of fresh and dry light weight concrete.
- B. Concrete Quality Charts. Comply with ACI 214 and ACI 301, and submit the following.
 - 1. Specified strength (f'_c).
 - 2. Required average strength (f_{cr}).
 - 3. Compressive strength versus date of sample.
- C. Optional design mix:
 - 1. At the CONTRACTOR's option, he may elect to provide a concrete mix that has been previously designed, tested, and used and which provides the quality required by these Specifications.

2. If the CONTRACTOR exercises this option, he shall submit to the ENGINEER for his approval all pertinent data, including test results to substantiate the design mix requested to be furnished.
- D. Aggregate Test Report: Submit for each aggregate source.
1. Date of test analysis.
 2. Sieve analysis.
 3. Organic impurities.
 4. Sodium sulfate soundness test.
 5. Reactivity of aggregate.
 6. Complete identification of aggregate source of supply.

1.03

QUALITY ASSURANCE

- A. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures, or aggregate without ENGINEER's approval.
- B. In proportioning materials for mixing, use scales certified by the State of Wyoming. No not use volume measurement except for water and liquid admixtures.
- C. Do not change the quantity of cement per cubic yard from approved mix design without written approval of ENGINEER.
- D. Use of admixture will not relax hot or cold weather placement requirements.
- E. Ready-mixed concrete to be in accordance with Alternate No. 3 of ASTM C 94 and requirements in this Section.
- F. Control Testing of Concrete: In Accordance with Section 03305.

1.04

REFERENCES

- A. AASHTO 26: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- C. ACI 211.2: Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
- D. ACI 211.3: Standard Practice for Selecting Proportions for Non-Slump Concrete.

- E. ACI 214: Recommended Practice for Evaluation of Strength Test Results of Concrete.
- F. ACI 301: Specifications for Structural Concrete for Buildings.
- G. ASTM C 33: Standard Specification for Concrete Aggregates.
- H. ASTM C 88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- I. ASTM C 94: Standard Specification for Ready-Mix Concrete.
- J. ASTM C 150: Standard Specification for Portland Cement.
- K. ASTM C 260: Standard Specification for Air-Entraining Admixtures for Concrete.
- L. ASTM C 289: Standard Test Method for Potential Reactivity of Aggregates (Chemical Method).
- M. ASTM C 494: Standard Specification for Chemical Admixtures for Concrete.
- N. ASTM C 618: Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.

1.05 DEFINITIONS

- A. Average Strength (f_{cr}): The required average strength for thirty (30) consecutive strength tests which statistically assures no more than the permissible proportions of tests will fall below Specified Strength.
- B. Specified Strength (f'_c): The indicated strength.

1.06 PRODUCT STORAGE AND HANDLING

- A. Store bagged and bulk cement in weatherproof enclosures to exclude moisture and contaminants.
- B. Stockpile aggregate to avoid segregation and prevent contamination.
- C. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

PART 2 PRODUCTS

2.01 CEMENT

- A. Portland Cement: ASTM C 150, Modified Type II - Low Alkali, with tri-calcium aluminate ($3\text{CaO Al}_2\text{O}_3$) of not more than 5% or Type V - Low Alkali.

- B. Do not use air-entraining cement.

2.02 WATER

- A. Clean, potable and free from injurious amounts of foreign matter.
- B. Comply with AASHTO 26.

2.03 AGGREGATES - GENERAL

- A. Gravel, crushed slag, crushed stone, or other inert materials, composed of hard, strong, durable particles free of injurious coatings.
- B. The materials passing the No. 200 sieve shall not exceed 1.75 percent by weight in the combined coarse and fine aggregate.

2.04 COARSE AGGREGATE

- A. Sieve Analysis: Graded in accordance with ASTM C 33, as indicated in Table No. 03304-2.04.
- B. Gradation limits of Table No. 03304, Subsection 2.04 may be changed if, in the judgment of the ENGINEER, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids, and the maximum aggregate size does not exceed the following requirements.
 - 1. One-fifth (1/5) of narrowest dimension between forms.
 - 2. One-third (1/3) of depth of slabs.
 - 3. Three-quarter (3/4) of minimum clear spacing between reinforcing bars.
- C. Deleterious Substances: Maximum percentage by weight.
 - 1. Soft Fragments: 2.0 percent
 - 2. Coal and Lignite: 0.3 percent
 - 3. Clay Lumps: 0.3 percent
 - 4. Other Deleterious Substances: 2.0 percent

TABLE NO. 03304-2.04

MASTER GRADING BAND LIMITS FOR COARSE AGGREGATION			
Sieve Sizes	COARSE AGGREGATE Percent Passing by Weight		
	Grade 467	Grade 57	Grade 67

in	Min	Max	Min	Max	Min	Max
2"	100	-	-	-	-	-
1 1/2"	95	100	100	-	-	-
1"	-	-	95	100	100	-
3/4"	35	70	-	-	90	100
1/2"	-	-	25	60	-	-
3/8"	10	30	-	-	20	55
#4	0	5	0	10	0	10
#8	-	-	0	5	0	5

2.05

FINE AGGREGATE

- A. Sieve Analysis: Graded in accordance with ASTM C 33, as follows.

TABLE NO. 03304-2.05

MASTER GRADING BAND LIMITS FOR FINE AGGREGATION		
	FINE AGGREGATE Percent Passing by Weight	
Sieve Sizes	MIN	MAX
in		
3/8"	100	-
#4	95	100
#16	45	80
#50	10	30
#100	2	10

- B. Deleterious Substances: Maximum percentage by weight.
1. Coal and Lignite: 0.3 percent.
 2. Clay Lumps: 0.5 percent.
 3. Other Deleterious Substances: 2.0 percent.

2.06

ADMIXTURES

- A. Air Entrainment: ASTM C 260.
- B. Water Reducing and Set Retarding Agents: ASTM C 494.
1. Type A: Set water reducing.
 2. Type B: Set retarding.
 3. Type C: Set accelerating.
 4. Type D: Water reducing and set retarding.
 5. Type E: Water reducing and set accelerating.

6. Type F: High range water reducing (super plasticizer). *
7. Type G: High range water reducing and set retarding. *

* - The relative durability factor of water reducing admixtures shall not be less than 80, and the chlorides content (as C1-) shall not exceed 1 percent by weight of the admixtures.

- C. Calcium Chloride: None allowed.
- D. Pozzolan: Pozzolan conforming to the requirements of ASTM C 618, Class F, is allowed as a Portland cement replacing agent under the following conditions:
 1. The maximum percentage of Portland cement replacement is:
 - a. Fifteen (15) percent, for concrete exposed to weather.
 - b. Twenty (20) percent, for interior concrete.
 2. The ratio of replacement by weight of Pozzolan to cement shall be 1.25 to 1.0.
 3. The minimum cement content shall be used in the design formulas before replacement is made.
 4. Loss of ignition of pozzolan is less than three (3) percent, and the water requirement does not exceed one hundred (100) percent.
 5. All other requirements of this Section still apply.
 6. Mix designs including trial batches are required for each aggregate source and for each concrete class.

2.07 ACI MIX DESIGN

- A. The amount by which the average strength (f_{cr}) of a concrete mix exceeds the specified compressive strength (f'_c) shall be based upon no more than one (1) in one hundred (100) random individual strength tests falling more than five hundred (500) psi (3.45 mPa) below the specific strength.
- B. Proportion the materials in accordance with ACI 211.1, 211.2, or 211.3 as applicable to produce concrete having the properties or limitations of Table No. 03304-2.08.

2.08 HAND MIXING

- A. Do not hand mix batches exceeding 0.5 cubic yards.
- B. Hand mix only on watertight platform. Mix cement and aggregate prior to adding water.

- C. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency.

2.09

HEATING, WATER, AND AGGREGATE

- A. Do not allow products of fuel combustion to contact the aggregate.
- B. Heat mixing water to 150°F maximum. Heat aggregates uniformly.
- C. Do not mix cement with water and aggregate at a mix temperature greater than 100°F.

TABLE NO. 03304-2.08

CONCRETE MIX PROPERTIES						
CONCRETE PROPERTIES	CONCRETE CLASSIFICATIONS					
	Class 7000	Class 6000	Class 5000	Class 4000	Class 3000	Class 2000
Specified Compressive Strength f'_c at 28 days, min., psi	7000	6000	5000	4000	3000	2000
Compressive Strength at 7 days, psi, min. (a)	4690	4020	3350	2680	2010	1430
Cement content (94-lb sacks of cement per Cubic yard of concrete), Min. (b)	(c)	(c)	(c)	6.0	5.5	4.5
Entrained air content, (%by column)	(d)	(d)	(d)	6 ± 1	$6 \pm 1 \pm 1.5$	4.5
Slump range, in. (e)	2 – 4	2 – 4	2 – 4	2 – 4	2 – 4	2 – 5

- (a) Used for monitoring purposes only.
- (b) Includes pozzolan replacements.
- (c) Cement content shall be appropriate to produce a mixture meeting the requirements for water/cement ratio and workability for the specific job conditions.
- (d) Air content shall be appropriate to the exposure conditions.
- (e) Not more than eight (8) inches after adding high range water reducing admixture (super-plasticizer) at site.
- (f) Not allowed if concrete is exposed to freezing and thawing temperatures. Use Class 4000 or higher compressive strength and 6 ± 1.0 percent air entrainment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. CONCRETE WORK; Section 03310.
- B. CONCRETE QUALITY CONTROL; Section 03305.
- C. CONCRETE CURING; Section 03370.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Concrete will be measured by the cubic yard to the nearest one-tenth cubic yard in accordance with the dimensions shown on the plans or ordered. Volumes occupied by reinforcing steel, anchors, or expansion devices, conduits, weep holes, structural steel, pre-cast, pre-stressed concrete girders, or steel piling will not be deducted from the concrete volume. Eye bolts required for box culverts and bridges to attach fencing, as shown on the plans, shall be considered subsidiary to other contract items.
- B. Where the ENGINEER determines that it is impracticable to determine the volume of concrete by the dimension method, concrete will be measured by batch volumes incorporated into the Work. When batch measurement is used, an inspector will observe the weight of materials batched, and the weight will be converted to volume in accordance with the design mix.

4.02 BASIS OF PAYMENT

- A. The accepted quantities of structural concrete will be paid for at the contract unit price per cubic yard complete in place.
- B. Payment will be made under the specific type or class of concrete, and the pay unit shall be by the cubic yard basis.

END OF SECTION

SECTION 03305 — CONCRETE QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Testing requirements for CONTRACTOR's quality control of Portland cement concrete mixtures.
- B. Re-testing potentially defective concrete.

1.02 SUBMITTALS

- A. Field and laboratory control test reports for material properties enumerated herein.
- B. Material certificates.

1.03 QUALITY ASSURANCE

- A. Test Forms and Storage Areas: ASTM C 31.
- B. Control testing in accordance with Section 01440.

1.04 REFERENCES

- A. ACI 318: Building Code Requirements for Reinforced Concrete.
- B. ASTM C 31: Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- C. ASTM C 39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- D. ASTM C 42: Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- E. ASTM C 78: Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
- F. ASTM C 138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- G. ASTM C 172: Standard Method of Sampling Freshly Mixed Concrete.
- H. ASTM C 173: Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.

- I. ASTM C 231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- J. ASTM C 567: Standard Test Method for Unit Weight of Structural Lightweight Concrete.
- K. ASTM D 4832: Standard Test Method for Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.05 PROJECT CONDITIONS

- A. Furnish labor to assist in obtaining and handling samples at site or sources.
- B. As a result of failed tests, perform remedial Work at no additional cost to the OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TESTING COMPRESSION STRENGTH

- A. Obtaining Samples: Unless indicated otherwise, secure composite samples in accordance with ASTM C 172. Obtain samples from different portions of the batch of concrete.
- B. Casting:
 - 1. Cast and cure four (4) concrete cylinders in accordance with ASTM C 31, 3 for testing and one (1) to be cured as a spare. Determine unit weight, slump, air content, and temperature of concrete casting.
 - 2. For controlled low-strength material (CLSM) and lime treated fills, cast concrete cylinders in accordance with ASTM D 4832.
- C. Testing: Perform compression tests on samples in accordance with ASTM C 39.
 - 1. Two (2) specimens shall be tested at twenty-eight (28) days for acceptance and one (1) shall be tested at seven (7) days for information. The acceptance test results shall be the average of the strengths of the two (2) specimens tested at twenty-eight (28) days. If one specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the spare specimen shall be tested and averaged as one (1) of the two (2) constituting the 28-day test.
 - 2. For controlled low-strength material (CLSM) and lime treated fills, test one (1) cylinder at three (3) days and the remainder at twenty-eight (28) days.

3. If any one (1) cylinder in a 28-day test shows definite evidence, other than low strength, of improper sampling, molding, handling, curing, or testing, discard. The average strength of the remaining cylinders shall be considered the test result.

3.02 TESTING FLEXURAL STRENGTH

- A. Obtaining Samples: Secure composite samples in accordance with ASTM C 172. Obtain samples from different portions of the batch of concrete.
- B. Casting: Cast and cure four (4) concrete beams in accordance with ASTM C 31. Determine slump, air content, and temperature of concrete casting. Report deviations from requirements.
- C. Testing: Perform flexural tests on samples; ASTM C 78.
 1. Test one (1) beam at seven (7) days or as approved by ENGINEER for determining when construction traffic is permitted on paved surfaces.
 2. Test the remaining beams at twenty-eight (28) days. If any one beam in a 28-day test shows definite evidence, other than low strength, of improper sampling, molding, handling, curing, or testing, discard. The average strength of the remaining beams shall be considered the test results.

3.03 TESTING CONCRETE PAVEMENT THICKNESS

- A. Determined from cores secured in accordance with ASTM C 42.

3.04 TESTING CONCRETE PAVING SMOOTHNESS

- A. Maximum perpendicular distance between three (3) straightedge points and the pavement surface:
 1. Parallel to Centerline: One-eighth (1/8) inch to ten (10) feet.
 2. Perpendicular to Centerline: One-quarter (1/4) inch to ten (10) feet.

3.05 ADDITIONAL TESTING

- A. Slump Test: ASTM C 231.
- B. Air Test:
 1. Normal weight concrete air content; ASTM C 231.
 2. Light weight concrete air content; ASTM C 173.
- C. Unit Weight:

1. Normal weight concrete; ASTM C 138.
 2. Light weight concrete; ASTM C 567.
- D. When requested, test concrete in place by impact hammer, sonoscope, or other non-destructive device:
1. To determine relative strengths in various locations in Work.
 2. To aid in evaluating concrete strength.
 3. To select areas to be cored.
 4. To verify quality control in the absence of Control Testing.

