SPECIFICATIONS

for

REPAIR NORTH SOUTH BASE WATER PHASE II

PROJECT NUMBER 1080765

MALMSTROM AIR FORCE BASE

Prepared for:

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Submitted to:

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Portions of the Technical Specifications are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, “Furnish….” means “Contractor shall furnish…”, “Provide ….” means “Contractor shall provide…”.

The Specifications and Drawings are intended to provide the basis for proper completion of the work suitable for the intended use of the Government and establish the minimum standards for quality of workmanship and appearance. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the project shall be included.

SECTION 01 00 00 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Project titled: "Repair North South Base Water Systems, Project 1080765". This project consists of the replacement of various water mains within MAFB including valves, fittings, fire hydrants, meters, and various appurtenances. In addition, the project will include removal and restoration/replacement of the associated surface concrete driveways, sod, curb and gutter and asphalt surfacing. These improvements are located on Malmstrom Air Force Base, Montana.

1.2 UTILITIES

A. All reasonable quantities of utilities will be made available from existing utilities to the Contractor without charge. Any temporary connection or lines that may be required will be installed, maintained, and removed by the Contractor at his own expense and in such a manner satisfactory to the Contracting Officer. Removal of such connections or lines will be accomplished prior to final acceptance of the construction. The Contractor shall provide any necessary portable power.

1.3 SAFETY

A. The Contractor shall comply with all existing Occupational Safety and Health Act (OSHA) standards of safety at all times in the performance of this contract. Hazards to the safe use of the premises due to the Contractor's work and/or equipment shall be suitably marked at all times. Pedestrian and vehicle traffic ways shall be kept clear and unobstructed.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 INSPECTION

A. There will be one primary Contracting Officer's Representative assigned to inspect for compliance. An alternate Contracting Officer's Representative will also be assigned and will perform all inspection duties in the absence of the primary Contracting Officer's Representative. The Contracting Officer's Representative will be the spokesman for compliance with the specifications and drawings. Controversies between the Contracting Officer's Representative and the Contractor will be resolved by the Contracting Officer. If, for some reason, a change in the primary or alternate Contracting Officer's Representative is required, the Contractor will be notified. The Contractor shall coordinate Contractor activities with the Contracting Officer's Representative.

3.2 CONTRACTOR VEHICLES AND EQUIPMENT

A. The Contractor shall provide all vehicles and equipment necessary to accomplish the contract work. Power equipment shall be equipped with safety and noise limiting devices. The equipment shall be in a safe and efficient operating condition. The Contractor shall not park vehicles in the project area during non-working hours. A designated parking area for vehicles and equipment will be provided. Vehicles will not be allowed on lawns or sidewalks without prior written approval. All equipment will be clearly marked with the Company name.

B. Truckload Limits: The following load limits shall apply to all contractor-operated equipment on this project:

April 1 to June 1	--	350 #/inch width of tire
All Other Times	--	400 #/inch width of tire

3.3 CONTINUED USE OF FACILITIES

A. Building, structures, facilities, and utilities will continue in use by the Government during this contract. The Contractor shall notify the Contracting Officer's Representative (Construction Inspector and/or Contract Specialist) when a no-work condition will occur for more than one day by the Contractor or sub-contractors (except weekends and federal holidays).

3.4 MAINTENANCE OF AIR FORCE OPERATIONS

A. It is required and essential that the primary use of the facilities continue uninterrupted throughout the contract period. Work, once commenced, shall be carried to completion with a minimum of interruption to Government operations.

3.5 AS-BUILT FIELD DATA

A. General: The Contractor shall keep at the construction site a complete set of full size prints of the contract drawings, reproduced at Contractor expense. During construction, these prints shall be marked to show all deviations in actual construction from the contract drawings. The color red shall be used to indicate all additions and green to indicate all deletions. The drawings shall show the following information but not be limited thereto:

1. The locations and descriptions of any utility line and other installations of any kind or description known to exist within the construction area. The location includes dimensions to permanent features, and depth.

2. The locations and dimension of any changes within the building or structure, and the accurate location and dimension of all underground utilities and facilities.

3. Correct grade or alignment of roads, structures, and utilities if any changes were made from contract plans.

4. Correct elevations if changes were made in site grading from the contract plans.

5. Changes in details design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including, but not limited to, fabrication, erection, installation, and placing details, pipe size, pipe material, insulation material, dimensions of equipment foundations, etc.

6. The topography and grades of all drainage installed or affected as part of the project construction.

7. All changes or modifications from the original design and from the final inspection.

8. Where contract drawings or specifications allow options, only the option actually used in the construction shall be shown on the as-built drawings. The option not used shall be deleted.

9. These deviations shall be shown in the same general detail utilized in the contract drawings. Marking of the prints shall be pursued continuously during construction to keep them up-to-date. In addition, the Contractor shall maintain full size mark-up drawings, survey notes, sketches, nameplate data, pricing information, description, and serial numbers of all installed equipment. This information shall be maintained in a current condition at all times until completion of the work. The resulting field-marked prints and data shall be referred to and marked as "As-Built Field Data," and shall be used for no other purpose. They shall be made available for inspection by the Contracting Officer's representative whenever requested during construction and shall be jointly inspected for accuracy and completeness by the Contracting Officer's representative and a responsible representative of the Contractor prior to submission of each pay estimate. If the As-Built Field Data is not accurate and complete, a percentage of the pay request will be withheld from the payment and any future payments until the As-Built Field Data is up to date, complete and accurate. The Contracting Officer will determine the percentage to be retained.

B. Submittal of the As-Built Field Data: The As-Built Field Data shall reflect the exact installation performed and two copies shall be submitted to the Contracting Officer for review and approval a minimum of three calendar days prior to the date of final inspection. If review of the preliminary as-built drawings reveals errors and/or omissions, the drawings will be returned to the Contractor for corrections. The Contractor shall make all corrections and return the drawings to the Contracting Officer within 10 calendar days of receipt. The "Red LINE" drawings shall be reviewed at the final inspection for completeness. Once As-Built Field Data have been reviewed and approved one copy will be returned to the contractor with and electronic

copy of contract drawings. The electronic contract drawings will be updated with the field data by the contractor and submitted to the Contracting Officer.

C. Preparation--As-Built Contract Drawing, Non AutoCAD Original Record Tracing:

1. Approved preliminary as-built drawings will be returned to the Contractor along with one set of the contract drawing original record tracings. These drawings are part of the permanent records of this project and the Contractor will be held responsible for their protection and safety until they are returned to the Contracting Officer. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced in like medium, quality and size as the originals at the Contractor's expense. The drafting work shall be performed by certified Engineering Technicians and/or individuals with a minimum of five years drafting experience. The name and qualifications of these individuals shall be submitted in writing to the Contracting Officer for approval.

2. Drafting of the data onto the original contract drawing shall be done in a quality equal to that of the originals. Linework, lineweights, and lettering, and use of symbols shall be the same as the original line work, line weights, and lettering, and symbols. All revisions shall be noted in revision block with revision symbol in chronological sequence. This symbol shall also be placed on drawing where revision was made. Plastic drafting leads or ink shall be used. Graphite leads shall only be used where used on the original drawings. If additional drawings are required, they shall be prepared on the same medium and of equal size and quality as the original record tracings. Sufficient blank sheets for this purpose will be furnished by the government at no cost to the Contractor upon request. When final revisions have been completed, each drawing shall be lettered or stamped with the words "As-Built" in block letters at least 3/8 inch high placed above the title block of space permits, or if not, below the title block between the border and the trim line. The date of completion and the words "REVISED AS-BUILT" shall be placed in the revision block above the latest revision notation. Markings on the reverse side of the drawings will not be permitted. The submittal shall include the approved "Red Line" drawings and the revised original record drawings as stated above.

D. Preparation--As-Built Contract Drawings, AutoCAD Original Record Tracing:

1. Approved preliminary as-built drawings will be returned to the Contractor along with AutoCAD CD (Release 2014) of the original drawings. All work on the CD will be accomplished by a Certified Engineering Technician and/or individuals with a minimum of five years drafting experience, at least three of which must be using AutoCAD. The name of the individual shall be submitted in writing to the Contracting Officer.

2. Modifications to the CD shall be accomplished on the appropriate layer showing the work being changed. All revisions shall be done in the same format as the original drawing. On each sheet the words "AS BUILT" in block letters will be added to the discs. The size of the letters will be at least 3/8 inch high and be placed either above the title block or to the left of the title block. Fill in the revisions block with "REVISED AS-BUILT", date and initials. The submittal shall include the revised AutoCAD CD, the approved "Red Line" drawings and a full size plot of the drawings from the revised CD.

E. Preparation--As-Built Contract Drawing, Both AutoCAD and Non AutoCAD Original Record Drawings:

1. Approved preliminary as-built drawings will be returned to the Contractor. These drawings are part of the permanent records of this project and the Contractor will be held responsible for their protection and safety until they are returned to the Contracting Officer. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced in like medium, quality and size as the originals at the Contractor's expense. The drafting work shall be done by a certified Engineering Technician and/or other individual drafting experienced and on AutoCAD.

2. For Non AutoCAD drawings, drafting onto the contract drawing original mylar record tracings shall be done in a quality equal to that of the originals. Linework, lineweights, lettering and use of symbols shall be the same as the original. All revisions shall be noted in the revision block with revision symbol in chronological sequence. This symbol shall also be placed on drawing where revision was made. Plastic drafting leads or ink shall be used. Graphite leads shall only be used where used on the original drawings. Additional drawings, if required shall be the same format, size and quality as provided on the AutoCAD CD. The additional drawings will be added to the CD provided.

3. For AutoCAD drawings, modifications to the CD shall be accomplished on the appropriate layer showing the work being changed. All revisions shall be done in the same format as the original drawing.

4. When the final revisions have been completed, each drawing shall be lettered or stamped, for original record tracings and lettering added to the CD with the words "AS-BUILT" in block letters at least 3/8 inch high. The lettering shall be place either above the title block or to the left of the title block. The words "REVISED AS-BUILT" shall be placed in the revision block along with the date of completion and the initials of the reviser. The submittal shall include the approved "Red line" drawings, the revised original record tracings, the revised AutoCAD CD and a print of the drawings from the revised CD.