3.06

RE-TESTING POTENTIALLY DEFECTIVE CONCRETE

- A. If a concrete test result is below specification and the Work is considered potentially deficient:
1. A request to ENGINEER for re-testing must be made within thirty-five (35) days from time of placement if
 2. CONTRACTOR desires re-test.
 3. No coring or re-testing shall be done after forty (40) days have elapsed from the time of placement.
 4. Only one (1) re-test shall be allowed for a test subplot.
- B. Obtain and test cores in accordance with ASTM C 42. Secure a minimum of three (3) cores from each subplot considered potentially deficient. Coordinate test locations with ENGINEER.
- C. If concrete in Work will be dry under service condition, air-dry cores for seven (7) days before tests. Unless otherwise specified, use air temperature 60°F to 80°F and relative humidity less than sixty (60) percent.
- D. If concrete in Work under service conditions will be more than superficially wet, test cores after moisture conditioning (liquid or vapor water cure).
- E. If one (1) or more cores show evidence of having been damaged before testing, provide replacement.
- F. Evaluate cores in accordance with ACI 318.

- G. If core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the Work, load test may be required and evaluated in accordance with ACI 318.
- H. Fill core holes with non-shrink, low slump concrete mortar. Coat sides of holes with an approved concrete epoxy resin adhesive. Match color and texture of surrounding concrete.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Measurement will be made only if additional testing and analysis required if the tests show deficiencies. Measurement will be based on the independent lab units of measurement.

4.02 BASIS OF PAYMENT

- A. Pay all costs incurred in providing additional testing and analysis required if the tests show deficiencies. If additional testing shows concrete meets specification, OWNER will pay for additional testing.

END OF SECTION

SECTION 03310 — CONCRETE WORK

PART 1 GENERAL

1.01 SUMMARY

- A. Concrete placement operations for cast-in-place slabs on grade, slabs on fill, structural building frame, and other concrete components.

1.02 SUBMITTALS

- A. Quality control test reports and material certificates; Section 03305.
- B. Record of Placed Concrete: Record date, location of pour, quantity, air temperature, and CONTRACTOR's quality control test samples taken.
- C. Product name, type, and chemical analysis of the following as applicable:
 - 1. Curing compound.
 - 2. Sealing compound.
 - 3. Chemical hardener.
 - 4. Bonding compound.
- D. Batch Delivery Ticket: Submit for each batch delivered to site.
 - 1. Slump of batch at the job site.
 - 2. Date.
 - 3. Producer and plant.
 - 4. Job.
 - 5. Name of contractor.
 - 6. Serial number of ticket.
 - 7. Truck number and time dispatched.
 - 8. Volume of concrete.
 - 9. Reading of revolution counter at first addition of water.
 - 10. Signature or initials of Ready-Mix representative.
 - 11. Type and brand of cement.

12. Amount of cement.
13. Total water content (W/C ratio).
14. Water added for receiver of concrete and receiver's initials.
15. Admixture types and amounts.
16. Maximum size of aggregate.
17. Separate weights of fine and coarse aggregate.
18. Indication that all ingredients are as previously certified or approved.

1.03

QUALITY ASSURANCE

- A. Rejection: Concrete Work which fails to meet one or more of the following requirements and which cannot be brought into compliance shall be rejected. ENGINEER shall determine appropriate modifications or payment adjustments to be made.
 1. Appearance: Concrete exposed to view with defects which adversely affect appearance of specified finish.
 2. Strength: Strength of concrete fails to comply with any of the following requirements.
 - a. The average of three (3) 28-day compressive or flexural strength samples made from the same batch of concrete falls below the acceptance level.
 - b. Reinforcing steel size, quantity, strength, position, damage, or arrangement at variance with requirements.
 - c. Concrete which differs from required dimensions or location in such a manner as to reduce its strength or load carrying capacity.
 - d. Method of curing is not as specified.
 - e. Inadequate protection of concrete from extremes of temperature during the early stages of hardening and strength development.
 - f. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength development.
 - g. Workmanship likely to result in deficient strength.
 3. Slab Tolerance: Finishing which fails to comply with Section 03345 requirement.

4. Material Sources: Failure to comply with Section 03305.

B. Finishers: Approved by ENGINEER or ACI certified.

1.04 REFERENCES

A. ACI 301: Specifications for Structural Concrete for Buildings.

B. ACI 305: Hot Weather Concreting.

C. ACI 306.1: Cold Weather Concreting.

D. ACI 309: Standard Practice for Consolidation of Concrete.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete: Class as indicated, material in accordance with Section 03304.

B. Bonding Compound: Polyvinyl acetate base or acrylic base, of the type that cannot be re-hydrated.

C. Vapor Barrier: 10-mil-thick, clear, polyethylene sheet. Type recommended for below grade application and shall be free from pin holes, tears, scars, and other defects.

D. Forms: In accordance with Section 03100.

E. Reinforcement: In accordance with Section 03200.

F. Coverings and Curing Compound: In accordance with Section 03370.

G. Non-shrink Grout: Adhesives epoxy, in accordance with Section 03600.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not impede placing concrete.

B. Do not allow construction loads to exceed member capacity.

C. Prepare previously placed concrete by cleaning with steel brush and applying bonding compound. Apply bonding compound in accordance with manufacturer's instructions.

D. At locations where new concrete is dowelled to existing Work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.

- A. Slump: Do not discharge concrete if its slump is greater or less than permissible slump. Report results of slump test on batch delivery tickets.
- B. Concrete Placement Time Limit: After the introduction of mixing water to the cement and aggregates at the batch plant, discharge concrete from truck mixer within the following air temperatures and time periods.
 - 1. Air temperature less than 80°F: 1-1/2 hours.
 - 2. Air temperature over 80°F without a retarder added to the mix: One (1) hour maximum.
 - 3. Air temperature over 80°F with retarder added to the mix: 1-1/2 hours maximum.
- C. Tempering
 - 1. When concrete arrives at site with slump below specified, water may be added if the maximum approved water/cement ratio and the maximum slump is not exceeded, provided that:
 - a. The approved mix design has allowed for on-site addition of water.
 - b. The amount of water added at the site is accurately measured to ± 1 gallon of the desired added amount.
 - c. That water addition is followed by three (3) minutes of mixing at mixing speed prior to discharge.
 - d. That the person authorized to add water is mutually approved of in writing by ENGINEER, CONTRACTOR, and Ready-Mix Supplier.
 - 2. Do not add water after concrete discharge from the mixer commences.
- D. Cold Weather, Hot Weather Concreting: Maintain mixed concrete temperature at times of placement between 60°F and 90°F.
- E. Super-plasticizer
 - 1. Pre-measure and add high range water reducing agent in accordance with manufacturer's instructions.
 - 2. If added at site, add agent using injection equipment capable of rapidly and uniformly distributing the admixture to the concrete. Prior to discharge, mix for

a minimum of five (5) minutes at a drum rate not less than twelve (12) rpm or more than fifteen (15) rpm.

3. If added at plant, do not deliver to site unless batch delivery ticket displays water/cement ratio prior to super-plasticizer addition.
4. Tempering with super-plasticizer after expiration of allowable delivery times is prohibited.

3.03 CONCRETE PLACEMENT

- A. Notify ENGINEER minimum twenty-four (24) hours prior to commencement of concrete placement operations.
- B. Place concrete in accordance with ACI 301.
- C. Hot Weather Placement: When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature, provided the water equivalent of the ice is calculated to the total amount of mixing water.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 3. Wet forms thoroughly before placing concrete.
- D. Cold Weather Placement
 1. Protect concrete Work from physical damage or reduced strength, which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified. If necessary to place concrete under conditions of low temperature, placement shall be approved by the ENGINEER.
 2. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat all water and aggregates before mixing, as required to obtain a concrete mixture temperature of not less than 50°F and not more than 70°F for three (3) days or 50°F for five (5) days.
 3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen material.

- 4. Do not use calcium chloride, salt and other material containing antifreeze agents, or chemical accelerators, unless otherwise accepted in writing by the ENGINEER.
- E. Do not disturb reinforcement, inserts, embedded parts, and formed joints.
- F. Do not break or interrupt successive pours such that cold joints occur.
- G. Honeycomb or embedded debris in concrete is not acceptable.

3.04 JOINTS AND JOINT SEALING

- A. Expansion and contraction joints, in accordance with Section 03251.

3.05 CONSOLODATION

- A. In accordance with ACI 309.
- B. Keep spare vibrator available during concrete placement operations.

3.06 FINISHING

- A. Do not add water to concrete surface (i.e., sprinkle) without written approval.
- B. Slab Finishing Tolerance: In accordance with Section 03345.
- C. Finishes: In accordance with Section 03345. When type of finish is not indicated, use following finishes as applicable:
 - 1. Sidewalks, garage floors, and ramps: Broom or belt finish.
 - 2. Exterior concrete pavement: Broom or belt finish.
 - 3. Exterior platforms, steps, and landings, exterior and interior pedestrian ramps, not covered by other finish materials: Non-slip finish.
 - 4. Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
 - 5. Surfaces intended to receive roofing, except future floors, waterproofing membranes, and roof surfaces which are future floors or sand bed terrazzo: Floated finish.
 - 6. Floors and roof surfaces which are floors intended as walking surfaces or to receive floor coverings: Troweled finish.
 - 7. Unpainted concrete surfaces not exposed to public view: Rough as-cast form finish.

8. Unpainted concrete surfaces exposed to public view: Smooth as-cast form finish.
9. Concrete surfaces to receive paint or plaster: Grout cleaned finish.

3.07 CURING

- A. Cure in accordance with Section 03370. Unless specified otherwise, apply a liquid membrane curing compound.

3.08 CONTROL TESTING

- A. Arrange for and perform all control testing required for qualification of proposed materials and the establishment of mix designs, in determining strengths for early form removal and other needs of CONTRACTOR.
- B. One slump test for each batch of concrete placed in the Work.
- C. Two slump tests, one before and one after the addition of super-plasticizer.

3.09 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required levels, lines, details, and elevations.
- B. Structural analysis and additional testing may be required at no additional cost of OWNER when the strength of a structure is considered potentially deficient.
- C. Patch imperfection. Refer to Section 03345 requirements.

3.10 PROTECTION AND REPAIRS

- A. Protection: Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimum moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Random Cracks in Pavement Slabs on Grade: When cracks occur within two (2) feet of expansion or construction joints, remove and repair. Otherwise, grout with Section 03600 epoxy adhesive grout. Use saw cuts and dowels in all cut planes.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Measurement of this item shall be of the number of cubic yards placed for each concrete structural unit or category individually identified in the "Bid Schedule".

4.02 BASIS OF PAYMENT

- A. Payment for concrete work shall be based on the unit price bid for each individual concrete category multiplied by the number of units (cubic yards) placed and measured as above.

END OF SECTION

SECTION 03345 — CONCRETE FINISHING

PART 1 GENERAL

1.01 SUMMARY

- A. Finishing interior and exterior concrete surfaces.

1.02 SUBMITTALS

- A. Name, type, chemical analysis and manufacturer's recommended rate of application for liquid chemical hardener.

1.03 REFERENCES

- A. ACI 303: Guide to Cast-in-Place Architectural Concrete Practice.

1.04 PROJECT CONDITIONS

- A. Protect adjacent materials and finishes from dust, dirt, and other surface or physical damage during finishing operations. Provide protections as required and remove from site at completion of Work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mortar and Grout: In accordance with Section 03600.
- B. Dry Shake: Blend of metallic or mineral aggregate with Portland cement concrete in proportions recommended by manufacturer.
- C. Proprietary Materials: If permitted or required, proprietary compounds may be used in lieu of or in addition to foregoing materials. Use such compounds in accordance with manufacturer's recommendations.
- D. Liquid-Chemical Hardener: Colorless, aqueous solution containing a blend of magnesium fluosilicate, zinc fluosilicate, and a wetting agent. Mixture contains not less than two (2) pounds fluosilicate per gallon and does not interfere with adhesives and bonding of finishes where such is indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Examine the areas and conditions under which Work of this Section will be performed.
- B. Correct conditions detrimental to timely and proper finishing.
- C. Do not proceed until unsatisfactory conditions are corrected.

3.02 FINISHING OF FORMED SURFACES

- A. General
 - 1. Allow concrete to cure not more than seventy-two (72) hours before commencing surface finish operations, unless approved otherwise.
 - 2. Revise the finishes as needed to secure approval.
- B. As-Cast Form Finish
 - 1. Rough: Patch defects and chip or rub off fins exceeding one-quarter (1/4) inch height.
 - 2. Smooth: Patch tie holes and defects and remove fins completely.
 - a. When surface texture is impaired and form joints misaligned, grind, bush hammer, or correct affected concrete.
 - b. Slurry grout areas evidencing minor mortar leakage to match adjacent concrete.
 - c. Repair major mortar leakage as a defective area.
 - d. When workmanship is less than acceptable standard, provide one of rubbed finishes at no additional cost to OWNER.
- C. Rubbed Finish
 - 1. Smooth Rubbed: Remove forms and perform necessary patching as soon after placement as possible.
 - a. Finish newly hardened concrete no later than twenty-four (24) hours following form removal.
 - b. Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced.

2. Grout Cleaned: Undertake no cleaning operations until all contiguous surfaces are completed and accessible.
 - a. Wet surface of concrete sufficiently to prevent absorption of water from grout.
 - b. Apply grout uniformly.
 - c. Immediately after grouting, scrub surface with cork float or stone to coat surface and fill voids.
 - d. While grout is still plastic, remove excess grout by working surface with rubber float or sack.
 - e. After surface whitens from drying, rub vigorously with clean burlap.
 - f. Keep damp for at least thirty-six (36) hours after final rubbing.
3. Cork Floated: Remove forms within two (2) to three (3) days of placement where possible.
 - a. Remove ties.
 - b. Remove all burrs and fins.
 - c. Dampen wall surface.
 - d. Apply mortar with firm rubber float or with trowel, filling all surface voids.
 - e. Compress mortar into voids.
 - f. If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer.
 - g. Produce final texture with cork float using a swirling motion.

D. Unformed Finish

1. After concrete is placed, strike smooth, tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces.
2. Float to texture which is reasonably consistent with formed surfaces.
3. Continue final treatment on formed surfaces uniformly across unformed surfaces.

E. Blasted Finish

1. Perform abrasive blasting within twenty-four (24) to seventy-two (72) hours after casting.
2. Coordinate with form work construction, concrete placement schedule, and form work removal to ensure that surfaces are blasted at the same age for uniform results.
3. Re-apply curing protection after blast finishing.