F. The final as-built submittal shall be completed and returned together with the approved preliminary as-built drawings to the Contracting Officer within 30 calendar days of the final inspection. The Contracting Officer will review all final as-built

record drawings for accuracy and conformance to the drafting standards and other requirements contained herein. The submittal shall be returned to the Contractor if corrections are necessary. The Contractor shall make all corrections and shall return the submittal to the Contracting Officer within seven calendar days of receipt.

1. All costs incurred by the Contractor in the preparation and furnishing of as-builts shall be included in the contract price and no separate payment will be made for this work. Approval and acceptance of the final as-built record drawings shall be accomplished before final payment is made to the Contractor.

2. In addition to the above requirements, one set of marked-up as-built blueprints shall be furnished to the Contracting Officer at the time of system acceptance testing. These as-built blueline prints shall be in addition to the requirements stated for the submission of the Operation and Maintenance Manuals.

3.6 CONCEALED WORK

A. All items of work to be concealed shall be Government inspected prior to concealment.

3.7 OPERATING AND MAINTENANCE INSTRUCTIONS

A. One complete set of instructions, in post-form binders, containing the manufacturer's operating and maintenance instructions for all equipment shall be furnished to the Contracting Officer. In addition, (2) CD-ROM discs containing the same information as the hard copy shall be provided. Where information or instructions are included for more than one model, the Contractor shall clearly mark the model actually installed on the job. The manuals shall be sectionalized using dividers with labeled tabs identifying the product/item behind the dividers. One complete set shall be furnished at the time test procedures are submitted, and the remaining sets shall be furnished before the contract is completed. Furnishing operating and maintenance instructions does not relieve the Contractor of the responsibility of furnishing framed instructions and schematics where specified. Each binder shall be indelibly marked on the exterior front and edge with the project name, project number, contract number, name of contractor and the date.

3.8 CONTRACTOR FURNISHED EQUIPMENT DATA

A. Ten days prior to final inspection and acceptance of work, the Contractor shall submit the following data:

1. Equipment List: An itemized equipment list showing unit retail value and nameplate data including serial number, model number, size, manufacturer, etc., for all Contractor furnished electrical and mechanical equipment installed

under this contract. A sample form showing minimum data required is provided at the end of this section.

2. Guarantees: Provide a list of all equipment items which are specified to be guaranteed, accomplished by a copy of each specified guarantee therefore. For each specific guaranteed item on the list shall include the name, address, and telephone numbers of the subcontractor who installed the item, the supplier, or distributor and the manufacturer. The completion data of the guarantee period shall correspond to the applicable specification requirements for each guarantee item.

3.9 RESERVED

3.10 SHOP DRAWINGS:

A. Shop drawings will include specially prepared technical data for this project and will consist of drawings, diagrams, performance curves, schedules, calculations, measurements, and will expand the general application to this specific project. Shop drawings show complete and accurate descriptions of specific equipment or systems to be installed. This will include detailed drawings showing routings, material types, installation and anchoring methods, component sizes, mounting methods, spacing, interface with existing systems, wiring and electrical systems, and all other details associated with the installation.

3.11 START OF WORK NOTIFICATION

A. The Contractor shall notify the Construction Management (CM) Office and the Contracting Officer 5 working days in advance of the start of all work. This shall include, but is not limited to, notifying CM when the initial work shall begin; notifying CM when work shall resume after a work stoppage of more than five work days; notifying CM when work shall begin following the end of all specified exclusion periods. The Contractor shall be aware that the Notice to Proceed is not sufficient notification to the CM when initial work will begin.

3.12 NOTICE OF PRE-FINAL AND FINAL INSPECTIONS

A. The Contractor shall, after notifying the Contracting Officer's Representative 14 days prior, schedule a date with the Contracting Officer for a pre-final inspection. After all discrepancies found during the pre-final inspections have been corrected, the Contractor shall schedule a final inspection with the Contracting Officer 14 days prior to his projected completion of the project. The red line "As-Built" drawings shall be provided by the Contractor at the final inspection.

3.13 CONSTRUCTION NEAR UTILITY SYSTEMS

A. All contractors shall be responsible for processing their own **Work Clearance Request (AF Form 103)** and coordinating with Government Contracting Officer's Representative as required. The contractor is responsible for obtaining all coordination signatures for the permit. The approved permit shall be valid for a period not to exceed 90 calendar days. **To the maximum extent possible, eliminate permanent markings on pavement and curbs.** The contractor shall be responsible for maintaining all utility markings. Location marks shall be removed after 14 calendar days if not used. All markings shall be accomplished with water-based chalk (Aervoe Pacific Inc. 1-800-227-0196 or equal). No paints will be used. **Detailed permit procedures and guidelines shall be provided to the contractor during the Pre-performance Conference.** Digging within three feet of buried communications cables, environmental monitoring wells, electrical cables, irrigation systems, and gas lines shall be performed by hand digging until the utility is exposed. The Contracting Officer's Representative shall be notified three days prior to digging within a three-foot area near this utility. A representative from the Communications Office must be present during excavation of Communications Cables. The cable routes must be marked prior to excavation in the area. The Contractor shall be held responsible for any damage to a marked or identified utility by excavation procedures. Once the utility is exposed, mechanical excavation may be used if there is no chance of damage occurring to the cable or piping system. The contractor is responsible for marking all excavations he will do, five (5) work days prior to needing existing utilities marked by the government.

B. Reburial of Exposed Utilities: If the cover over direct bury communication utilities is reduced to a depth of less than 36-inches, the utility shall be lowered to a depth of at least 36-inches. Cover over concrete duct bank communication lines shall be maintained at 48-inches minimum depth. If the cover over existing gas utilities is reduced to less than 42-inches, the utility shall be lowered to a depth of at least 42-inches. If the cover over existing electrical utilities is reduced to less than 30-inches, the utility shall be lowered to a depth of at least 30-inches. When existing utility lines are reburied, a tape, detectable by pipe detector systems, shall be installed above the uncovered length of the utility at a depth of 12 inches below grade. Tape shall be a minimum five mil plastic tape with metallic tracer, minimum six inches wide, lettering on tape continuously marked "BURIED UTILITY", and brightly colored. If tape marked "BURIED UTILITY" is not readily available, special order tape with the correct lettering shall be acquired by the contractor.

C. Access to Communications Manhole or Handhole: No communications manhole or handhole shall be entered without first obtaining a fiber optic cable briefing. Coordinate through Construction Management with the Base Communications Officer.

D. All repairs due to cable cuts on communications cables shall be the responsibility of the Contractor. Repair actions must be accomplished by the current communications contractor and paid for and coordinated under this contract at no additional cost to the Government if the contractor is deemed to be at fault by the Contracting Officer.

Work to restore lost service must begin within one hour after the cut and must continue unceasingly until the job is completed, tested, and accepted. Work will be inspected by Communications Squadron and personnel.

E. All utilities or anticipated underground obstacle crossings must be located by manual and other non-destructive excavation (hydro-vac) prior to mechanical excavation. All non-destructive excavation shall be considered incidental to project completion.

3.14 UTILITY OUTAGES

A. All utilities programmed to be interrupted during construction shall be scheduled at least 14 working days in advance of the outage and at a time convenient for the government. The "Utility Outage Notice" will be completed by the Contractor and submitted to Construction Management for approval. No interruptions shall be made until the outage notice is approved and returned to the Contractor. Notification forms that are to be filled out by the contractor, will be provided at the pre-construction conference. Utilities will include all overhead and underground utilities and road closures or partial closures.

3.15 SUBMITTALS

A. Contractor shall submit three copies of all submittals, to be recorded on AF Form 66. Submittal items, including samples, shall be marked with a number corresponding to the item number on the AF Form 66, and the page and paragraph number of the specification requiring the submittal. Contractor shall hi-lite specifics when submitting catalogs, etc. It is the **responsibility of the contractor to complete column 13, "Required Submission Date", in the submittal form** and insert dates for each submittal item not already designated by the Government as having a mandatory due date. The contractor shall schedule and submit all required items for major systems (such as HVAC, etc) at the same time to enhance review of interrelated components. It is the Contractor's responsibility to ensure the dates provided on the form do not create any delays in construction. Provide the completed form to the Contracting Officer at or prior to the Pre-Construction meeting. The completed form will then be used by the Government for tracking submittal progress. **If the contractor is proposing to use an exact brand name or product identified, a submittal for that item is not required.** In lieu of a submittal, the contractor shall submit a letter to the Contracting Officer outlining each item that will be provided exactly as specified. These items will also be annotated as such on the AF Form 66. Even though a specified product is provided, in some circumstances a submittal may still be required for color selection, etc. If a recycle initiative product is specified and the contractor wishes to provide a substitute product, the Contractor shall request the substitution as indicated in paragraph 3.28 of this Section.

3.16 CONTRACTOR STORAGE AREA AND WORK SITE

A. Prior to notice to proceed, Contractor will be provided a storage area on the base within three miles of the project site or as designated on the site plan. All contractor equipment and materials shall be stored in this area except for materials that will be used on the job within a 48 hour period. Contractor is responsible for the security of assigned storage area (3,000 S.F., more or less). Temporary storage buildings (excluding tractor trailers) sited in the storage area shall conform to the base color scheme (Antique Linen, Fed. No. 23578). Architectural and structural features of all temporary facilities (including tractor trailers) shall be maintained in good repair as required by the Contracting Officer. Storage areas shall be enclosed by 6' chain link fence with access gates. Spare keys to any locked gates shall be provided to the base fire department dispatch office. Storage areas and job sites shall be clean, orderly, and free of debris, demolished/excess materials, etc. Job sites will be cleaned daily and refuse and debris removed from the site. Fences will be maintained. Grass and weeds shall be cut weekly at the storage area and work site. All landscaping, trees and shrubs will be protected, irrigated and maintained. If irrigation system to an existing area is interrupted due to construction activities, the Contractor shall provide a means of temporary irrigation until the permanent system is operational. If at any time during the life of the contract, the Contracting Officer determines that base standards are not being met, he/she may direct the Contractor to perform such actions as necessary to bring the area and/or facilities up to base standards at no additional cost to the Government. If the contractor fails to bring the area and/or facilities up to standards, the Contracting Officer may direct the Contractor to remove themselves and/or the facility/storage unit or materials from the base at no cost to the Government.

3.17 REPAIR OF ROAD CUTS

A. Asphaltic surface shall be completely in-place within 48 hours after placement of base gravel. Between placement of base gravel and pavement, road shall be kept in drivable and passable condition.

3.18 QUALITY CONTROL

A. General. THE CONTRACTOR IS RESPONSIBLE FOR QUALITY CONTROL WHICH IS CONSIDERED BY THE GOVERNMENT TO BE A MAJOR INSPECTABLE ITEM OF THIS CONTRACT. In addition to CONTRACT CLAUSE, INSPECTION OF CONSTRUCTION, the Contractor shall comply with the Quality Control Provisions as specified herein. The Contractor shall perform all Quality Control inspection and/or testing required by this contract unless specifically designated to be performed by the Government. The Quality Control system must consist of personnel, plans, procedures, and organization necessary to provide materials, equipment, workmanship, fabrication, construction, and operations which comply with contract requirements. The system shall cover construction operations, including fabrication both on-site and off-site, and shall be keyed to the proposed construction sequence. If the Contractor fails to submit an acceptable Quality Control Plan within the time herein prescribed, the Contracting Officer will refuse to allow construction to start.

B. Quality Control Plan: General: Prior to the start of construction, the Contractor's Quality Control Plan must be acceptable to the Government. Construction will be permitted to begin only after acceptance of the contractor's Quality Control Plan. The Contractor's Quality Plan shall identify the personnel, procedures, instructions, records, forms, and as a minimum, shall include the following:

1. A description of the Quality Control management organization including an organizational chart.

2. The number, classifications, qualifications, duties, responsibilities, and authorities of personnel: A copy of a letter, signed by an authorized official of the firm, which describes the responsibilities and delegates the authorities of the Quality Control manager shall be furnished. The Quality Control manager must have a minimum of five years of documented experience in the primary areas of construction included in this contract. Include qualifications in the submitted plan for Government approval.

   This contract does not require a full time Quality Control Manager. The individual assigned may have other duties within the contractor's organization but must commit, as a minimum, an average of two hours per day towards fulfilling the QC requirements of this section. Hours dedicated to this function will be annotated on the submitted QC records.

   a) The Contractor's Quality Control activities to be performed, include those of subcontractors, off-site fabricators, and suppliers. A job specific detailed work item list for inspection purposes will be developed by the contractor. The list will be broken into sections identical to the contract specifications and will contain all inspection actions necessary to ensure full compliance with the contract. A sample from a simplified and generic project is included as Attachment 1 to indicate the level of detail expected in this checklist.

   b) Quality Control testing procedures including corrective actions to be taken where non-compliance is noted by the Quality Control Manager.

   c) Documentation format for Contractor's Quality Control activities and testing. The attached form is to be used for documenting daily inspections, corrective actions, etc.

   d) Procedures for ensuring As-Builts are accurate and updated daily.

   e) Safety program that ensures complete compliance with OSHA and the U.S. Army Corps of Engineers manual EM 385-1-1, Safety Health Requirements Manual. Any non-compliance issues are the responsibility of the Contractor and not the Government.

f) Methods to ensure scheduled appointments are met and documentation to verify arrival and departure times at the work site.

g) A listing of all required electrical testing and operational tests.

C. Acceptance: The Quality Control Plan will be reviewed and approved, if acceptable, by the Contracting Officer. The Contractor shall make such changes and additions necessary for clarity and completeness as requested by the Contracting Officer. Acceptance is conditional and the Government reserves the right to require the Contractor to make changes in the Quality Control Plan, personnel, and operations to correct deficiencies found by the Government during performance of work. No change shall be implemented prior to acceptance in writing by the Contracting Officer. Non-compliance with the Quality Control Plan will result in one or more of the following actions at the Government's discretion:

1. Directed removal and replacement of the QC Manager.

2. Cure notices and other applicable contracting actions up to and including possible contract termination for default.

3. Other contractual actions deemed appropriate by the Contracting Officer.

D. Quality Control Records: The Quality Control Records shall contain a record of daily inspections for all work accomplished. Specific items of work checked each day will be annotated. All work-in-place must be certified as complying with the contract plans and specifications. Non-compliance items must be clearly noted. Corrective actions must be outlined and detailed for non-compliance items. The Contractor shall maintain daily records, which will be on-the-job site and available for review by the Contracting Officer or Representative. Daily reports will be signed by the designated Quality Control Manager and will indicate hours spent on Quality Control that day. A copy of the QC daily reports shall be given to Construction Management by noon on the following day.

E. Submittals: The contractor will submit three copies of the proposed Quality Control Plan for acceptance not more than 10 days after Award. No work will start until acceptance is made by the Contracting Officer. No exceptions will be provided to this requirement.

3.19 CONTRACT PROGRESS SCHEDULE AND REPORT

A. Contractor shall complete Project Schedule Form 3064 using bi-monthly intervals, starting at the Notice to Proceed until Final Acceptance. The project schedule is required to be delivered to the Contracting Officer for review and approval prior to the start of work. Work may not commence until the project schedule is approved unless the Contracting Officer waives the requirement.

B. Contractor shall complete Progress Report Form 3065 and submit to the Contracting Officer every two weeks, starting at the Notice to Proceed until Final Acceptance. The Progress Report shall mirror the intervals approved on the Project Schedule.

3.20 1354 CHECKLIST

A. Contractor shall complete the Property Inventory checklist and submit it to the Contracting Officer 10 days prior to final inspection. Prior to completing the Form 1354 checklist, the Contractor shall request assistance from the Resource Management Flight. The checklist will be delivered to the Contractor at the Preconstruction conference.

3.21 WORK SCHEDULE

A. Working hours for the Contractor will normally be between the hours of 7:45 a.m. and 4:15 p.m. excluding Saturdays, Sundays, and Federal Holidays. With prior government approval, the Contractor may work 4-10 hour days per week, Monday through Thursday or Tuesday through Friday. If the Contractor desires to work during periods other than above, additional government inspection forces may be required. The Contractor must notify the Contracting Officer three days in advance of his/her intention to work during other periods to allow assignment of additional inspection forces when the Contracting Officer determines that they are reasonably available. If such force is reasonably available, the Contracting Officer may authorize the Contractor to perform work during periods other than normal duty hours/days.

B. Weekly construction meetings will be held throughout the duration of the project at a time and place specified in the Pre-construction Conference.

3.22 NUCLEAR DENSOMETERS

A. The use of nuclear densometers or other devices containing radioactive elements on Malmstrom AFB is controlled for safety and management purposes. The contractor must have proof of a Nuclear Regulatory Committee (NRC) permit for its use. The Contractor must also keep all radioactive equipment locked up when not in use and remove it from the base at completion of the work day. All projects requiring use of radioactive devices will be required to submit, for approval 30 days prior to use, the following information for review by the Base Radiation Safety Officer in (341 MDOS/SGOAB, Fax 406 731-2469):

1. Brief description of proposes activity.

2. Copy of current NRC or Agreement State License with NRC form 241

3. Name, address, phone number of responsible local representative and Radiation Safety officer (RSO) named on their license.

4. Copy of part of the Air Force Contract describing work to be done and inclusive dates of the work.

5. An acknowledgement that the installation RSO can make periodic checks on use of the equipment.

3.23 REFERENCES

A. All references listed in these specifications are intended to be the current version or edition.

3.24 ENERGY EFFICIENT PRODUCTS

A. All equipment supplied under this contract that requires energy usage shall be ENERGY STAR compliant.

END OF SECTION 01 00 00

SECTION 010010 - SECURITY

PART 1 - GENERAL

1.1 IDENTIFICATION OF EMPLOYEES

A. The Contractor shall furnish an Entry Authority List (EAL) of employees needing access on base to the Base Contracting Officer. Employees without a badge and identification in their possession will be denied access to the base and work areas. All security issues will be discussed during the preconstruction conference. Note that it may take up to 14 calendar days after submitting EAL to be cleared to receive badge.

1.2 FORCE PROTECTION

A. Contractor personnel are required to abide by all real world Force Protection Condition (FPCON) measures, random anti-terrorism measures (RAMs), shelter-in-place orders, evacuations and lock-down notices as directed. Examples include mandatory badge or ID checks, facility single points-of-entry and searches of hand carried items.

1.3 ANTI-TERROISM (AT) AWARENESS TRAINING

In accordance with DoDI O-2000.16v1_AFI 10-245-O, Antiterrorism (AT) Program Implementation, ensure Level I - AT Awareness Training is completed by all personnel within 30 days of requiring access, and annually thereafter. The training will be provided by the government. The objective of the training is to provide personnel with requisite knowledge necessary to remain vigilant and enable employment of AT tactics, techniques, and procedures. This training will be conducted by 341st Contracting Squadron, by providing a written pamphlet for review.

1.4 PICTURES ON ANY DOD FACILITY

No pictures shall be allowed of any government property or component, which includes pictures of government property, from non-government property (EX: pictures of buildings physically on Malmstrom AFB, from exterior private property adjacent base perimeter), without prior consent from Malmstrom 341st Contracting Squadron. Any photograph, sketch, picture, drawing, map, or graphical representation of US Government property to include: facilities, aircraft, components, equipment, or other resources, is prohibited without first obtaining permission from the government (e.g. Security Forces convoys, Helicopters, Entry Control Points, etc.)

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 CONDUCT OF WORK

A. Coordination and Access to Site: Coordination with using agencies shall be made through the

Contracting Officer or designated representative to assist the Contractor in completing the work with a minimum of interference and inconvenience.

B. General Area Requirements: Security requirements and procedures shall be coordinated with the 34l Security Forces Squadron, Operations Section (extension 731-6416/4341), Malmstrom AFB. Activities of the Contractor and the Contractor's employees and subcontractors and their employees while on the base, will be in accordance with base regulations, including those of the fire marshall, as well as security directives. This includes, but is not limited to, giving way to all emergency vehicles that are in a response mode. All personnel performing duties as an escort official(s) for contractors within a restricted area are briefed thoroughly on control methods and actions to take to enforce control. Contractors will be briefed on security procedures and their responsibilities prior to the start of a contract. Contractor personnel are required to abide by all real world FPCON measures, RAMs (Random Anti-Terrorism Measures) shelter-in-place, evacuations, lock-down notices as directed, search of personnel and items, and ID checks. Contractors will be notified as necessary, to changes in security procedures.