F. Architectural Finish

1. General: In accordance with ACI 303.
2. Tooled Finish:
 - a. Dress thoroughly cured concrete surface with electric, air, or hand tools to uniform texture, and give a bush hammered surface texture.
 - b. Remove sufficient mortar to exposed coarse aggregate in relief and to fracture coarse aggregate for tooled finish.

G. Patched Finish

1. Repair defective areas.
 - a. Remove honeycomb and defective concrete to sound concrete.
 - b. Make edges perpendicular to surface or slightly undercut.
 - c. Feathered edges are not permitted.
 - d. Dampen area to be patched and at least six (6) inches surrounding it to prevent absorption of patching mortar water.
 - e. Prepare bonding grout.
 - f. Mix to consistency of thick cream.
 - g. Brush into surface.
2. Tie Holes: Unless indicated otherwise, after being cleaned and thoroughly dampened, fill tie holes solid with patching mortar.
3. Make any patches in concrete to closely match color and texture of surrounding surfaces. Determine mix formula for patching mortar by trial and obtain a good color match with concrete when both patch and concrete are cured and dry.

- a. Mix white and gray Portland cement as required to match surrounding concrete to produce grout having consistency of thick paint.
 - b. Use a minimum amount of mixing water.
 - c. Mix patching mortar in advance and allow to stand without frequent manipulation, without addition of water, until it has reached the stiffest consistency at which it can still be placed.
 - d. After initial set, dress surfaces of patches manually to obtain same texture as surrounding surfaces.
4. After surface water has evaporated from patch area, brush bond coat into surface.
 - a. When bond coat begins to lose water sheen, apply patching mortar.
 - b. Thoroughly consolidate mortar into place and strike-off to leave patch slightly higher than surrounding surface.
 - c. Leave undisturbed for at least one (1) hour before final finish.
 - d. Keep patched area damp for seventy-two (72) hours or apply curing compound.
 - e. Do not use metal tools in finishing an exposed patch.
5. Where as-cast finishes are indicated, total patched area may not exceed one (1) in five hundred (500) of as-cast surface. This is in addition to form tie patches, if ties are permitted to fall within as-cast areas.
6. In any finishing process which is intended to expose aggregate on surface, patched areas must show aggregate.
 - a. Outer one (1) inch of patch shall contain same aggregates as surrounding concrete.
 - b. For aggregate transfer finish, patching mixture shall contain same selected colored aggregates.
 - c. After curing, expose aggregates together with aggregates of adjoining surfaces by same process.

A. Slab Finishing Tolerances:

1. Class A finish: 1 in 1000.
2. Class B finish: 1 in 500.
3. Class C finish: 1 in 250.

B. Broom and Belt Finish: After concrete has been placed, consolidated, struck-off, and leveled to the required tolerance, roughen surface transversely with stiff brushes, rakes, or burlap belt before final set.

C. Floated Finish: After concrete has been placed, consolidated, struck-off, and leveled, do not work further until ready for floating.

1. Begin floating when water sheen has disappeared and surface has stiffness sufficient to permit operation.
2. During or after first floating, check planeness of entire surface with a 10-foot-long straightedge applied at two (2) or more different angles.
3. Cut down high spots and fill low spots to the required tolerance.
4. Re-float slab immediately to a uniform sandy texture.

D. Trowel Finish

1. Float finish surface.
2. Power trowel.
3. Hand trowel as required to provide surface. Do not apply water (i.e., sprinkle) to surface of concrete in finishing operations.
4. First troweling after power floating shall produce smooth surface relatively free of defects but which may still show some trowel marks.
5. Second trowel by hand after surface has hardened.
6. Leave finished surface essentially free of trowel marks, uniform in texture and appearance.
7. On surfaces intended to support floor coverings, grind off defects which would show through floor coverings.

- E. "Dry Shake" Finish: Give surface a floated finish.
1. Apply approximately two-thirds (2/3) of a blended material for required coverage to surface by a method that ensures even coverage without segregation.
 2. Begin floating immediately after application of first "dry shake".
 3. After material has been embedded by floating, apply remainder of blended material to surface at right angles to prevent application.
 4. Make second application heavier in any areas not sufficiently covered by first application.
 5. Immediately follow with second floating.
 6. After selected material has been embedded by second floating, complete operation with a broomed, floated, or troweled finish, as indicated.
- F. Non-slip Finish: Give surface a "dry shake" application, using crushed, ceramic-bonded, aluminum oxide particles. Apply at twenty-five (25) pounds per one hundred (100) square feet.
- G. Exposed Aggregate Finish: Immediately after surface of concrete has been leveled to tolerance and surface water has dissipated, spread aggregate uniformly over surface to provide complete coverage to the depth of a single stone.
1. Embed aggregate into surface by light tamping.
 2. Float surface until embedded aggregate is fully coated with mortar and surface has been brought to tolerance.
 3. Start exposure of aggregate after matrix has hardened sufficiently to prevent dislodgment.
 4. Flow ample quantities of water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush.
 5. Continue until aggregate is uniformly exposed.
 6. An approved chemical retarder sprayed onto freshly floated surface may be used to extend working time.
- H. Chemical-Hardener Finish: Apply liquid chemical-hardener finish to interior concrete floors where indicated. Do not apply liquid chemical concrete hardener on floor areas scheduled to receive synthetic matrix terrazzo, setting beds for tile, terrazzo, vinyl flooring, or like items. Apply hardener after complete curing and drying of

concrete surface in accordance with manufacturer's recommendations. Evenly apply each coat, and allow twenty-four (24) hours for drying between coats. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

PART 4 METHOD OF MEASUREMENT

4.01 METHOD OF MEASUREMENT (THIS WORK WILL NOT BE MEASURED FOR PAYMENT)

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 03370 — CONCRETE CURING

PART 1 GENERAL

1.01 SUMMARY

- A. Concrete curing material requirements and methods.

1.02 SUBMITTALS

- A. Manufacturer's specifications, test data, and other data required to prove compliance with the specified requirements.
- B. Manufacturer's recommended installation procedures which, when approved by ENGINEER, will become the basis for accepting or rejecting actual installation procedures used in the Work.

1.03 QUALITY ASSURANCE

- A. Use workers who are trained, experienced, and completely familiar with the curing and protection requirements of ACI 301 and the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Maintain concrete with minimum moisture loss at relatively constant temperature recommended by manufacturer for a period necessary for hydration of cement and hardening of concrete.

1.04 REFERENCES

- A. ACI 301: Specifications for Structural Concrete for Buildings.
- B. ASTM C 171: Standard Specification for Sheet Materials for Curing Concrete.
- C. ASTM C 309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- D. ASTM C 642: Standard Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.

1.05 PRODUCT HANDLING

- A. Protect the materials of this Section before, during, and after installation, and protect the Work and materials of other trades.

- B. In the event of damage, immediately make replacements and repair at no additional cost to OWNER.

PART 2 PRODUCTS

2.01 WATER

- A. Clean, non-straining and non-detrimental.

2.02 MOISTURE-RETAINING SHEET MATERIALS

- A. ASTM C 171, white, waterproof paper, polyethylene film, or burlap-polyethylene sheet.

2.03 ABSORPTIVE MAT MOISTURE COVER

- A. Cotton or burlap fabrics, clean roll goods.

2.04 CURING COMPOUND

- A. Liquid membrane, in accordance with ASTM C 309.
- B. Substance type: Unless indicated, CONTRACTOR to select from the following:
 - 1. Chlorinated rubber.
 - a. Type of Compound: Type 2, white pigmented (Titanium Oxide (TiO₂), 7 to 9 percent by weight of total solids.
 - b. Vehicle Solids Material: Class B, restricted to all resin materials. Forty (40) percent minimum by weight of total solids remainder of vehicles solids to chlorinated paraffin.
 - c. Total Solids: Twenty-five (25) percent minimum by weight of compounds.
 - d. Viscosity: Twenty (20) seconds maximum (Ford Cup).
 - e. Fineness of Grand: Six (6) minimum.
 - f. Drying Time:
 - 1) Set to Touch: Twenty (20) minutes maximum.
 - 2) Dry Hard: Forty-five (45) minutes.
 - 3) Alkali Resistance: Forty-eight (48) hours minimum.
 - g. Salt Spray (5 percent @ 95°F (35° C)): Five hundred (500) hours minimum.

2. Sodium silicate.
 - a. Type of Compound: Type 2, white pigmented.
 - b. Vehicle Solids Material: Class A, no restriction.
3. Poly-siloxane (alkyl-alkoxy siloxane).
 - a. Type of Compound: Type 1, clear or translucent without dye.
 - b. Vehicle Solids Material: Class B, restricted to all resin materials.
- C. Water Solubility: Less than one (1) percent.
- D. Weight Gain: At least eighty-five (85) percent reduction of water absorption during initial 24 hour curing period when compared to untreated test sample, ASTM C 642.
- E. Scaling Resistance: Weight loss less than 2.0 percent when subject to five hundred (500) cycles of freeze-thaw.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify concrete surfaces are ready for curing. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Prepare the surface in strict accordance with manufacturer's recommendations.

3.03 MOISTURE COVER CURING

- A. Apply one or both of the following methods.
 1. Water or continuous water-fog spray.
 2. Cover concrete surface with absorptive mat, thoroughly saturate with water, and keep continuously wet.
- B. Place absorptive mat to provide coverage of concrete surfaces and edges. Lap over adjacent absorptive covers.

3.04 MOISTURE-RETAINING SHEET CURING

- A. Place cover in widest practicable width with sides and ends lapped and sealed to prevent moisture loss.
- B. Repair any holes or tears during curing period.

3.05 FORMED SURFACE CURING

- A. Cure formed concrete surface, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed.
- B. If forms are removed, continue curing by curing compound or methods indicated above, as applicable.

3.06 UNFORMED SURFACE CURING

- A. Cure unformed surfaces, such as slabs, floor toppings, and other surfaces by application of appropriate curing method.
- B. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless approved otherwise.

3.07 CURING COMPOUNDS

- A. Apply the approved product to the designated surfaces in strict accordance with the manufacturer's recommended application procedures.
- B. Apply immediately following the final finishing operation as soon as the concrete is firm enough to work on.
- C. Apply uniformly in continuous operation.
- D. Maintain continuity of coating and repair damage during cure period.
- E. Should side forms be removed before expiration of cure period, coat exposed surface with curing compound.
- F. Unless specified otherwise by manufacturer of curing compound, do not use curing compound on surfaces which are to be covered with coating materials.

3.08 SCHEDULE OF CURING APPLICATIONS

- A. Concrete Exposed to Potable Water (as in Water Storage Reservoirs): Moisture cover curing.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT (THIS WORK WILL NOT BE MEASURED FOR PAYMENT)

- A. Unless otherwise noted in the special provisions, no separate measurement will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

4.02 BASIS OF PAYMENT

- A. Unless otherwise noted in the special provisions, no separate payment will be made for items under this section. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

END OF SECTION

SECTION 03480 — PRE-CAST CONCRETE UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Pre-cast concrete units, complete with required connecting and supporting devices.

1.02 SUBMITTALS

- A. Prepare Shop Drawings under seal of Professional Engineer.
- B. Submit Shop Drawings in accordance with Section 01340.
- C. Indicate unit locations, unit identification marks, fabrication details, reinforcement, connection details, pertinent dimensions, and erection support points. Unit identification marks to appear on all manufactured units.
- D. Do not proceed with fabrication until Shop Drawings have been accepted.

1.03 QUALITY ASSURANCE

- A. Design pre-cast concrete units in accordance with ACI 318 and PCI design handbook.
- B. Under direct supervision of Professional ENGINEER who is fully experienced in design of units.
- C. Design units to support required stripping and handling loads, live, dead, and construction loads.
- D. Design component connections to provide adjustment to accommodate misalignment of structure during installation.

1.04 MANUFACTURER AND ERECTOR QUALIFICATIONS

- A. Manufacture and transportation only by company experienced in providing pre-cast products and services normally associated with pre-cast and pre-stressed concrete construction.
- B. Welders: certified in accordance with AWS D1.1 and AWS D1.4.

1.05 REFERENCES

- A. ACI 318: Building Code Requirements for Reinforced Concrete. This reference standard includes other ASTM material standards.
- B. ASTM A 36: Standard Specification for Structural Steel.

- C. ASTM C 478: Standard Specification for Pre-cast Reinforced Concrete Manhole Sections.
- D. ASTM C 858: Standard Specification for Underground Pre-cast Concrete Utility Structures.
- E. AWS D1.1: Structural Welding Code Steel.
- F. AWS D1.4: Structural Welding Code Reinforcing Steel.
- G. PCI: Design Handbook
- H. PCI MNL-116: Quality Control and Assurance for Plant Production of Pre-stressed Concrete.
- I. PCI MNL-117: Quality Control and Assurance for Plant Production of Architectural Pre-cast Concrete.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle pre-cast units in positions consistent with their shape and design. Lift and support only from support points indicated on Shop Drawings.
- B. Embedded Lifting or Handling Devices: Capable of supporting units in positions anticipated during manufacture, storage, transportation, and erection.
- C. Block and laterally brace units while stored at manufacturers. Provide lateral bracing that is sufficient to prevent bowing and warping that is clean, non-staining, and will not inhibit uniform curing of exposed surfaces.
- D. Provide edges of units with adequate protection to prevent staining, chipping, or spalling of concrete.
- E. Unless otherwise approved in writing, do not deliver units to job site until required for installation.

PART 2 PRODUCTS

2.01 CONCRETE

- A. Concrete for Above Ground Structures: Class 5000 minimum, in accordance with Section 03304 and ACI 318, unless a different strength of concrete is indicated.
- B. Concrete for Underground Structures: Class 4000 minimum, in accordance with Section 03304 and ASTM C 478 or ASTM C 858.

2.02 ACCESSORIES

- A. Connecting and Supporting Devices: Steel, in accordance with ASTM A 36.
- B. Bolts, Nuts, and Washers: High-strength steel.
- C. Concrete Reinforcement: Grade 60 reinforcing for all pre-cast units unless approved in writing by ENGINEER.

2.03 FABRICATION

- A. Maintain plant records and quality control program during production of structural pre-cast concrete.
- B. Make records available to ENGINEER.
- C. Use molds which are rigid and constructed of material that will result in uniform finished products.
- D. Deposit and vibrate concrete to ensure proper consolidation, elimination of unintentional cold joints, and minimize entrapped air on surface.
- E. Fabricate required connecting devices, plates, angles, items fit to steel framing members, bolts, and accessories.
- F. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are sufficiently embedded, anchored, and properly located.
- G. Ensure finished surfaces of pre-cast structural units are uniform.
- H. Cure units under identical conditions to develop specified concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

2.04 DESIGN DEVIATIONS

- A. Deviation: Provide installation equivalent to basic intent without additional cost to OWNER. Deviations from exact required cross-section will be permitted only with approval.
- B. Manufacturer's Proposed Design: Supported by complete design calculations and drawings. When requested, submit design calculations for review bearing seal and signature of Professional Engineer.