1. Identification Credentials: All Contractor personnel, except those not under the Contractor's direct control, such as material deliveries, will be required to process in and obtain an Application for Civilian Identification Card (Air Force Form 355 or AF Form 1172) from the Malmstrom AFB Contracting Office in Building 145. After completion of the AF Form 355 or AF Form 1172, proceed to the Visitor Control Center in Bldg 192, open 0730-1630, to obtain identification badge. In addition, all private vehicles requiring access to the base will be required to display a vehicle sticker (AF Form 75) which may also be obtained in Bldg 192 after presentation of vehicle registration and certification of vehicle insurance coverage. The Contractor shall notify the 341 Security Forces Squadron, Operations Section, through the Contracting Officer, of any lost badges within 48 hours after the loss, by name, address, social security number, and badge number. Employees who have terminated employment or who have been dismissed must surrender their AF Form 75 Visitor/Vehicle Pass and Identicard 2000 Contractor ID Card to the Visitors Control Center through the Contracting Officer. Employees without a badge in their possession will be denied access to the base and work areas and may be subject to detainment until proper identification is made. The badge shall not be worn or displayed off the military base.

2. Commercial or company vehicles will be allowed access to the base provided company emblems are permanently attached to the sides of the vehicles. Magnetic signs are not acceptable. Personnel still require a badge or pass as identified in paragraph 1.

END OF SECTION 01 00 10

SECTION 01 36 00 (*Ver 30 July 2020*)

ENVIRONMENTAL PROTECTION

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Attachment 1-013600, Summary of Solid Waste Disposal and Diversion
Attachment 2-013600 - EESOH-MIS Hazardous Materials List

1.0 **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The Contractor shall conform to the Occupational Safety & Health Act, Environmental Protection Agency, Montana Department of Environmental Quality (MDEQ), U.S. Air Force and all other Federal, State and Local environmental regulatory requirements.

29 CFR	Occupational Safety and Health Administration
40 CFR	Environmental Protection Agency
49 CFR	Department of Transportation
EM 385-1-1	U.S. Army Corps of Engineers Safety and Health Requirements Manual (1996)
WETLANDS	U.S. Army Corps of Engineers Wetlands Delineation Manual
HWMP	Malmstrom Hazardous Waste Management Plan

ISWMP	Malmstrom Integrated Solid Waste Management Plan
SWMP	Malmstrom Storm Water Management Plan
AMAN32-7002	Environmental Compliance and Pollution Prevention (4 February 2020

2.0 **PERMITS AND FEES**

2.1 No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. The contract price shall include all costs associated with this section. The Contractor shall pay all fines, fees, or other costs for violation or non-compliance with Federal, State, Regional and local laws and regulations.

2.2 The Contractor shall obtain and comply with all environmental permits and commitments required by Federal, State, regional, and local environmental laws and regulations unless otherwise stated.

2.3 Environmental Deliverables: The Contractor shall provide all applicable environmental permits, forms, plans, etc. to the Contract Officer (CO), Contract Officer Representative (COR), Quality Assurance Examiner (QAE), Project Manager, or other Government representatives. Deliverables shall include all required signatures.

Deliverables include (as applicable):

- construction dewatering permit (see §4.2.2)
- construction storm water notice of intent (see §4.2.2.A)
- construction storm water pollution prevention plan (see §4.2.2.B)
- construction storm water notice of termination (see §4.2.1.1.C)
- asbestos documents (see §6.1.3)

3.0 **AIR QUALITY**

3.1 Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal and State air emission and performance laws and standards.

3.2 The Contractor shall not conduct open burning of waste material on Malmstrom Air Force Base or Missile Field property.

3.3 Particulates - The contractor shall not operate a construction site or demolition project unless reasonable precautions are taken to control particulate matter emissions. Airborne particulate matter emissions shall not exceed 20 % opacity as defined in Title 40 Code of Federal Regulations (CFR) Chapter 60 Appendix A. In general, this means that the contractor shall reduce or eliminate any visible dust plume or other visible emissions.

3.4 Sound Intrusions - The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise.

3.5 Ozone Depleting Substances (ODS) -The contractor shall ensure activities performed under this contract comply with Air Force Manual (AFMAN)32-7002, paragraphs 3.3.1.6, 3.3.5.1, 5.6.4.1.1, etc. The contractor shall not purchase, use, or specify the use of any Class I ODS in the production, design, or maintenance of the end item. Class II ODS may be used or specified only with the written approval of the Contracting Officer. For reference, 40 CFR 82 defines Class I and Class II ODS.

3.6 Heating, Ventilation, and Air-Conditioning (HVAC) Systems - The contractor shall comply with all refrigerant handling standards or regulations during HVAC maintenance, repair, replacement or demolition work. The contractor shall meet all applicable HVAC permitting, licensing, or other Federal, state, or local requirements.

Refrigerant technicians shall possess the necessary state and local certifications for HVAC repairs, refrigerant handling, or operating refrigerant reclamation or recycling equipment. Refrigerant technicians shall use only EPA-certified refrigerant recovery or reclamation equipment during HVAC work.

The contractor shall not intentionally vent or cause to be vented any chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) refrigerants during HVAC equipment repair, replacement, maintenance, or demolition. Replacement compressors and other replacement equipment used in repairing CFC-containing systems shall be compatible with CFC replacement refrigerants.

4.0 **WATER RESOURCES AND STORM WATER DISCHARGE**

4.1 General

4.1.1 The Contractor shall monitor construction activities to prevent surface water and ground water pollution. The Contractor shall not apply toxic or hazardous chemicals to soil or vegetation unless otherwise directed. The Contractor shall monitor all water areas affected by construction activities. For construction activities immediately adjacent to surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State- or Federally- issued Clean Water Act permits.

4.1.2 Municipal Separate Storm Sewer System (MS4) - The Contractor shall not discharge any contaminated materials into the MAFB MS4. The Contractor shall consult with CES/CEIE regarding discharges of any non-storm water effluent such as irrigation drainage, pavement wash-waters, uncontaminated ground water, etc. The contractor shall obtain MDEQ General Permit coverage for disinfected water discharges into the MS4 from hydrant testing, hydrostatic testing, water mains disinfection, disinfected potable water, or similar.

4.2 Storm Water

4.2.1 Construction Dewatering- The Contractor shall obtain coverage under the MDEQ General Permit for Construction Dewatering, MTG070000, prior to construction dewatering activities where necessary.

4.2.2 Construction Activities – The Contractor shall obtain coverage under the MDEQ General Permit for Storm Water Discharges Associated with Construction Activity, MTR10000 (Construction General Permit), prior to projects which will disturb 1 acre or more of land. This includes sub-phases of larger projects that will disturb 1 acre or more of land.

4.2.2.1 If a permit is required, the contractor shall submit a completed Notice of Intent (NOI) package to CES/CEIE for review prior to submitting to MDEQ. Allow 10 business days for CES/CEIE review. The package shall contain the following:

A. A Notice of Intent Form

B. A Storm Water Pollution Prevention Plan (SWPPP). This plan must meet the basic SWPPP requirements provided in the Construction General Permit. The SWPPP must also include:

- detailed site plan, including construction traffic control plans, in a format that can be maintained and updated throughout the project
- project activity timelines including excavation and landscaping schedules in a format that can be maintained and updated throughout the project
- initial descriptions and locations of construction storm water Best Management Practices (BMP) in a format that can be maintained and updated throughout the project

4.2.2.2 The contractor shall perform the following in accordance with the Construction General Permit:

A. The Contractor shall keep the SWPPP, associated plans and logbooks, and copies of the NOI and Construction General Permit on site.

B. Throughout the project, the Contractor shall perform inspections specified in the Construction General Permit, Part III. The Contractor shall record all SWPPP changes, modifications, and updates in logbooks or as notations on the documents.

C. When the contactor determines that the site has achieved final stabilization the contractor will prepare and submit a Notice of Termination (NOT) to 341 CES/CEIE for review prior to submittal to MDEQ. CES/CEIE will inspect the site and determine if final stabilization has been achieved. MAFB and the Construction General Permit define final stabilization as:

- the time at which all soil disturbing activities at the site are complete
- the Contractor has established vegetative cover with a density of at least 70 percent of pre-disturbed conditions

The Contractor shall not submit the NOT to MDEQ until CES/CEIE concurs that final stabilization was achieved.

4.2.2.3 The contractor should reference the MDEQ's website: https://deq.mt.gov for NOI Forms, instructions, SWPPP information, and other storm water requirements and guidelines.

4.2.3 Concrete Truck Washout and Masonry Cleanup - All concrete truck washout, masonry cleanup, and tool cleaning must occur off base or at a designated concrete washout containment area designated by the CO, COR, or QAE. The contractor will identify the area with visible signage. Contractor shall control and contain all concrete washout fluids and debris and remove them from the site prior to project completion.

4.3 Sanitary Sewer - The Contractor shall not discharge any restricted materials down the sanitary sewer or wastewater disposal system without Government approval. All discharges to the sewer shall meet Federal, State, and Local regulatory requirements and shall meet the permit requirements limiting MAFB discharges.

The Contractor shall coordinate with the CO, COR, QAE, and CES/CEIE for any discharges to the sanitary sewer greater than 100,000 gallons/day.

4.3.1 Restricted waste water materials include:

4.3.1.1 Any pollutants which create a fire or explosion hazard, specifically any waste stream with a closed cup flashpoint of less than sixty degrees Celsius;

4.3.1.2 Any pollutant which will cause corrosive structural damage but in no case with a pH lower than pH 5.5;

4.3.1.3 Any solid or viscous substances which may cause obstruction in the sewage system;

4.3.1.4 Any other discharge that causes Pass Through or Interference at the City of Great Falls Wastewater Treatment Plant;

4.3.1.5 Any water or waste containing metals in excess of the following limits:

Arsenic-1.57 milligrams per liter (mg/L)
Cadmium- 3.51 mg/L
Chromium, Total- 5.92 mg/L
Chromium III- 0.57 mg/L
Chromium VI- 0.04 mg/L
Copper- 0.19 mg/L
Lead- 0.14 mg/l
Mercury- 0.02 mg/L
Nickel- 0.59 mg/L
Silver- 0.62 mg/L
Selenium- 0.002 mg/L
Zinc- 2.13 mg/L

Sulfide- 3608 mg/L

4.3.1.6 Any trucked or hauled waste to include liquid waste from portable toilet facilities

5.0 **EROSION, SEDIMENT CONTROLS, AND WETLANDS**

5.1 Wetlands - The Contractor shall not enter, disturb, destroy, place fill into, or allow discharge of contaminants into any wetlands except as specifically authorized by the Government. The Contractor shall protect MAFB wetlands. Government authorization to enter specific wetlands shall not relieve the Contractor from any obligation to protect other wetlands within, adjacent to, or in the vicinity of the construction site and associated boundaries. The Contractor may obtain MAFB wetlands maps from CES/CEIE.