2.05 OPENINGS

- A. Provide required openings, six (6) inches or larger. If approved, smaller sizes may be field constructed by coring or sawing.

2.06 FINISHES

- A. General: The required finish will be described in one of the following paragraphs. If no finish is indicated or selected by ENGINEER, the standard finish below shall be used.
- B. Standard Finish: Produced in forms such as plastic or metal lined that impart a smooth finish to the concrete. Small surface holes, normal form joint marks, minor chips and spalls are acceptable if approved. Major or unsightly imperfections, honeycomb, or structural defects are not acceptable.
- C. Commercial Finish: Produced in forms such as plywood or lumber that imparts texture to concrete. Remove fins and large projections and fill large holes. Faces: true and well-defined. Correct exposed ragged edges by rubbing or grinding.
- D. Architectural Grade A Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over one-quarter (1/4) inch in diameter with sand-cement paste. Grind smooth form offsets to fins over one-eighth (1/8) inch. Coat with neat cement paste using float. After paste coat has dried, rub with burlap to remove loose particles.
- E. Architectural Grade B Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over one-quarter (1/4) inch in diameter with sand-cement paste. Grind smooth form offsets or fins over one-quarter (1/8) inch.
- F. Special Finishes: Sandblasting, acid washing, retarders, or form liners as approved by ENGINEER. Special finishes require submittal of two (2) 12- by 12-inch samples showing a representative color and texture to be used.
- G. Painted Finishes: Use only paint compatible form release agents on concrete that is to be painted.

2.07 REPAIR

- A. Repair of damaged units is acceptable if structural integrity or appearance is not impaired.

2.08 ALLOWABLE TOLERANCES

- A. Length: Plus or minus three-quarter (3/4) inch, or plus or minus one (1/8) inch per ten (10) feet of length, whichever is greater, or as indicated.
- B. End Squareness: One-half (1/2) inch maximum.
- C. Blockouts: One (1) inch of centerline location indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Do not install pre-cast units until concrete has attained its design compressive strength.
- B. Install members plumb, level, and in alignment with PCI MNL-116 or PCI MNL-117 and indicated limits of erection tolerances.
- C. Clean weld marks or other marks, debris, or dirt from exposed surfaces of units.

3.02 PERFORMANCE REQUIREMENTS

- A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory pre-cast units as required.
- B. Rejection: Units may be rejected for any one of the following:
 - 1. Exceeding specified installation tolerances.
 - 2. Damaged during construction operations.
 - 3. Exposed-to-view surfaces that develop surface deficiencies.
 - 4. Other defects as listed in PCI MNL-116 or PCI MNL-117.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Measurement of Precast Concrete Units shall be the number of each unit individually identified in the "Bid Schedule" complete in place and accepted.

4.02 BASIS OF PAYMENT

- A. Payment for Precast Concrete Units shall be based on the Contract Lump Sum Unit Price for each unit completed in place and accepted.

- B. Payment shall be considered as full compensation for furnishing all labor, materials, tools, equipment and other incidentals necessary to furnish, fabricate, transport and erect each completed Precast Concrete Unit.

END OF SECTION

SECTION 03600 — GROUT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes pre-mixed non-metallic shrinkage resistant, pre-mixed water stop hydraulic cement, epoxy, and Portland cement grouts.
 - 1. Grouting for leveling beds of structural steel plates.
 - 2. Sealing of joints and gaps between piping and structures.
 - 3. Sealing of joints between construction components.

1.02 REFERENCES

- A. ASTM C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens).
- B. ASTM C 144: Standard Specification for Aggregate for Masonry Mortar.
- C. ASTM C 150: Standard Specification for Portland Cement.
- D. ASTM C 157: Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
- E. ASTM C 190: Standard Test Method for Tensile Strength of Hydraulic Cement Mortars.
- F. ASTM C 207: Standard Specification for Hydrated Lime for Masonry Purposes.
- G. ASTM C 472: Standard Methods for Physical Testing of Gypsum Plasters and Gypsum Concrete.
- H. ASTM C 595: Standard Specification for Blended Hydraulic Cements.
- I. ASTM C 827: Standard Test Method for Early Volume Change of Cementitious Mixtures.
- J. ASTM C 881: Standard Specification for Epoxy - Resin - Base Bonding Systems for Concrete
- K. ASTM D 570: Standard Test Method for Water Absorption of Plastics.
- L. ASTM D 638: Standard Test Method for Tensile Properties of Plastics.
- M. ASTM D 695: Standard Test Method for Compressive Properties of Rigid Plastics.

N. CE-CRD-C-621: Corps of Engineers specification for grouts.

1.03 SUBMITTALS

- A. Group mix components. Indicate proportions used, environmental conditions, and admixture limitations. Indicate material "Type", "Grade", and "Class" which suits project requirements.
- B. Manufacturer's data for latex bonding agent.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

- A. Portland Cement: ASTM C 150, natural color Type II (normal) or Type IIA (air entraining).
- B. Lime: ASTM C 207, Type S, hydrated.
- C. Water: Clean, non-staining, and non-detrimental.
- D. Grout Aggregate: ASTM C 144, standard masonry type.

2.02 PORTLAND CEMENT CONCRETE

- A. Proportions by volume shall be one (1) part Portland cement, and sand 2-1/2 to three (3) times sum of volumes of cement and lime.
- B. Mix for five (5) minutes maximum with sufficient water to form stiff plastic putty. Add water as required for workability.
- C. Compressive Strength: ASTM C 109, 2800 psi in twenty-eight (28) days.

2.03 GYPSUM PLASTER GROUT

- A. Pre-mixed, pre-packaged, wood fiber gypsum plaster with an ASTM C 472 minimum average dry compressive strength of 2000 psi in twenty-eight (28) days. Mix with water in accordance with manufacturer's instructions for intended use to form a stiff plastic mix required for workability.

2.04 NON-METALLIC, SHRINKAGE RESISTANT GROUT

- A. Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CE-CRD-C-621.
- B. Compressive Strength: ASTM C 109, 6500 to 9000 psi in twenty-eight (28) days.

- C. Non-shrink Percentage: ASTM C 827 and ASTM C 157, 0.5 percent.

2.05 EPOXY ADHESIVE GROUT

- A. Two component material suitable for use on dry or damp surfaces, one hundred (100) percent solids, high, moisture insensitive, complying with ASTM C 881.
 - 1. Tensile Strength: ASTM D 638, 5000 psi, minimum in fourteen (14) days.
 - 2. Tensile Elongation: ASTM D 638, two (2) percent minimum.
 - 3. Compressive Strength: ASTM D 695, 6500 psi minimum in twenty-four (24) hours and 70°F, 12,500 psi in twenty-eight (28) days and 70°F.
 - 4. Water Absorption: ASTM D 570, one (1) percent maximum.
 - 5. Bond Strength:
 - a. Direct Shear: Four hundred (400) psi.
 - b. Direct Tension: Two hundred fifty (250) psi.
 - c. Beam Break: Eight hundred (800) psi.
 - 6. Pot Life: 5 minutes maximum at 70°F.

2.06 BONDING GROUT

- A. Of approximately one (1) part cement to one (1) part fine sand passing a No. 30 sieve with approved latex bonding agent when allowed.

2.07 PNEUMATICALLY PLACED PLASTER ("GUNITED" OR "SHOTCRETE")

- A. Materials: Portland Cement, lime, water, and sand.
- B. Compressive Strength: ASTM C 109, 2800 psi in twenty-eight (28) days.
- C. Proportioning: One (1) part cement to not more than five (5) parts sand.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Fill joints, voids, and pockets completely.
- B. Comply with manufacturer's instructions and UBC Chapter 47.
- C. Finish surfaces exposed to view smooth.

- D. Pneumatically Placed Plaster: Screened and reused rebound material in an amount not greater than twenty-five (25) percent of the total sand in any batch.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 METHOD OF MEASUREMENT

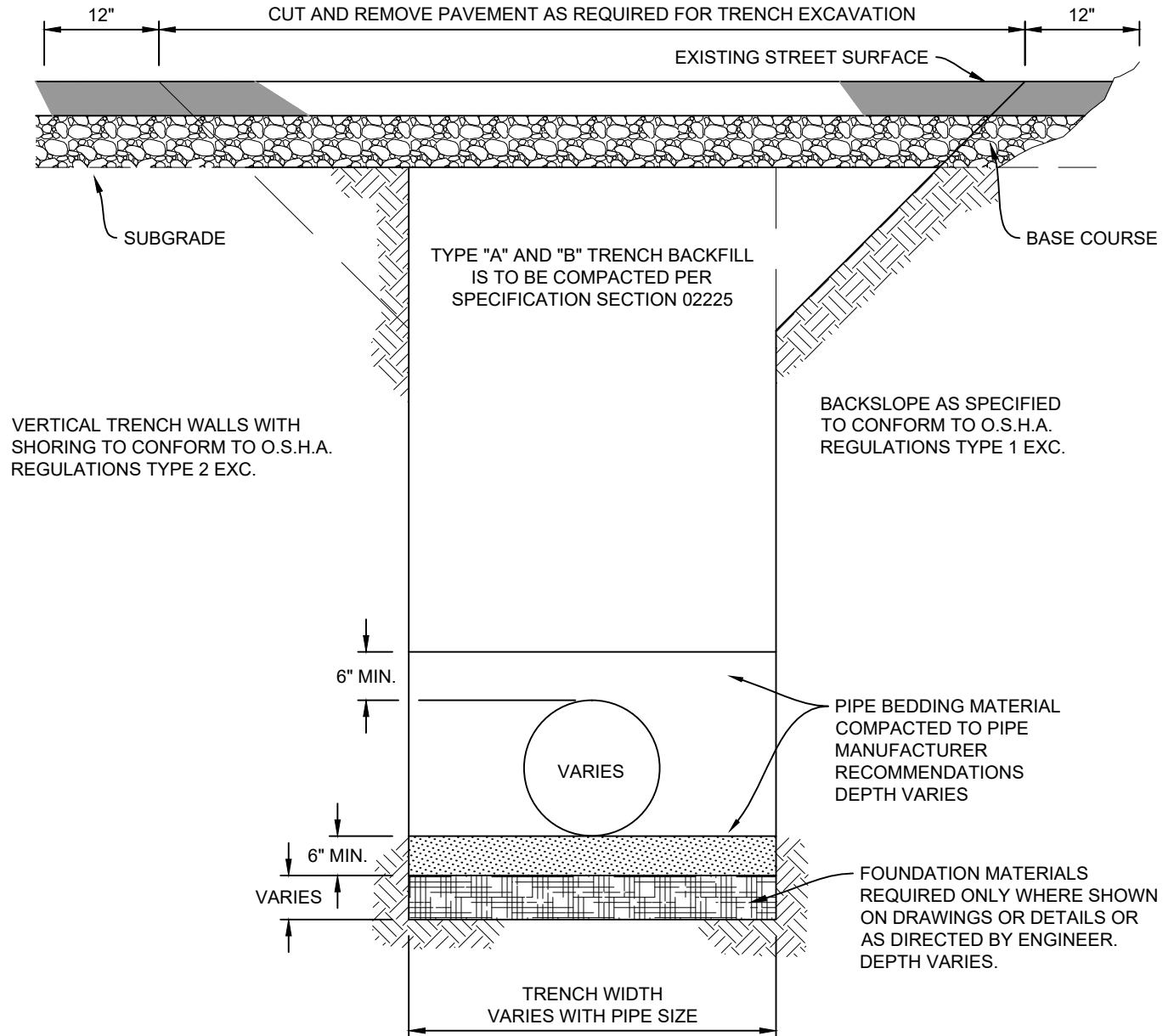
- A. Grouting for leveling for structural plates, sealing joints and gaps, filling voids and pockets and masonry cells shall not be measured for payment.
- B. Pneumatically placed plaster ("Gunitite" or Shotcrete") will be measured by the actual areas in the plane of work.

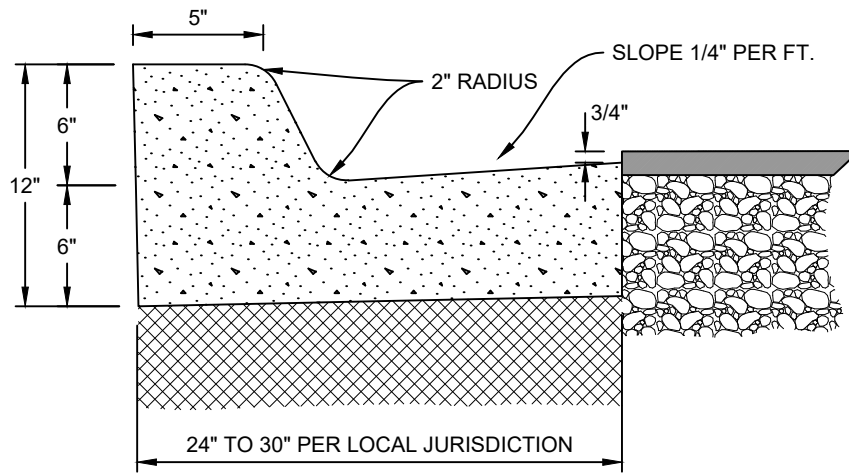
4.02 BASIS OF PAYMENT

- A. No separate payment will be made for items included in A. above. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.
- B. Payment for Pneumatically placed plaster ("Gunitite or Shotcrete") will be based on the Contract Unit Price Bid and shall include full compensation for preparing the foundation, setting all formwork, and grounds, furnishings and placing reinforcement, placing the concrete, finishing surfaces, curing and structural backfill as shown on the Plans. Full compensation shall be considered as included in the prices paid for the various contract items and no additional compensation will be allowed therefore.

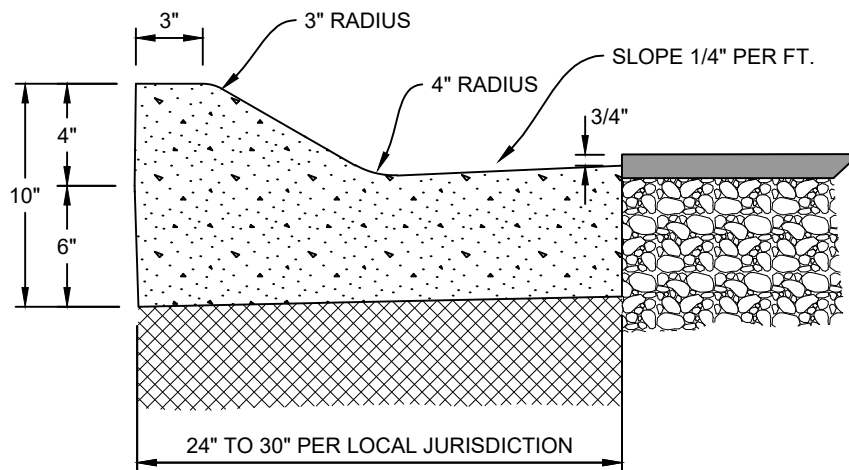
END OF SECTION

NOTE:
WHERE TRENCH PASSES THROUGH EXISTING PAVEMENT THE PAVEMENT SHALL BE
CUT IN ACCORDANCE WITH SECTION 02075-3.01.





TYPE "A"

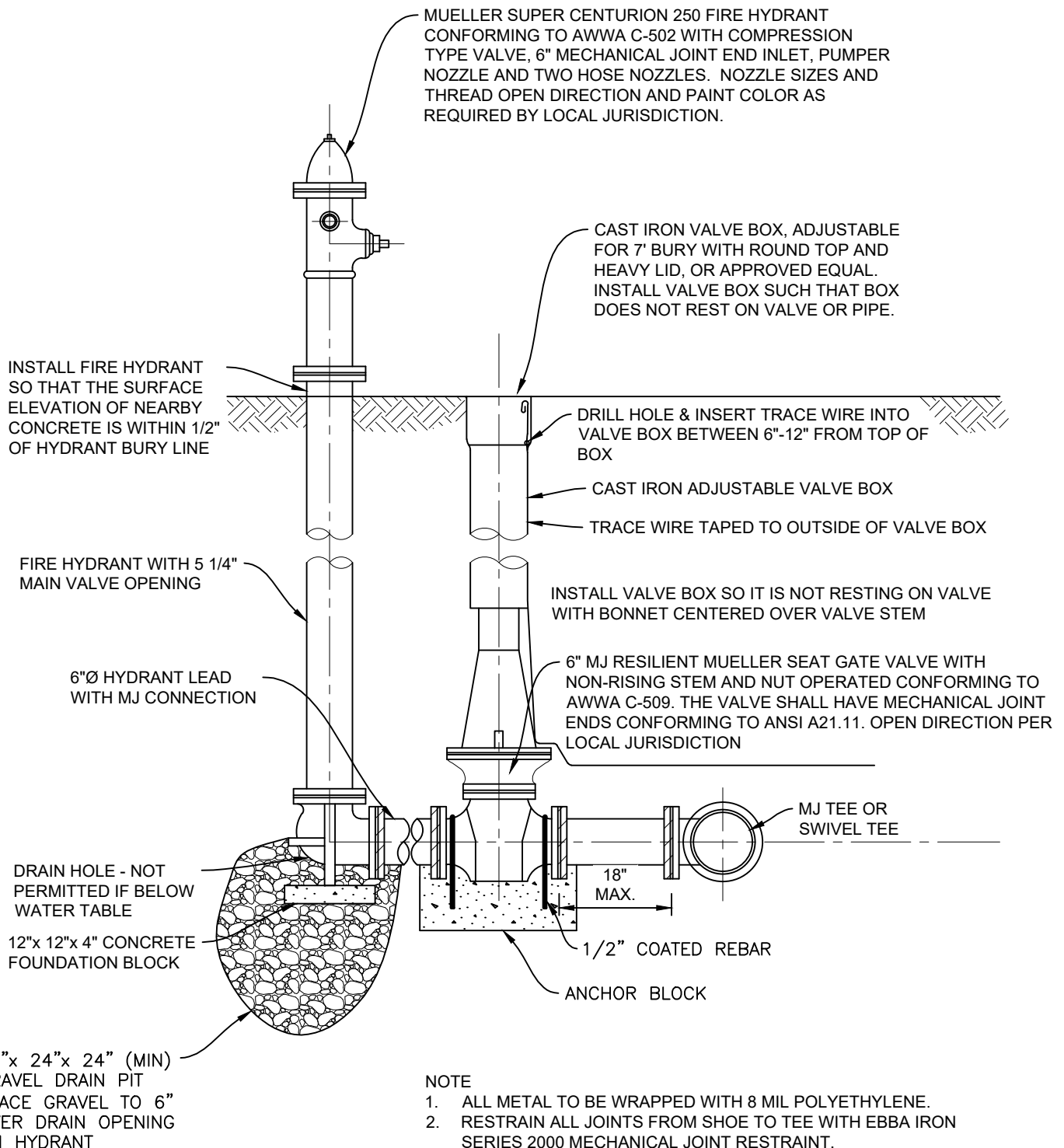


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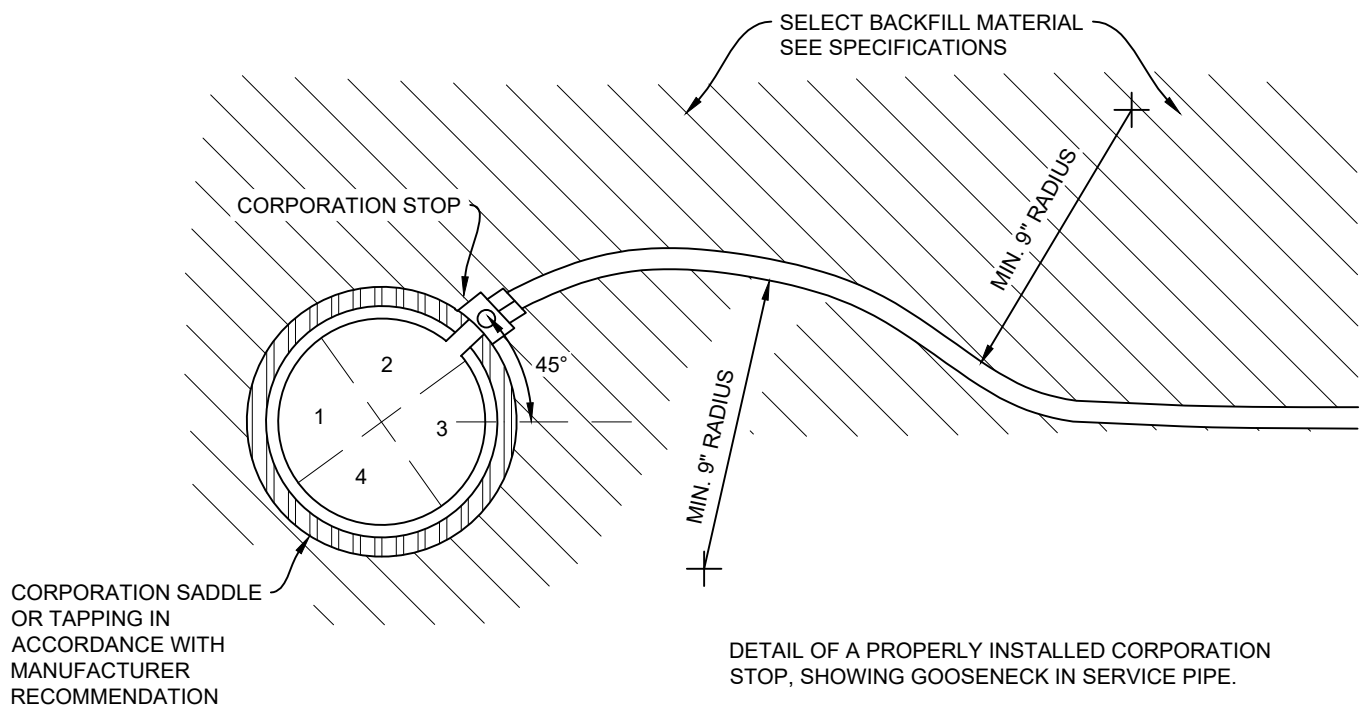
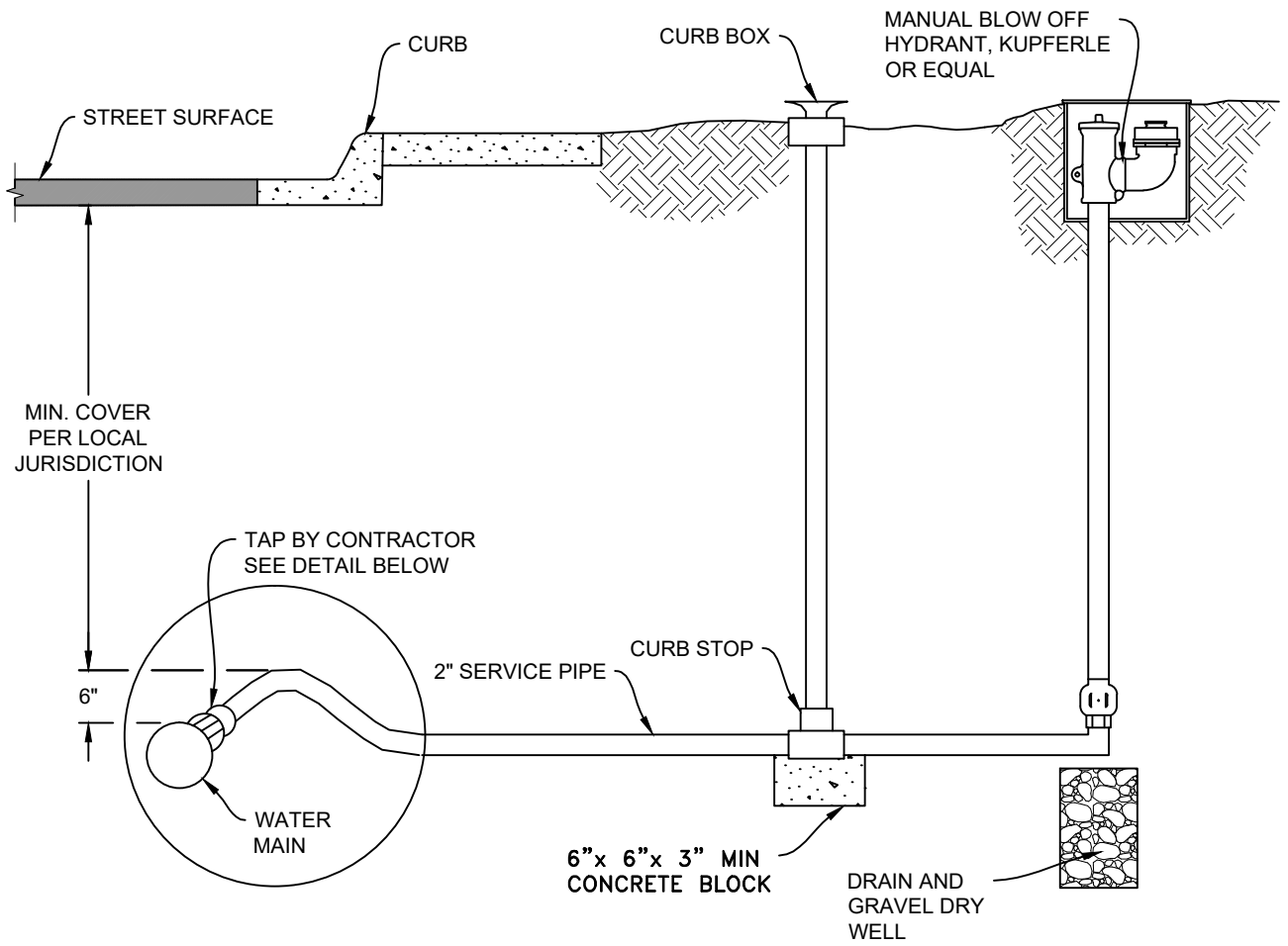
NOTE:

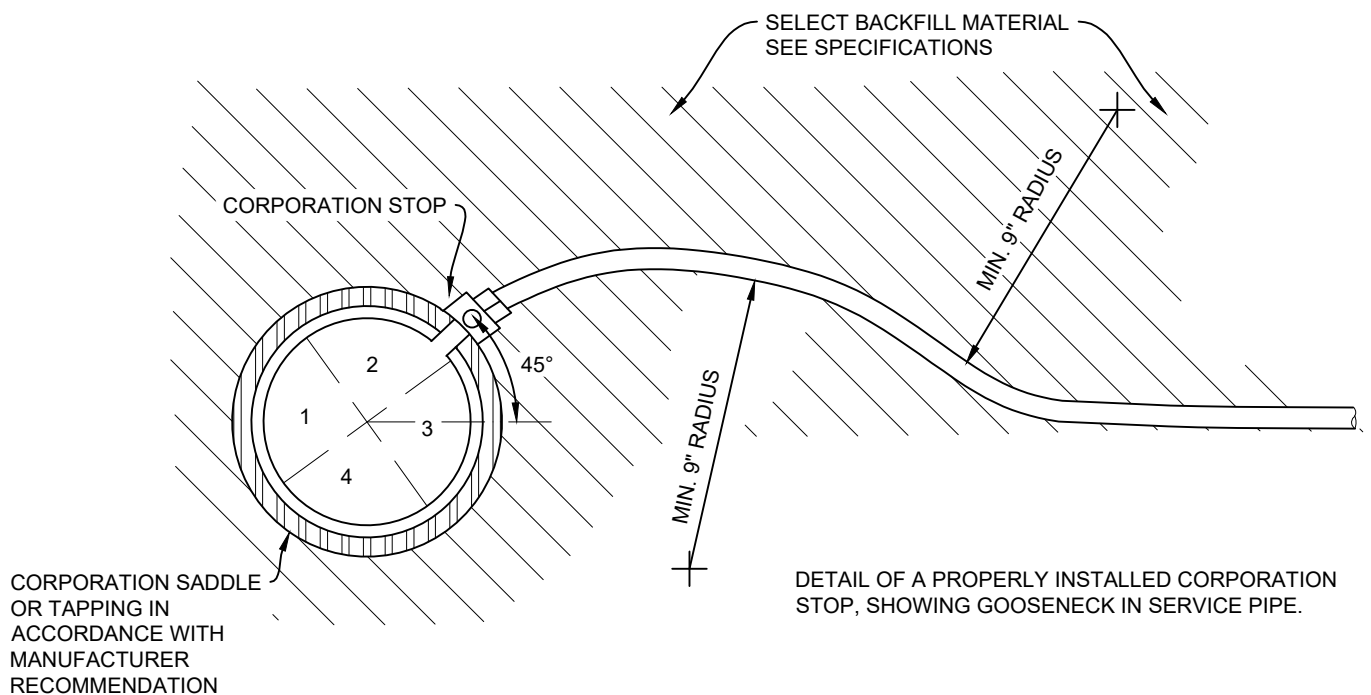
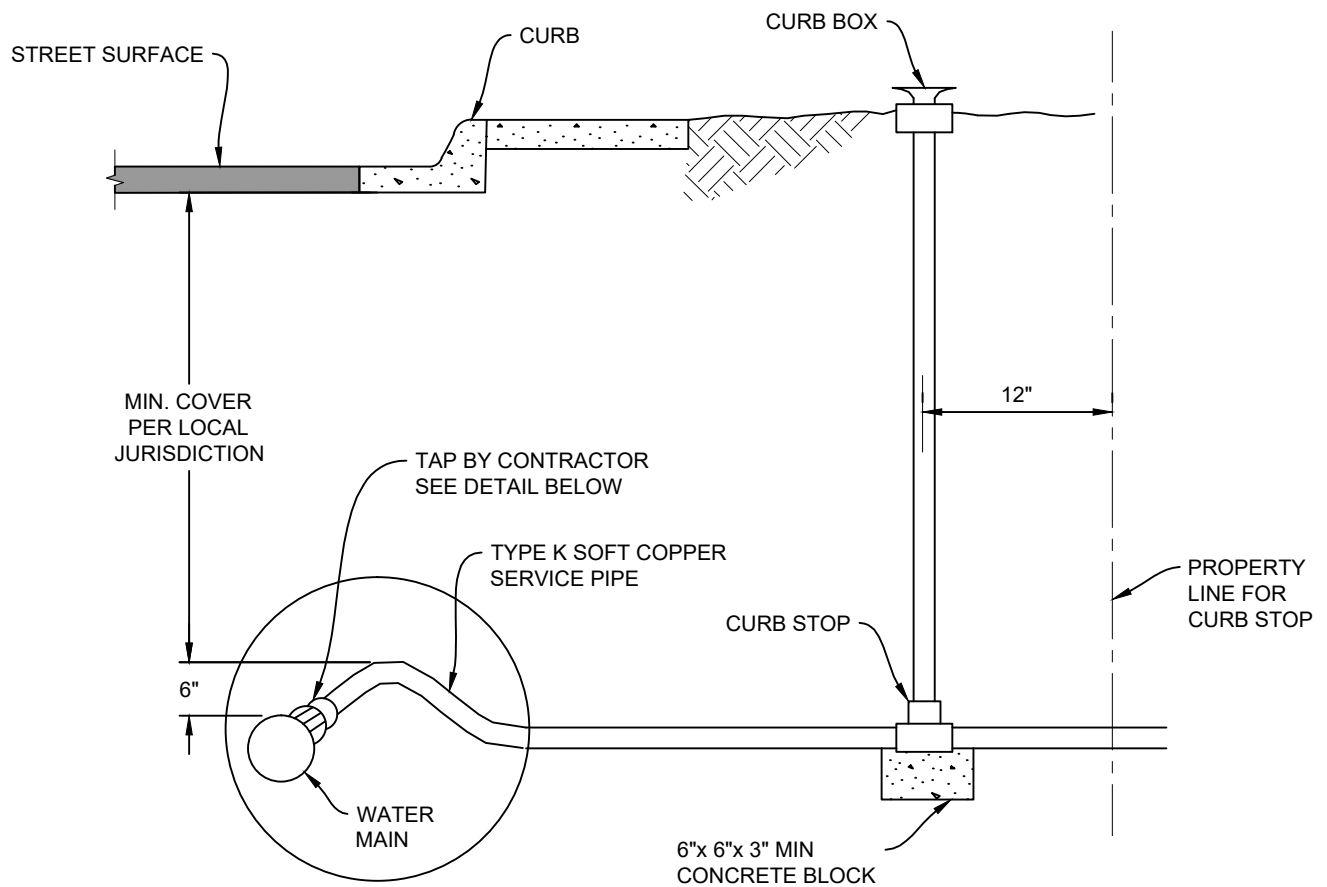
1. SUBGRADE COMPACTION SHALL CONFORM TO SECTION 02231
2. 1/2" EXPANSION JOINT MATERIAL SHALL BE PLACED AT P.C., P.T. AND CURB TURNS.
3. * CONTRACTION JOINTS SHALL COMPLY WITH SECTION 02520
4. NO CURB AND GUTTER SHALL BE PLACED WITHOUT A FINAL FORM INSPECTION BY THE ENGINEER.
5. CLASS 4000 CONCRETE SHALL BE USED, SECTION 03304, PART 2.08.

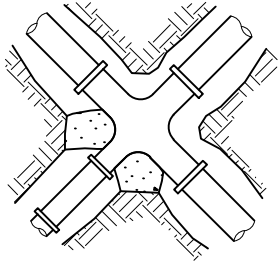
* CONTRACTION JOINTS SHALL BE CONSTRUCTED BY SAWING OR SCORING. WHEN SCORING, A TOOL SHALL BE USED WHICH WILL LEAVE CORNERS ROUNDED AND DESTROY AGGREGATE INTERLOCK FOR SPECIFIED MINIMUM DEPTH.



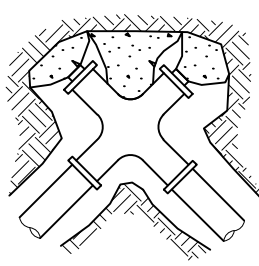




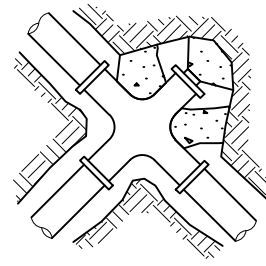




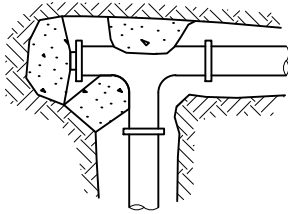
UNBALANCED CROSS



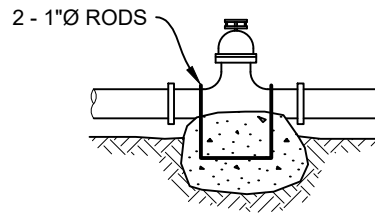
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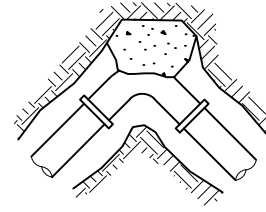
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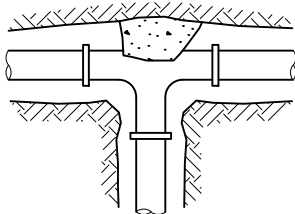
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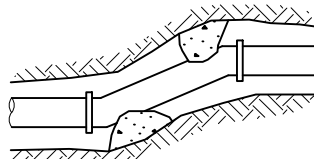
VALVE



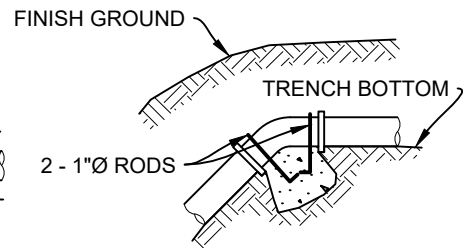
HORIZONTAL BEND



TEE

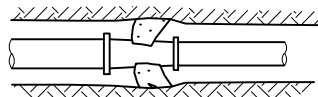


OFFSET

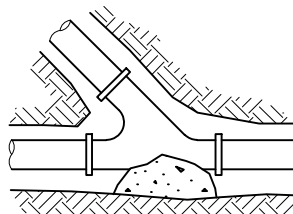


VERTICAL BEND

ENGINEER TO SPECIFY CONSTRUCTION



REDUCER



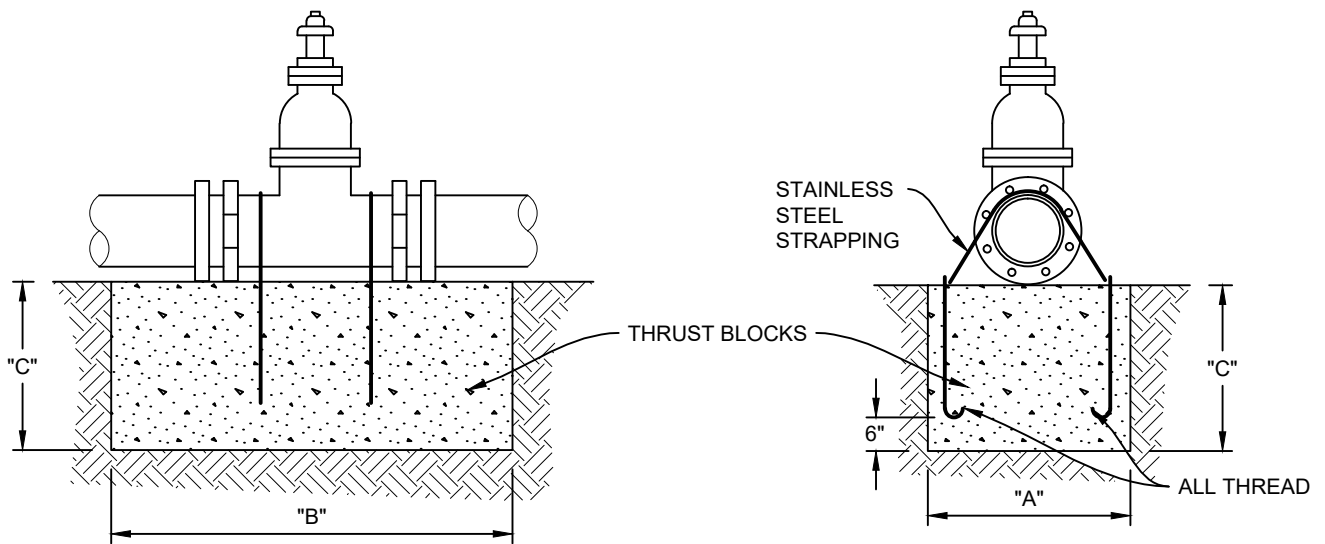
"Y" BRANCH



DEAD END

NOTES:

1. SIZE OF BLOCK SHALL BE A MINIMUM OF 6" THICK.
2. ALL BLOCKING SHALL BEAR AGAINST UNDISTURBED MATERIAL.
3. FITTINGS TO BE SEPARATED FROM THRUST BLOCK WITH AN APPROVED BOND BREAKER.



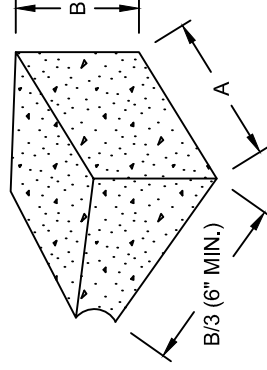
MINIMUM DIMENSIONS FOR THRUST BLOCKING								
ANCHOR ROD SIZE		3/4"	3/4"	3/4"	1"	1 1/8"	1 1/4"	1 3/8"
VALVE SIZE		6" & 8"	10"	12"	14"	16"	18"	24"
100 PSI	"A"	2'-0"	2'-0"	2'-3"	2'-3"	3'-0"	3'-8"	4'-4"
	"B"	2'-0"	2'-0"	2'-0"	2'-0"	3'-0"	3'-0"	4'-0"
	"C"	2'-0"	2'-0"	2'-9"	2'-4"	2'-11"	3'-0"	4'-0"
150 PSI	"A"	2'-0"	2'-6"	3'-0"	3'-5"	4'-4"	5'-5"	6'-5"
	"B"	2'-0"	2'-6"	3'-0"	3'-0"	3'-0"	3'-0"	4'-0"
	"C"	2'-0"	2'-0"	2'-8"	3'-0"	3'-0"	3'-0"	4'-0"
200 PSI	"A"	2'-0"	2'-9"	3'-5"	4'-6"	4'-1"	5'-1"	6'-6"
	"B"	2'-0"	2'-6"	3'-0"	3'-0"	4'-0"	4'-0"	5'-0"
	"C"	2'-0"	2'-6"	3'-0"	3'-0"	4'-0"	4'-0"	5'-0"
250 PSI	"A"	2'-0"	3'-0"	4'-3"	4'-0"	5'-1"	6'-4"	6'-5"
	"B"	2'-0"	3'-0"	3'-0"	4'-0"	4'-0"	4'-0"	6'-0"
	"C"	2'-0"	3'-0"	3'-0"	4'-0"	4'-0"	4'-0"	6'-0"
300 PSI	"A"	2'-0"	3'-7"	5'-1"	4'-9"	6'-1"	5'-9"	7'-8"
	"B"	2'-0"	3'-0"	3'-0"	4'-0"	4'-0"	5'-0"	6'-0"
	"C"	2'-7"	3'-0"	3'-0"	4'-0"	4'-0"	5'-0"	6'-0"

NOTES:

1. PRESSURES SHOWN ABOVE ARE MAXIMUM WORKING PRESSURE IN THE SYSTEM.
2. TO BE INSTALLED AS CALLED FOR AND AT THE LOCATIONS SHOWN ON THE PLANS.
3. COAT EXPOSED PORTIONS OF ANCHOR RODS WITH "KOPPERS" BITUMASTIC NO. 50 COATING OR APPROVED EQUAL.
4. DESIGN IS BASED ON ALLOWABLE 2000 PSF SOIL BEARING CAPACITY.

MINIMUM DIMENSIONS FOR THRUST BLOCKING

FITTING SIZE	TEES & PLUGS		90° BENDS		45° BENDS & WYES		REDUCERS & 22 1/2° BENDS		11 1/4° BENDS	
	A	B	A	B	A	B	A	B	A	B
4"	1'-7"	1'-2"	1'-9"	1'-6"	1'-8"	1'-10"	1'-7"	0'-6"	0'-6"	0'-6"
6"	2'-0"	1'-11"	2'-5"	2'-2"	1'-10"	1'-7"	1'-9"	0'-10"	1'-0"	0'-6"
8"	2'-8"	2'-6"	3'-2"	3'-0"	2'-5"	2'-1"	1'-9"	1'-6"	1'-0"	1'-0"
10"	3'-4"	3'-3"	4'-0"	3'-10"	3'-0"	2'-9"	2'-2"	1'-11"	1'-6"	1'-0"
12"	4'-0"	3'-10"	4'-8"	4'-8"	3'-8"	3'-3"	2'-7"	2'-3"	2'-0"	1'-0"
14"	5'-5"	3'-10"	6'-6"	4'-11"	4'-9"	3'-5"	3'-5"	2'-5"	2'-0"	1'-6"
20"	5'-0"	5'-0"	6'-0"	6'-0"	5'-0"	4'-0"	3'-6"	3'-0"	3'-0"	2'-0"
24"	6'-0"	6'-0"	7'-0"	7'-0"	5'-0"	5'-0"	4'-6"	3'-0"	3'-0"	3'-0"
30"	7'-6"	7'-6"	8'-0"	8'-0"	6'-3"	6'-3"	4'-9"	4'-6"	3'-3"	3'-3"

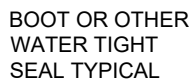


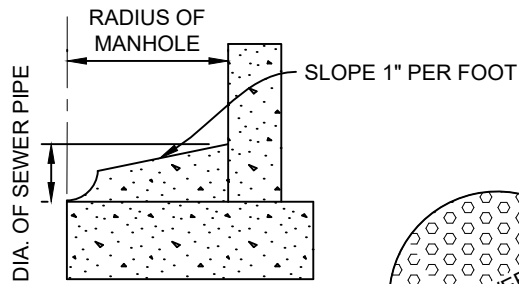
NOTES:

- FITTINGS TO BE SEPARATED FROM BLOCKS WITH AN APPROVED BOND BREAKER, SUCH AS POLY WRAP.
- ALL BLOCKS TO BEAR AGAINST UNDISTURBED MATERIAL.
- DESIGN IS BASED ON 150 PSI MAIN PRESSURE AND 2000 PSF SOIL BEARING CAPACITY.