5.2 The Contractor shall select, provide, and maintain erosion and sediment control BMPs in accordance with Federal, State, and local laws and regulations, and the MS4 Storm Water Management Plan (SWMP). The selected BMPs shall function such that they do not violate water quality standards as a result of the Contractor's construction activities.

The Contractor should minimize the area of exposed bare soil due to construction activities. Construction site plans shall include or record updated descriptions of any exposed bare soil, BMP installation and maintenance, corrective actions, etc.

5.3 The Contractor shall construct or install temporary or permanent erosion and sediment control BMPs in accordance with the MS4 SWMP or the Construction SWPPP (if applicable; see Section 4.2.2). BMPs may include, but are not limited to:

- vegetation cover
- stream bank stabilization
- slope stabilization
- silt fences
- terrace construction
- interceptor channels
- sediment traps
- culvert or flow channel inlet and outfall protection
- diversion channels
- sedimentation or retention basins

The Contractor shall remove all temporary BMPs after the area has reached stabilization and prior to the project’s completion or the Construction SWPPP NOT submittal.

6.0 **TOXICS**

The Contractor shall ensure that no employees and no Government personnel suffer toxic material exposure such as airborne asbestos, lead from lead base paint, polychlorinated biphenyls (PCBs), etc.

6.1 Paint and Paint Hazards - Existing Paint: Existing painted surfaces may contain lead based paint. The Contractor shall ensure that no employee is exposed to concentrations of lead in excess of the permissible exposure limit (PEL) equal to an eight hour time weighted average of 50 micrograms per cubic meter (ug/m3).

The Contractor shall conform to all the requirements of 29 CFR 1926.62. Lead Workers shall wear respirators unless air testing establishes that lower protection factors are sufficient. Engineering and work practice controls may be sufficient to reduce exposure to or below the PEL. If the lead PEL is exceeded all workers shall wear appropriate personal protective equipment.

The Contractor may opt to use a steady spray of water during demolition work in order to limit worker exposures. If so, the Contractor shall contain all discharges to prevent watershed, MS4, sanitary sewer, or any other contamination. The Contractor shall not contaminate the soil with lead due to excessive use of water.

The Contractor shall limit public access and the Contractor shall prevent public exposure to any lead concentrations above the PEL.

For any remodeling or renovation work in base housing or child-occupied facilities built before 1978, certified renovators shall direct all lead paint removals, remediations, or abatemenets. The certified renovator shall meet 40 CFR 745.90(a), 40 CFR 745.90(b)(2), and all other applicable training, certification, or credentialing requirements.

For lead based paint removal in base housing or child-occupied facilities, the Contractor shall develop a written Occupant Protection Plan. The Occupant Protection Plan is unique to the structure and shall include the requirements of 40 CFR 745.227(e)(5). Abatement workers must have appropriate EPA certification.

6.1.1 New-Paint Restriction - The Contractor shall not furnish or use any paints or coatings containing mercury or lead for interior or exterior applications. Paints, solvents, and surface preparation chemicals shall not contain Hexavalent Chromium.

6.1.2 No oil-based paints or coatings are to be used on base unless the entire liquid material is applied to the intended surface. No oil based paint liquid is to be left for disposal by base personnel . This material shall be properly disposed of by the contractor.

6.1.3 The Government recommends that the Contractor use environmentally safe water base paints and stains where possible.

6.2 Polychlorinated Biphenyls (PCBs) - No PCBs or products containing PCBs shall be installed on Malmstrom AFB.

6.2.2 The contractor shall assume that hermetically sealed electrical equipment contains greater than 50 parts per million (ppm) PCB unless the equipment bears a label which states that it contains no PCBs.

6.2.3 Turn in all PCB containing light ballasts, capacitors, transformers, switch gear, etc. to CES/CEIE.

6.2.4 Contractor shall:

6.2.4.1 Count the number of units for turn in.

6.2.4.2 Place units in a 49 CFR 178.500, Subpart L shipping container furnished by the Contractor. Ensure the container meets Department of Transportation regulations and bears the proper labels.

6.2.4.3 Call CES/CEIE (731-6163) three days in advance to schedule contractor delivery.

7.0 **EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT**.

For contracts over $100,000, contractors shall comply with the Toxic Release Inventory reporting provisions of Emergency Planning and Right-to-Know Act (EPCRA) Section 313.

The Contractor shall provide a list of any hazardous substances listed under EPCRA along with maximum inventory and consumption. HAZMART registration fulfills this requirement. Contractors shall provide this information to CES/CEIE and HAZMART.

References: Federal Register, August 10, 1995, Vol. 60, No. 154, p40987-40992 and Federal Register, September 29, 1995, Vol 60, No. 189, p50737-50743.

8.0 **HAZARDOUS MATERIALS**

8.1 Hazardous Materials (HAZMAT) Contractor Authorization Procedures - Contractors must obtain an authorization prior to bringing any HAZMAT onto MAFB. HAZMAT includes all items covered under EPCRA (or other federal, state or local) tracking requirements, the OSHA HAZCOM Standard, and all Class I and Class II ODS.

MAFB tracks HAZMAT through the Enterprise Environmental, Safety, and Occupational Health Management Information System (EESOH-MIS). The contractor may obtain guidance from CES/CEIE at 731-6163 or 731-6441.

8.2 HAZMAT inventory submittal

8.2.1 Following contract award and a minimum of 30 calendar days prior to beginning work, the Contractor and all their subcontractors must submit their HAZMAT inventory to CES/CEIE through the CO, COR, or QAE. The Contractor shall provide a complete HAZMAT inventory intended for use during the contract, process or procedure descriptions, total quantities, individual container types and sizes, etc. The Contractor should use the form template provided in Attachment 2-013600.

8.2.2 The HAZMAT inventory must include a Safety Data Sheet (SDS) for each item listed. Each SDS shall be three (3) years old or less.

8.2.3 Special consideration: Single Contractors (i.e., those with no subcontractors) **and** with proposed HAZMAT inventories of 15 or fewer items may submit their list a minimum of 10 calendar days prior to beginning work.

8.3 CES/CEIE will review the submittal and identify those hazardous materials requiring HAZMAT authorization procedures within EESOH-MIS. Note that MAFB may prohibit use of some materials that the Contractor lists on Attachment 2-013600. Materials which do not require EESOH-MIS entry require no additional authorization. CES/CEIE will forward the identified hazardous materials list to the CO, COR, or QAE.

CES/CEIE and the Hazardous Materials Pharmacy (HAZMART) will coordinate entry of the listed HAZMAT into the EESOH-MIS tracking system. Note that any emergency response issues, such as acquisition of unplanned new HAZMAT, require prior CES/CEIE approvals.

8.4 HAZMART will issue bar codes each time the Contractor brings formally authorized HAZMAT onto the installation. The contractor shall provide monthly HAZMAT consumption reports to the HAZMART.

8.5 Prior to contract completion, the Contractor will submit a final report of the actual quantities used on base. CES/CEIE will coordinate with HAZMART or the Contractor to reconcile actual HAZMAT usage during the contract period. The Contractor shall submit a HAZMART account close out report to the CO ten (10) days prior to the final acceptance inspection as a formal contract submittal.

8.6 The Contractor shall remove of all excess HAZMAT from the base upon contract completion.

9.0 **STORAGE OF HAZARDOUS MATERIALS**

9.1 The contractor shall properly store all hazardous materials used on base property in designated areas in accordance with all Federal, State, local, and MAFB Fire Department regulatory requirements. Storage shall include, but not be limited to:

9.1.1 Keep containers closed when not in use.

9.1.2 Label containers and provide appropriate warning labels. Empty containers shall be labeled as empty.

9.1.3 Post hazardous signs as required.

9.1.4 Provide storage with secondary containment and routinely check for leaks and spills.

9.1.5 Store materials at a central location.

9.1.6 Flammable items must be stored in an approved flammable storage locker.

9.1.7 All fuel storage tanks must have secondary containment.

9.1.8 Compressed Gas Cylinders segregated and secured to prevent falling over.

9.1.9 Valve protection cap for a cylinder designed to accept a cap shall always be in place except when in use or connected for use.

9.2 Storage, fueling, and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. The Contractor shall store fuel, lubricants, fluids, oil, etc. in accordance with all Federal, State, Regional, and local laws and regulations. The Contractor shall store used lubricants, oil, or other fluids intended to be discarded in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations.

10.0 **HAZARDOUS WASTE**

10.1 The contractor shall properly dispose of any hazardous wastes generated from their operations and shall manage those wastes (except for those that come under Universal Waste Rules) in accordance with 40 CFR Subchapter I, Parts 260 - 268.

The contractor shall manifest all hazardous wastes per 40 CFR 263.20 and submit a copy of each waste manifest to CES/CEIE, 731-6163, within 45 calendar days of hazardous waste removal.

The contractor may obtain informal guidance from CES/CEIE on proper storage and handling of hazardous and universal waste from the contractor's MAFB operations. However, all responsibility rests with the contractor to comply with federal and state hazardous waste requirements. Any information obtained from CES/CEIE does not remove responsibility from the contractor for proper waste management.

10.1.1 The contractor shall properly collect and identify all hazardous waste generated at MAFB from their operations, including spill cleanup.

10.1.2 In the event that the Government responds to any Contractor-caused spill cleanup or hazardous waste event not covered by the Contract, the Contractor shall reimburse the government all costs associated with the disposal of the spill or hazardous waste.

10.1.3 The contractor is responsible for all fines and penalties which may stem from an EPA or State of Montana Department Environmental Quality hazardous waste inspection of their operation.

10.2 Universal Waste - See 40 CFR 273.9 for Universal Waste definitions.

10.2.1 Construction Contractors shall manage all Universal Wastes in accordance with 40 CFR 273.1 - 273.81.

10.2.2 Service Contractors shall turn Universal Waste in to CES/CEIE. Contact CES/CEIE at 731-6163 prior to any Universal Waste turn-in.

11.0 **SOLID WASTE**

11.1 Solid Waste Handling and Disposal - The Contractor shall properly handle and dispose of all job site solid waste including any laboratory testing, waste characterization, or documentation submittals required by the CO, landfill owner, local, state, or Federal agencies.