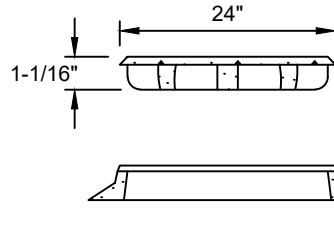
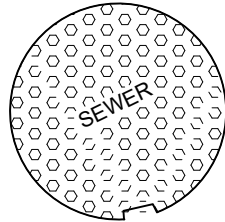


1. DROP ACROSS INVERT SHALL BE GREATER THAN OR EQUAL TO SLOPE OF ADJACENT SEWER.
2. BASES SHALL BE REINFORCED WHEN THE DISTANCE FROM INVERT TO TOP OF COVER EXCEEDS 15'. REINFORCEMENT TO BE APPROVED BY ENGINEER.
3. MANHOLES OUTSIDE R.O.W. SHALL HAVE BOLT TYPE LOCKING DEVICE.
4. REINFORCEMENT FOR PRECAST SECTIONS SHALL BE AS PER ASTM C-478
5. C.I. RING AND COVER HS-20-44



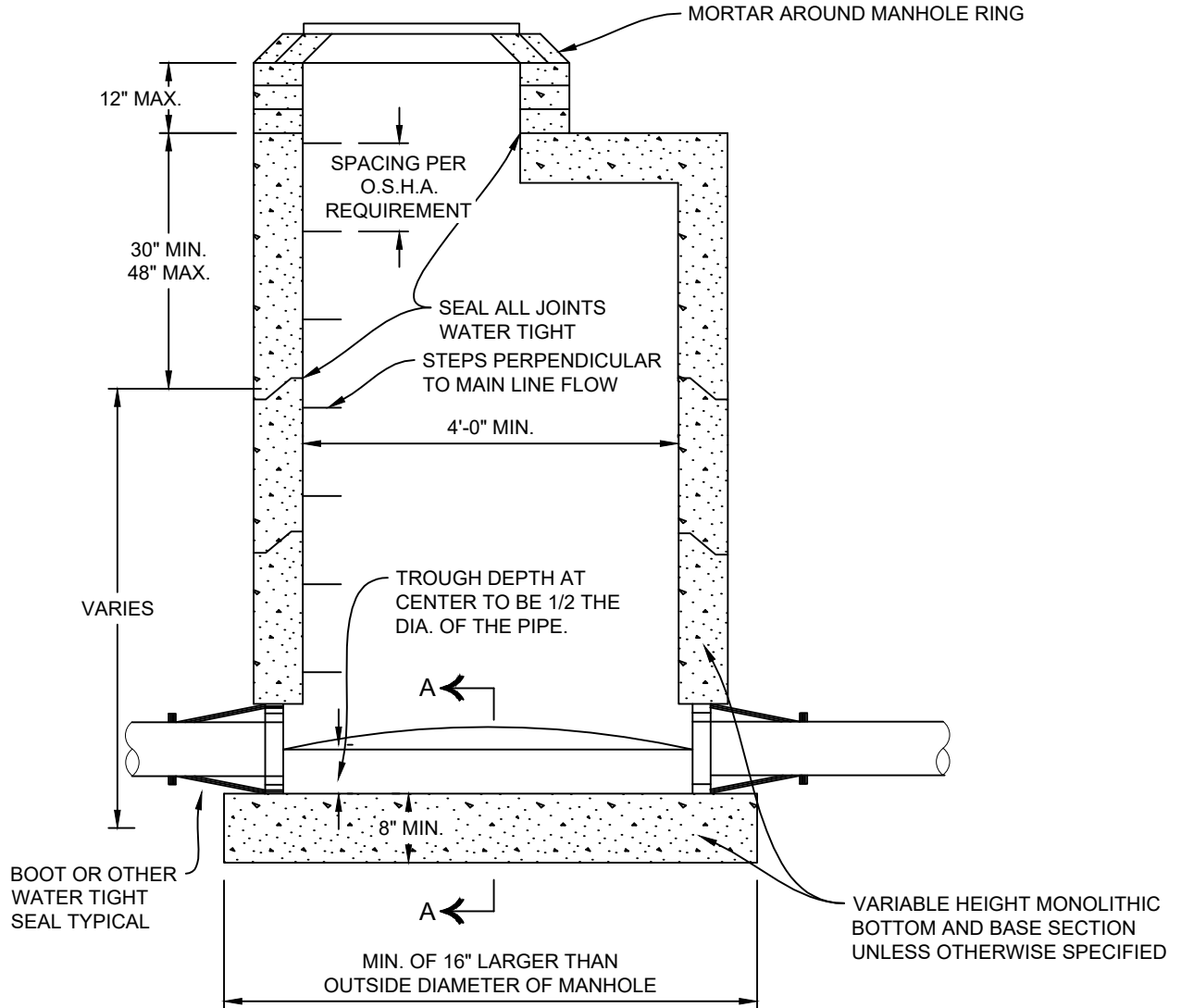


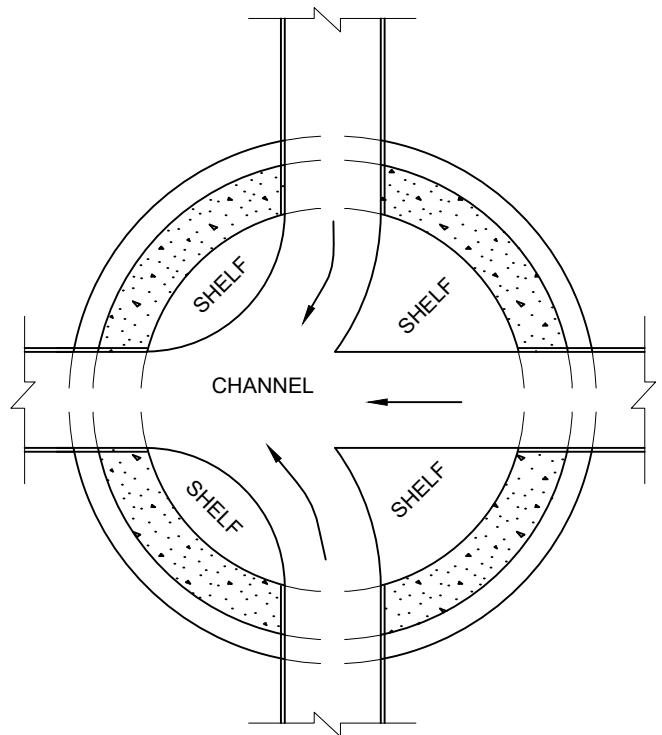
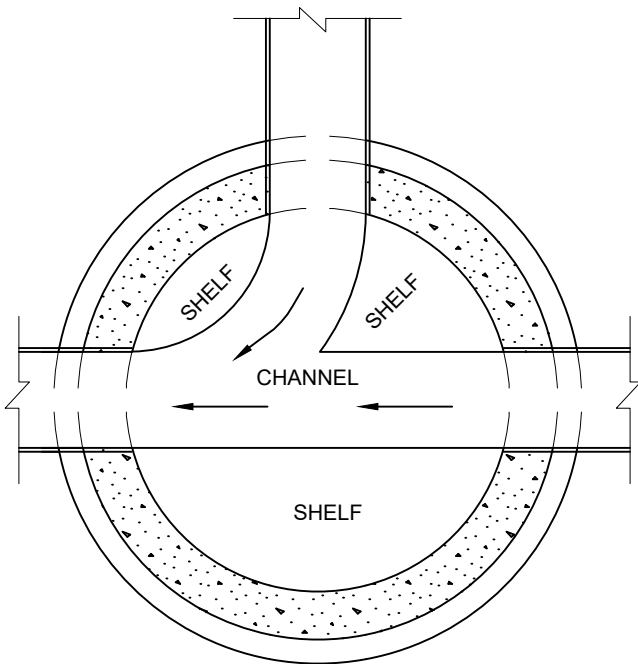
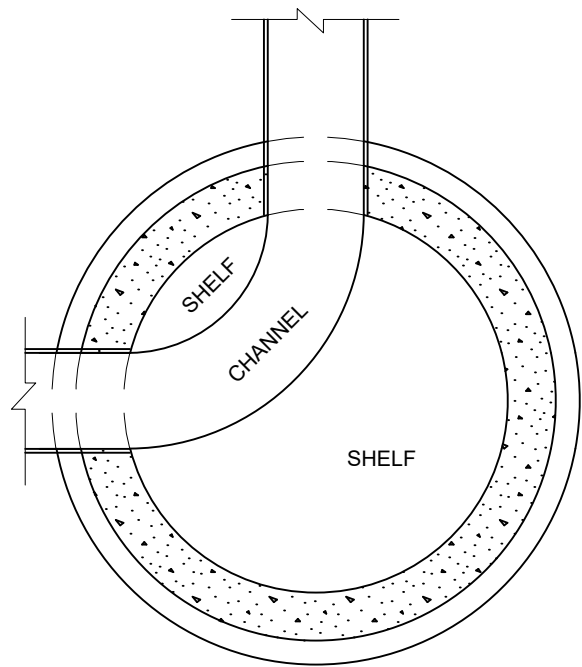
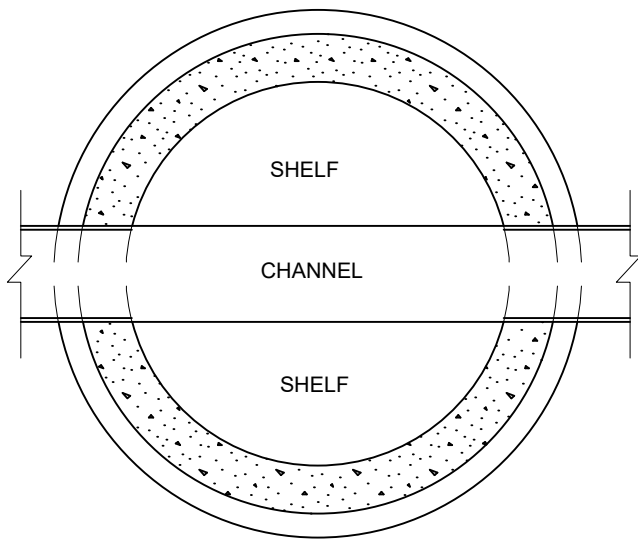
DETAIL A



NOTES:

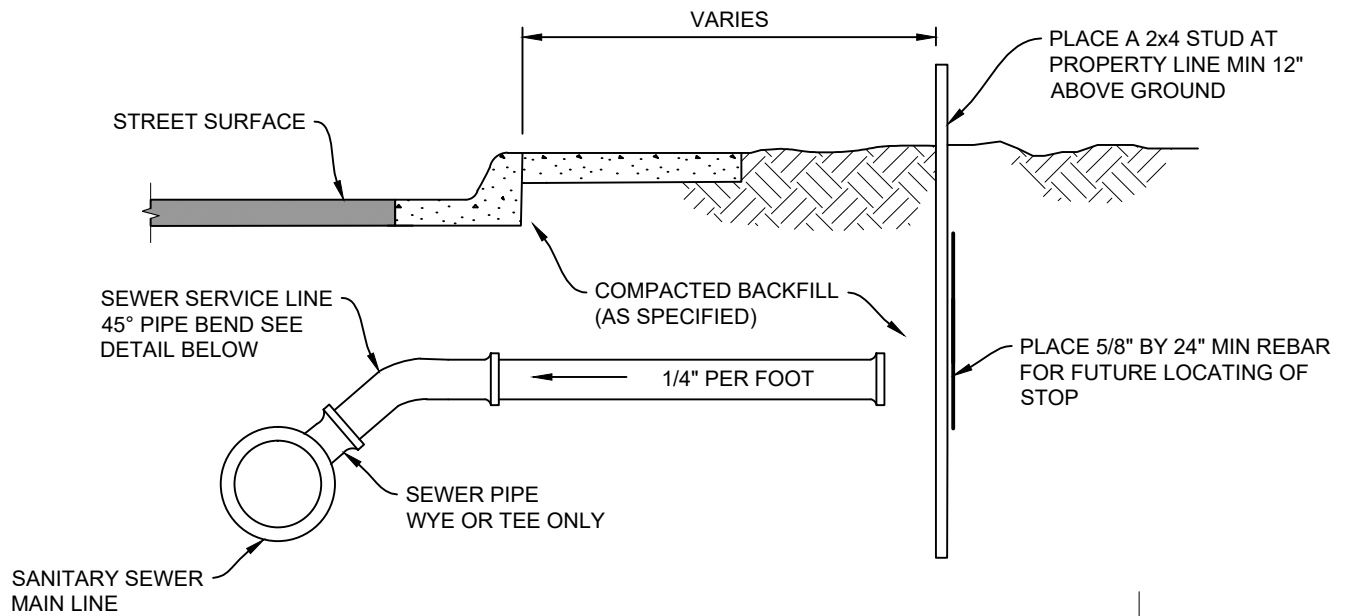
1. DROP ACROSS INVERT SHALL BE GREATER THAN OR EQUAL TO SLOPE OF ADJACENT SEWER.
2. BASES SHALL BE REINFORCED WHEN THE DISTANCE FROM INVERT TO TOP OF COVER EXCEEDS 15'. REINFORCEMENT TO BE APPROVED BY ENGINEER.
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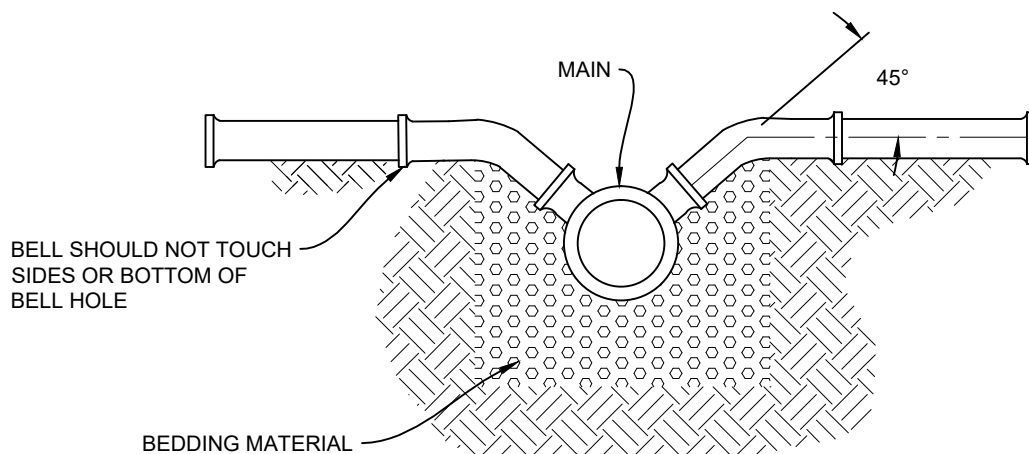
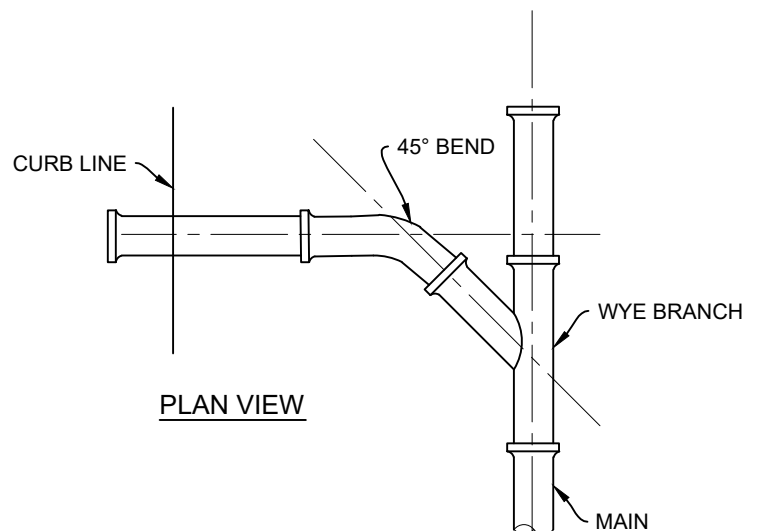


NOTES:

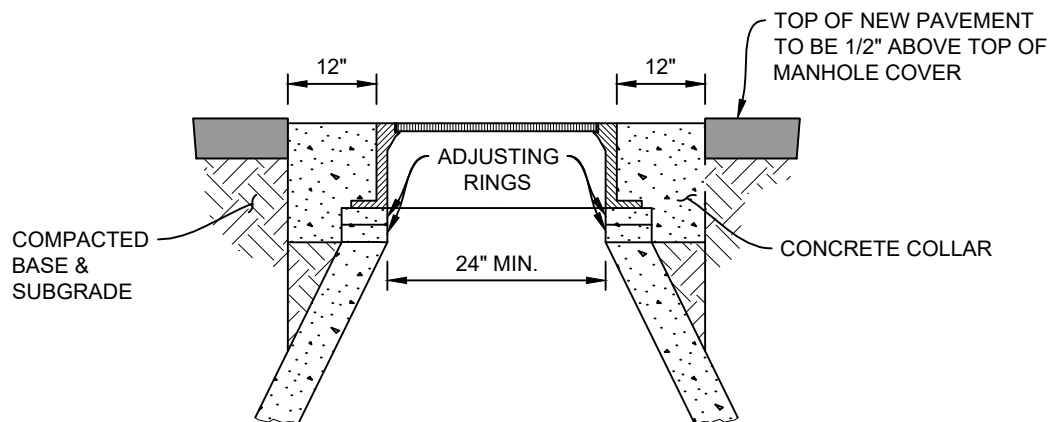
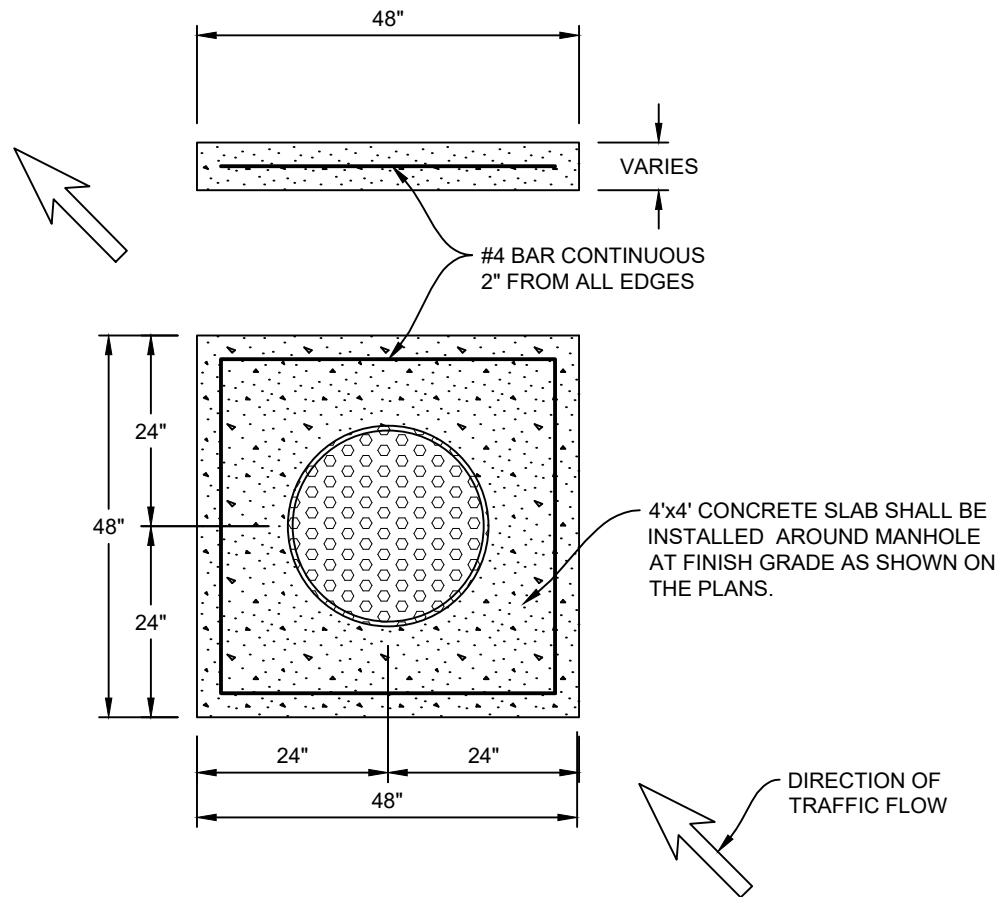
1. SLOPE ALL SHELVES TO CHANNEL AT 1" PER FOOT.
2. SEE PLAN-PROFILE SHEETS FOR SLOPE OF CHANNEL.



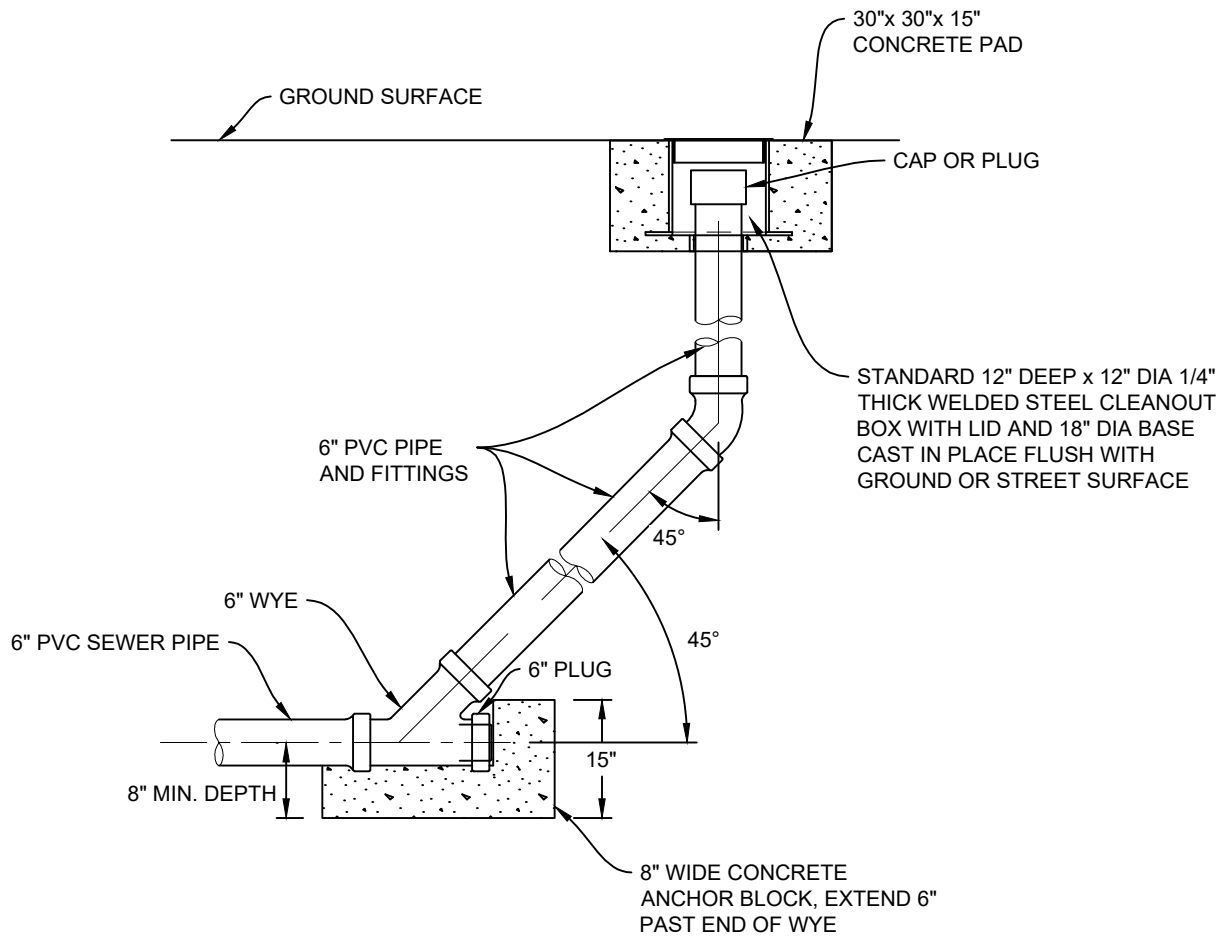
NOTE:
FOR PVC SERVICE STUB, BELL AT END OF STUB-IN
WILL BE OUT OF SQUARE. SOLVENT WELD CAP WILL
BE INSTALLED TO FACILITATE TESTING.

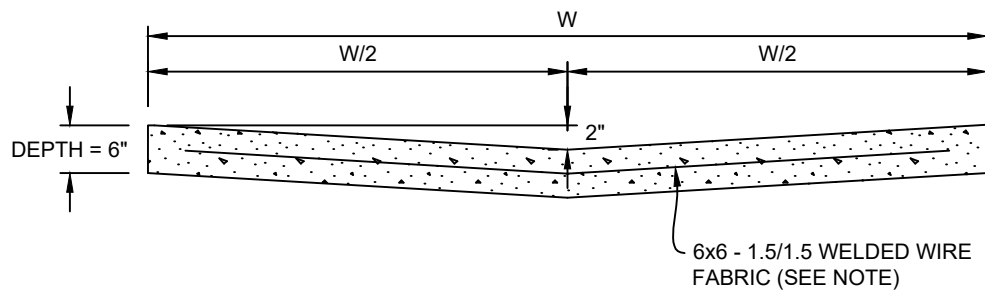
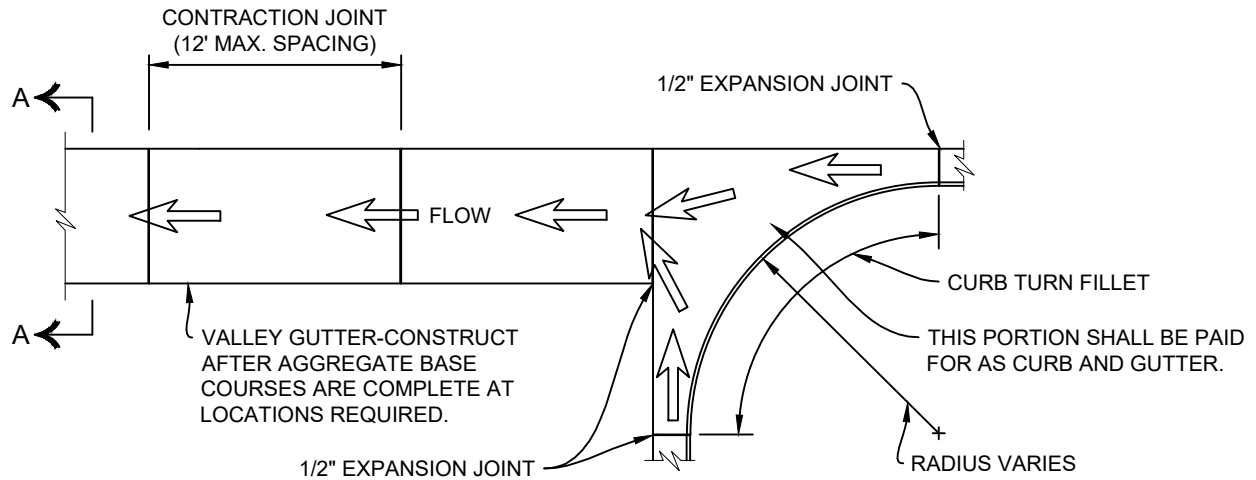


ELEVATION



NOTE:
ADJUST MANHOLES UPWARD WITH BRICK & MORTAR OR ADJUSTING RINGS UNDER
FRAME. ADJUST MANHOLE DOWNWARD BY REMOVING A PORTION OF THE
MANHOLE RISER AND REBUILDING TO PROPER DIAMETER. SLOPE MANHOLE RING
AS REQUIRED TO MATCH STREET GRADE AND CROSLOPE. FINAL MANHOLE
ADJUSTMENT WILL BE MADE AFTER PAVING AND BEFORE SEAL COATING.





SECTION A-A

NOTE:
FIBER REINFORCED CONCRETE OR #3 BARS @ 12" ON CENTER EACH WAY MAY BE
SUBSTITUTED FOR WELDED WIRE FABRIC UPON WRITTEN APPROVAL OF ENGINEER.