11.1.1 The Contractor shall transport all solid waste off Government property and dispose of it in compliance with local, State, and Federal solid waste disposal requirements.

11.1.2 The Contractor shall demonstrate that they dispose of wastes generated from their operations at the proper Landfill Classification for each Waste Group. Refer to ARM 17.50.503 for Waste Group II, III, and IV definitions and ARM 17.50.504 for Landfill Classification II, III, and IV definitions.

11.1.3 The Contractor shall comply with the following requirements in AFMAN32-7002 where applicable:

- Paragraph 6.8.3, Construction and Demolition (C&D) waste characterization requirements
    - Note: see ARM 17.50.503(c) for the definition of C&D waste
- Paragraph 6.8.4, C&D waste disposal
    - Note that "... Conditionally exempt small quantity generator hazardous waste that is generated as a part of a construction or demolition [C&D] project and that cannot practicably be removed from the construction and demolition waste may be included in waste disposed of in Class IV units", per ARM 17.50.504(c).
- Paragraph 6.9, *et seq*, Asbestos-contaminated C&D waste disposal provisions
- Paragraph 6.10, *et seq*, Lead paint or other lead-contaminated C&D waste disposal provisions

11.2 The Contractor shall place solid wastes, excluding grubbing and clearing debris, in containers that are emptied on a regular schedule.

11.3 The Contractor shall employ waste segregation or other measures to prevent solid waste and hazardous waste co-mingling or cross-contamination.

11.4 The Contractor shall not place any wastes in Government-owned containers or abandon any waste at MAFB, including but not limited to C&D waste.

11.5 Waste Documentation and Solid Waste Diversion - Contractors shall document waste disposal and they shall divert wastes for recycling or other uses "... in the most cost-effective

manner possible in accordance with [Department of Defense Instruction] DoDI 4715.23, with consideration given to cost savings and cost avoidance ..." (AFMAN32-7002, Paragraph 6.6.1)

11.5.1 The Contractor shall coordinate with CES/CEIE and the current MAFB Installation Solid Waste Management Plan to establish a list of wastes that are qualified for diversion, recycling, or entry into the MAFB Qualified Recycling Plan.

11.5.2 The Contractor shall document the weights of all disposed wastes, diverted, or recycled materials on the "Summary of Solid Waste Disposal and Diversion" form at Attachment 1-013600. CES/CEIE must receive the completed form by the 10th of each month. In general, the Contractor must report weights of:

- recycled materials
- diverted wastes
- non-hazardous wastes
- C&D wastes or debris, to include as separate items:
    - uncontaminated C&D waste or debris
    - asbestos-contaminated C&D waste
    - lead-paint or other lead-contaminated C&D waste

11.5.3 The Contractor shall provide copies of all disposal documents, weight tickets, etc. to the CO, COR, or QAE.

11.6 The Contractor shall bear cleanup costs for improperly disposed wastes or for removal of improperly placed hazardous waste materials.

12.0 **SPILLS AND SPILL RESPONSE**

12.1 The Contractor shall immediately report spills of any type material (excluding clean water) to CES/CEIE (731-1423) and the CO, COR, or QAE for evaluation to determine cleanup procedures and evaluate the need for reporting.

12.2 The Contractor shall reimburse the Government for the costs of any cleanups or disposal accomplished by Malmstrom personnel or by a Malmstrom cleanup contractor.

12.3 The Contractor shall comply with the MAFB Spill Prevention Control and Countermeasure Plan (SPCC). Only trained personnel shall handle or clean up spills. Refer to 40 CFR 112, 29 CFR 1910.120 and the MAFB SPCC for detailed information.

12.4 Any hazardous product or material of environmental concern cleaned up at MAFB must be tested to determine if it is a hazardous waste.

12.5 Spill Response procedures.

12.5.1 Determine if the Contractor can contain the spill. If so, follow the procedures in Paragraph 12.5.5.

12.5.2 For spills beyond the Contractor's capabilities, immediately call the MAFB Fire Department at 911 from a base phone or 731-3746 from a cell phone.

12.5.3 Evacuate the area downwind of the spill if warranted by type of release.

12.5.4 Ensure all workers safely shut down their operations and secure their equipment, time permitting.

12.5.5 If the spill can be contained without injury to personnel and without assistance from the MAFB Fire Department or other emergency response personnel, perform the following:

12.5.5.1 Stop the spill's source.

12.5.5.2 If on site containment, safety equipment, and absorbent materials are available: Contain and/or control the release. Clean up the release using proper absorbent media for the chemical spilled. Recover as much of the spill as possible using absorbent media or approved vacuum device to minimize hazardous waste volume. DO NOT hose down the spilled material into floor trench drains, storm drains, or sanitary sewer manholes.

12.5.5.3 *Immediately* report the spill to the CO, COR, or QAE ***and*** CES/CEIE (731-1423). CES/CEIE will provide reporting guidance and suggested disposal procedures for recovered material. Regardless of CES/CEIE guidance, however, the Contractor shall be responsible for proper handling and disposal of clean up materials.

13.0 DISCOVERY OF CONTAMINATED SOILS, MILITARY MUNITIONS, AND HISTORIC, ARCHAEOLOGICAL, OR CULTURAL RESOURCES

13.1 Contaminated Soil - indicated by petroleum odors, unnatural colors, unusual textures, etc.

13.1.1 The Contractor shall follow the spill procedures in Section 12.0 if they encounter any contaminated soil. Immediately notify the CO, COR, or QAE and CES/CEIE (731-1423).

13.1.2 Following site evaluation, the CO, in collaboration with CES/CEIE, will advise of the steps that the contractor must follow to complete the work through the contaminated area. Work practices or personnel requirements may include but not be limited to:

- 40 hour Hazardous Waste Operations and Emergency Response training
- Confined Space Entry training and permitting
- Respiratory protection
- Completion of a Site Safety & Health Plan

13.1.3 MAFB Contracting Squadron personnel will negotiate any additional costs for work in the contaminated area not specified in the original contract.

13.2 Military Munitions - In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260.10, the Contractor shall immediately stop work in that area and immediately inform the CO, COR, or QAE.

13.3 Historic, Archaeological, or Cultural Resources

13.3.1 The Contractor shall protect Historical, Archaeological, and Cultural Resources and shall be responsible for their preservation during the life of the Contract.

13.3.2 If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to:

- any human skeletal remains or burials
- artifacts
- shell, midden, bone, charcoal, or other deposits
- rock or coral alignments, paintings, wall, or other constructed features
- any indication of agricultural or other human activities.

13.3.3 Upon such discovery or find, the Contractor shall immediately:

- Cease all activities that may result in impact to or the destruction of these resources.
- Notify the CO, COR, or QAE ***and*** 341 CES/CEIE so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made.
- Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

14.0 ENVIRONMENTAL MANAGEMENT SYSTEM

15.1 Contractor personnel shall receive appropriate environmental training in accordance with Federal Acquisition Regulation (FAR) 52.223-19 if the contract has potential to negatively impact the environment.

END OF SECTION

ATTACHMENT 1-013600

SUMMARY OF SOLID WASTE DISPOSAL AND DIVERSION

Project:_____

Project Number:_____ Contract Number:_____

Contractor Names: _____

Address:_____Phone: _____

Submitter's Name:_____Report Period Start:_____ End: _____

Provide information MONTHLY by the 10th day after end of reporting period.

Type of Material	Disposed in Municipal Solid Waste Landfill		Diverted from Landfill by Recycling/Reuse QTY/Cost/Profit		
	Weight / Units (lb, ton, etc.)	Total Cost (Tipping fee, Transport, etc.)	Weight / Units (lb, ton, etc.)	$ received (recycled) or <*$ paid*> (disposal)	Other (donation, etc.)
Asphalt					
Concrete					
Pipe Insulation					
Ferrous Metal					
Non-Ferrous Metal					
Wood					
Debris					
Glass					
Porcelain					
Brick					
Bond Paper					
Newsprint					
Cardboard					
Plastic					
Gypsum					
Paint and paint cans					
Other					

Signature:_____ Title:_____

Date:_____ Questions? Call Solid Waste Manager at 731-6448 Data Base Input :_____

ATTACHMENT 2-013600 - EESOH-MIS Hazardous Materials List

Contractor Name:		Project Name / Description:	Contract #:		Container		Aerosol? Y/N
LINE #	TRACK	MATERIAL TYPE (Product Name)	MSN *	SDS *	Type *	Size *	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12		=					
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

QUALITY CONTROL REPORT TO INSPECTOR

Date: _____

CONTRACT NO. F24604-	**TITLE AND LOCATION** MALMSTROM AFB MT	**REPORT NO.**
CONTRACTOR (Prime or Subcontractor)	**NAME OF SUPERINTENDENT OR QC REP**	
WEATHER	**TEMPERATURE**	
WEATHER EFFECTS		

PRIME CONTRACTORS/SUBCONTRACTOR WORKFORCE
(If space provide below is inadequate, use additional sheets

NUMBER	TRADE	HOURS	EMPLOYER	ACTIVITY/TASK PERFORMED	COMP	NON COMP

TOTAL WORK HOURS ON JOB SITE THIS DATE	_____	KTR INITIALS CERTIFY INSPECTION OF ACTIVITY INITIALS
CUMULATIVE TOTAL OF WORK HOURS FROM PREVIOUS REPORT	_____	WERE THERE ANY LOST TIME ACCIDENTS THIS DATE? Δ YES Δ NO
TOTAL WORK HOURS FROM START OF CONSTRUCTION		IF YES, A COPY OF THE COMPLETED OSHA REPORT IS REQUIRED

CONSTRUCTION AND PLANT EQUIPMENT LEFT ON JOB SITE UNTIL USE IS COMPLETED

DESCRIPTION	DATE FIRST ON JOB (FIRST TIME ONLY)	HOURS WORKED THIS DATE	HOURS IDLED	DATE OF FINAL REMOVAL FROM JOB SITE

CONSTRUCTION AND PLANT EQUIPMENT NOT LEFT ON JOB SITE PERMANENTLY
(This will include pickup trucks and mobile mounted items, such as compressor, that are also used for transportation to and from the job)

DESCRIPTION	HOURS WORKED	HOURS IDLED

Attachment 1

SPEC PARA AND/OR	LOCATION AND DESCRIPTION OF DEFICIENCIES

DRAWING NO.	(Materials, Equipment, Safety, and/or Workmanship) ACTION TAKEN OR TO BE TAKEN

REFERENCE

DEFICIENCIES CORRECTED THIS DATE	REPORT NO.	COMPLIANCE NOTICE NO.

INSPECTION AND/OR TESTING PERFORMED TODAY-FOLLOW WITH REPORT	LOCATION AND/OR ELEMENT OF WORK	REMARKS RESULTS OF INSPECTION/TESTING

SPEC PARA/ DRAWING NO.	EQUIPMENT/MATERIAL RECEVIED TODAY TO BE INCORPORATED IN JOB (Description, Sizes, Quantity)	SUBMITTAL NO. OR CERTIFICATION	DATE APPROVED

REMARKS:
(Document Total QC Hours for this Day, Directions Received from Government, and Compliance Notices, Etc)

_____
Quality Control Rep Date

CONSTRUCTION REPRESENTATIVES REMARKS AND/OR EXCEPTIONS TO THIS REPORT

_____
Construction Representative Date

Attachment 1

SECTION 01570

CONSTRUCTION TRAFFIC CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is the furnishing of labor, materials and equipment for installing, maintaining and operating traffic control devices to ensure the safety of the general public and project personnel.

1.2 REQUIREMENTS

A. Perform work under this section meeting Manual of Uniform Traffic Control Services (MUTCD) and contract requirements.

1.3 NOTIFICATIONS

A. Coordinate all construction activities to reduce traffic conflicts at the work site, off-site events or other construction projects.

B. Furnish the Engineer, for Owner review, the construction traffic control plan at least one week before construction begins or before changes in segments or phases of the work on the project. The Owner will review and approve the Traffic Control Plan considering known off-site activities and may require modification to the plan or construction timing to coordinate events. Work shall not commence until said plan is approved.

C. For project sites involving a through street, provide the Engineer with a news release. Include in the news release, as a minimum, the work activity and duration. Once approved, furnish the news release to the local media at least three days before starting work. Notify all landowners or residents adjacent to the work of the type and duration of the construction.

PART 2 - PRODUCT

2.1 TRAFFIC CONTROL DEVICES

A. Assure all signs and barricades are reflectorized. Assure all night time traffic control devices meet MUTCD lighting requirements.

B. Use traffic control devices meeting the “Manual of Uniform Traffic Control Devices” and the “Traffic Control Devices Handbook” requirements, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20492.

C. Assure all traffic control devices are clean, legible, reflective for night-time use, and operable.

PART 3 - EXECUTION

3.1 WORK METHODS:

A. Place all traffic control devices as planned before permitting workers or equipment on the traveled way. Install signs, cones and barricades in that order.

B. Inspect the work area at least twice each day during construction and maintain records of traffic control devices used and their location.

C. Assure traffic control is appropriate to the work. Assure traffic control devices are appropriate and clean before suspending work for the day.

D. Remove traffic control devices in reverse order of installation at the end of each shift.

E. Remove and store all unnecessary traffic control devices away from traffic’s view.

3.2 NONCOMPLIANCE

A. Remove, repair or replace any traffic control device not providing its intended function.

B. Do not begin work until all required traffic control devices are placed.

C. The Engineer will periodically inspect the traffic control and inform the Contractor of any deficiencies.

D. Contractor failure to correct any deficiency in the traffic control within 4 hours of notification is cause to deduct monies from the contract payment on the next progress payment.

E. The Engineer may direct correcting traffic control deficiencies immediately. Failure to immediately correct the deficiency is cause for the Engineer to correct the deficiency at Contractor expense.

3.3 FLAGGING

A. Furnish competent and properly equipped flag persons as described in the booklet “Instructions for Flag persons” furnished by the Montana Department of Transportation.

End of Section

SECTION 01580

TEMPORARY WATER SUPPLY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide temporary water service to all residential and commercial service connections interrupted by water system replacement projects. The Contractor shall verify with the Engineer and Owner at least 72 hours (excluding weekends and holidays) prior to the suspension of service the areas where consumers will require a temporary water supply. Temporary water service shall not include temporary service for commercial fire protection unless specifically indicated on the drawings.

B. The Contractor shall not disrupt a residential water service for more than 8 hours without providing temporary water. The Contractor shall provide homes that are subject to more than two water shut downs with temporary water. The Contractor also shall not disrupt service to commercial customers unless:

1. The Contractor obtains an authorization letter from the property owner and business owner (if different) at least 7 days prior to the interruption of service. The owners shall agree in the letter to the time and dates of the interruption of the water service and;
2. The Contractor submits a comprehensive work plan to the Engineer for approval that details the planned methodology to be used to ensure the commercial facility is not out water for more than the time detailed in the above letter.

1.2 STANDARD DRAWINGS

A. It shall be the Contractor's responsibility to determine the extent of water system to be taken out of service to perform the work and the subsequent configuration of the temporary water system to provide service to all affected water customers.

1.3 SUBMITTALS

A. Contractor shall submit a shop drawing including all materials proposed to be used for temporary water. Additionally, a temporary water plan shall be submitted for each zone prior to starting the layout of the temporary water system. This submittal shall include as a minimum, connection points, hydrants and/or valves to be operated by the Owner, layout for connection to each service, and the location of all street crossings. Depending on the circumstances of the zone, additional information may be required by the Engineer. These submittals shall be submitted in accordance with Section 01300 of these specifications.

B. Contractor shall notify the Fire Department at least 48 hours in advance whenever the fire supply to any commercial buildings is interrupted.

1.4 APPLICABLE LAWS AND REGULATIONS

A. Contractor shall comply with all applicable laws and regulations.

PART 2 - PRODUCTS

2.1 TEMPORARY WATER PIPING

A. The water piping of temporary hoses, piping, etc. shall be a 160 psi rating, NSF approved hose, flexible polyethylene pipe, or PVC pipe. All pipe used for the temporary water system must have a visible NSF approval stamp by the manufacturer. A short section of high-pressure flexible rubber hose may be used for the connection to each residence. The temporary system must be leak proof.

2.2 SHUT OFF VALVE

A. The distribution pipe shall have a manual shut-off valve at each service tee. Shut- off valves shall be NSF approved valves.

2.3 BACKFLOW PREVENTER

A. The backflow prevention assembly shall be approved by the Engineer and the Owner during the submittal process. Backflow prevention devices shall be designed in accordance with the current AWWA Standard for Double Check Valve Backflow-Prevention Assembly.

B. Each backflow preventer shall be properly supported to protect the assembly and the attached piping from breakage.

C. The first time a backflow prevention assembly is set up on a project it shall be tested to verify its integrity. If the project is suspended over the winter, all backflow preventers shall be re-tested in the spring. All costs associated with this testing shall be the responsibility of the Contractor.

D. Each backflow prevention assembly shall be tested upon relocation. The cost for all subsequent tests shall be the responsibility of the Contractor.

PART 3 - EXECUTION

3.1 GENERAL

A. Following the Engineer's and Owner's review and approval of any proposed shutdown request, the Contractor shall be required to give a minimum 48-hour advance notice (excluding weekends and holidays) to all residential consumers whose service will be temporarily affected, by means of individual notices delivered to each consumer including the date, time, and length of the proposed shutdown. If the notices are not issued or the temporary service is not ready to be put in use, the Owner shall be free to exercise their authority in not closing down the existing valves and water main systems

B. The Contractor must have available all the necessary materials to complete the restoration of water to each of residential service within 8 hours after the suspension begins or before 5:00 p.m., whichever comes first. House-to-houseor building-to-building connections will not be allowed unless approved by the Owner.

C. Special arrangements shall be made by the Contractor to provide temporary water service for all commercial services regardless of the length of time the water main is out of service. The Contractor shall supply all hoses, fittings, etc., for providing temporary water service at Contractor's expense. Copper piping or other "non-taste" inducing pipe shall be necessary if the commercial consumer serves food or water products as part of the business.

D. Fire protection is not included unless specifically shown by the Engineer. The Fire Department may require the Contractor to provide personnel for continuous "fire watch" at assisted living facilities where residents may require assistance in the event of a fire.

E. At all times, the Contractor shall be responsible for ensuring no component of the temporary water system comes in contact with or is at risk of being in contact with sources of contamination. The Contractor shall also be responsible for ensuring there are not potential cross-connections to the temporary water system.

3.2 LOCATING CURB STOPS

A. The Contractor shall be solely responsible for all activities related to locating, exposing and operating curb stop valves to the individual properties. Existing conditions shall be identified and noted by the Contractor. Any existing condition that is suspected to indicate a defect of the curb stop valve, box, or service shall be reported immediately to the Engineer.

B. The Contractor shall be responsible for correcting any defects or damage that occurs to the curb stop valve, box, or service if not reported to the Engineer before the Contractor operates the curb stop valve.

3.3 LAWN WATERING CONNECTIONS

A. Each house connection shall be equipped with a tee connection for lawn watering. The tee shall be NSF approved and shall be equipped with an NSF approved vacuum breaker and shut off valve. The connection to each customer shall require a short section of high-pressure flexible rubber hose at the connection point.

3.4 TEMPORARY WATER SYSTEM SIZING

A. All pipe sizes shall be adequate to meet ordinary water supply demands of the consumers. The Contractor shall upsize the service at no additional cost if the home or business can show reasonable cause as to service deficiency.

B. The temporary water system shall be designed to maintain a minimum working pressure of 35 pounds per square inch at all points in the distribution system, including the service lines.

C. Where the accumulation of air could diminish the flow capacity of the system, the Contractor shall provide air relief.

3.5 TEMPORARY WATER SYSTEM DISINFECTION

A. All temporary water systems shall be assembled, flushed, and disinfected in place and approved by the Engineer and Owner before being placed into service. The disinfection procedures shall be equal to the procedures required for the new water main.

B. Temporary hoses, piping, fittings, etc. are to be flushed and disinfected in accordance with the State of Montana Department of Environmental Quality standards, and the standards of this specification prior to being put into service.

3.6 CONNECTION TO BUILDINGS

A. Once the temporary water system has been assembled, pressure tested and disinfected, the Contractor will make the final connection to the building. The Contractor should expect to find the existing plumbing on some services to have been in service for several years. The Contractor shall use an ordinary degree of care while working on these services. Also, there may not be any convenient point of temporary connection on some services. In this case, temporary fittings must be provided to achieve the connection. This work will be incidental to the temporary water work. Any damage to the existing residential plumbing shall be repaired at Contractor's expense.

3.7 CROSSING ROADS, ALLEYS AND DRIVEWAYS

A. The Contractor will be required to protect the pipe at road crossings, alleyways, or residential driveways. The method of pipe protection shall be approved by the Engineer prior to placement.

B. The Contractor will be required to install the temporary water supply at street crossings in a shallow trench or other methods acceptable to the Engineer. The Engineer may not allow new asphalt to be cut for temporary water trenches in which case the temporary water main is to be relocated or other crossing methods are to be used. Aerial crossings of the temporary water lines at street crossings will not be allowed. Temporary water supply pipes shall not be installed in storm drain pipes. Mounding millings or cold mix over a temporary water pipe that has been trenched into existing asphalt pavement will be allowed under the following conditions:

1. The maximum height shall be 2.5 inches.
2. Provisions are made to avoid impact loads on the temporary water pipe.
3. Signs are erected indicating a bump ahead at 500 feet and 100 feet from the bump and at the bump in both directions.

C. The asphalt crossings shall be cut straight and vertical shall have uniform width and shall be cut perpendicular to the centerline of the street. Restoration shall match the appropriate surface restoration detail and shall be a minimum of 2 feet wide and shall be compacted with a small mechanical compactor. There will be no payment for any street cuts or asphalt restoration under this item, this being incidental to the work. Exceptions to this requirement shall be made only on a case-by-case basis following the Contractor's proposal and subsequent review and approval by the Owner and Engineer.

3.8 RECONNECTION TO NEW WATER SYSTEM

A. After services are connected or reconnected and prior to flushing, testing and chlorinating the new main, the water service piping shall be thoroughly backflushed from the residence to the new main. Should any service include a backflow prevention device, Contractor shall temporarily remove such device or provide other means to backflush the service. The corporation stop for the reconnected services shall not be left open to the new main until the Bac-T testfor the new main has been completed and is acceptable.

END OF SECTION

SECTION 02112

REMOVAL OF EXISTING PAVEMENT, CONCRETE CURB, SIDEWALK, DRIVEWAY AND/OR STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work consists of removing and disposing of existing pavement, concrete curb, combined curb and gutter, sidewalk, private driveways, and crosswalks, along with any structures designated for removal in the contract documents. Details of removals are specified in the contract documents.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Dispose of all existing pavement, concrete curb, crosswalk and/or combined curb and gutter specified for removal in the contract documents or directed by the Engineer. Exercise care in such removal to assure that remaining nearby facilities and/or structures are not disturbed. Restore to original condition any such existing facilities or structures damaged by construction activities.

B. Cut, remove and dispose of designated existing pavement to the lines indicated on the contract documents, or directed by the Engineer. Make straight and approximately vertical cuts of edges along which new pavement is to be placed.

C. Remove and dispose of existing private concrete driveways and/or sidewalks which interfere with construction of street improvements or which do not match new grade as shown on the contract documents or as directed by the Engineer. Remove such driveways and/or sidewalks to distance of 8 inches (20 cm) behind curbs, or to greater distance if required to properly match the new curb and gutter grade. Remove along the neat line produced by a concrete saw cut. Make cuts to a depth of the thickness of the driveway and/or sidewalk or to a maximum depth of 6 inches (15 cm), whichever is lesser, and take care in removing the concrete assuring the slab breaks on the sawed neat line.

End of Section

SECTION 02114

RELOCATING OR REMOVING CONFLICTING ITEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This item consists of relocating or removing existing signs, fences, and other items as shown in the contract documents.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 STREET AND TRAFFIC CONTROL SIGNS

A. Remove and reinstall all street, stop, and other traffic control/direction signs designated to be relocated by the Contractor as designated by the Contracting Officer's Representative. Include removing, temporarily installing, storing, and permanently installing the signs.
The specific locations are to be designated by the Contracting Officer's Representative in the field.

B. Preserve all street, stop, and other traffic control and direction signs that are to remain in place. Should any such signs be moved for the Contractor's convenience, permanently reinstall the signs after curb and gutter construction is complete. Assume responsibility for any damage to such signs. No extra compensation will be allowed for preserving, removing, or replacing stop and traffic control and direction signs designated to remain in place since this work is considered incidental to the contract unit prices for the various items of the contract.

C. Where stop signs and traffic direction or control signs are temporarily removed but are needed for traffic reasons during construction, temporarily install a similar stop sign or traffic direction sign in locations acceptable to the Contracting Officer's Representative. Assure that the temporary signs remain in place until the permanent stop or traffic control signs are in place.

D. Do not install street signs temporarily.

E. Store signs which are not used for temporary installation.

G. Set all permanent signs to the same location and height as the preconstruction condition. Replace all signs which are damaged during removal with new signs.

3.2 FENCES

At locations where existing fence is in conflict with utility installation, remove and reinstall fencing as necessary for construction. Materials may be re-used if approved by the government. Any damaged material must be replaced with material matching the existing fence. Fences located on the project may be of various materials including metal, wood, vinyl, or masonry.

END OF SECTION

SECTION 02221

TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is the excavation, trenching, and backfilling for pipelines and appurtenances. It includes all clearing, grubbing, site preparation, removal, and disposal of debris from the excavation, handling and storing materials for fill and backfill, all bracing, shoring and trench protection, construction dewatering, all backfill, subgrade preparation, final grading, site dressing, and cleanup.

1.2 REFERENCES

A. The current publications listed below form a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)(600 kn-m/m^3))
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by the Sand-Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth)
AASHTO T11 (ASTM C117)	Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4253	Maximum Index Density and Unit Weight of Soils Using a Vibratory Tube
ASTM D4254	Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

1.3 DETAIL DRAWINGS

A. Detail Drawings applicable to this Section are as follows:
   1. Typical Utility Trench

1.4 TESTING

A. Field Density Testing
   1. Meet the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Quality Assurance.
   2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556), Sand Cone Method; or by AASHTO T310 (ASTM D6938) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the Engineer's discretion.
   3. Retesting failing areas is at the expense of the Contractor. Where Engineer provides testing on behalf of the Owner, the Contractor will be assessed the cost of all retests conducted by the Engineer, with that cost deducted from the progress payments.
   4. At the direction of the Engineer, provide the necessary equipment and labor to excavate and replace materials for test holes up to 5 feet deep into the compacted backfill to allow testing below the surface of any layers covered without inspection and approval by the Engineer.

B. Laboratory Maximum Density and Optimum Moisture
   1. Quality assurance tests will be made by the Engineer for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content according to AASHTO T-99 or ASTM D698.

C. Material Submittals
   1. Submit to the Engineer material quality test results, including Type 1 Bedding gradation and plasticity index, and Type 2 Bedding gradation.
   2. Submit to the Engineer laboratory moisture-density relationship testing results of on-site and off-site borrow soils.
   3. If applicable, submit a blasting plan to the Engineer.

PART 2 - PRODUCTS

2.1 PIPE BEDDING MATERIALS

A. Type 1 Pipe Bedding

   1. Type 1 Pipe Bedding includes the material placed from 4 inches (10 cm) below the bottom of the pipe to 6 inches (15 cm) over the pipe.

2. Provide Type 1 Bedding consisting of crushed stone or gravel, which is free of cementitious substances or thin, flat particles in an amount that would cause the material to cake, pack, or otherwise form and unyielding support for the pipe.

3. Provide imported granular material with a gradation as follows and a maximum plasticity index of 6, determined by AASHTO T89 and T90 or by ASTM D4318.

Percent by Weight Passing	
Sieve Size	% Passing
1" (25 mm)	100
3/4" (19.0 mm)	90 - 100
3/8" (9.5 mm)	20 - 55
No. 4 (4.75 mm)	5 - 10
No. 8 (2.36 mm)	0 - 5

4. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 50 percent of the material retained on the No. 4 sieve has at least one fractured face.

5. To prevent migration of material from around the pipe, do not use sand, sandy gravel, or material composed mainly of sand for bedding material in the pipe zone where groundwater is or will be present or where existing material contains voids which would allow migration. Where trench excavation encounters wet or unstable material, Type 1 Pipe Bedding must be well graded, free-draining, and non-plastic.

6. Refer to the Special Provisions and details in the Drawings for other requirements.

B. Type 2 Pipe Bedding

1. Type 2 Pipe Bedding is used as directed by the Engineer to replace unsuitable material encountered in the trench bottom.

2. Place Type 2 Pipe Bedding from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.

3. Type 2 Bedding consists of granular material meeting the following gradation and having a maximum plasticity index of 6 and a maximum liquid limit of 25%.

Percent by Weight Passing	
Sieve Size	Type B-Modified
3" (75 mm)	100
No. 4 (4.75 mm)	0 - 25
No. 8 (2.36 mm)	0 - 10

C. Separation Geotextile

1. The plans may require, or the Engineer may direct, the use of non-woven geotextile fabric intended to provide materials separation. The fabric will wrap all or part of the Type 1 Pipe Bedding and Select Type 1 Pipe Bedding to prevent materials migrating into the trench bottom and trench walls as shown on the plans or as directed by the Engineer. The fabric shall be AASHTO M288 Class 1, 2, or 3 as specified or determined by the Engineer and shall fully comply with MPW Section 2110.

2.2 TRENCH BACKFILL MATERIALS

A. Materials from Trench Excavation

1. Backfill material obtained from trench excavations must be free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. Backfill materials and placement are further described in the Execution Section of this specification.

B. Imported Backfill Material

1. Imported backfill material is from borrow source(s) outside the project limits and is used when, in the opinion of the Engineer, an adequate volume of suitable backfill material is not available within the project limits. Imported Backfill Materials must comply with the requirements of Section 2.2.A, MATERIALS FROM TRENCH EXCAVATION.

2.3 FLOWABLE FILL

A. If used, Flowable Fill is to meet the requirements of Section 2225, Flowable Fill.

2.4 DETECTABLE BURIED WARNING TAPE

A. Detectable buried warning tape is to have a minimum 6-inch (15cm) width and 5-mil (0.12mm) thickness and a solid aluminum core running the full length and width of the tape enclosed in a color-coded inert plastic jacket, impervious to alkalis, chemical reagents and solvents in the soil. The tape is to meet APWA/ULCC Color Code requirements and is to have a maximum 36-inch(90cm) imprint.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING PROPERTIES

A. General

1. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, and fences. Restore or replace all disturbed or damaged facilities to its original condition at the Contractor's expense.

2. Contact utility owners using the Montana One Call System in accordance with Section 01041, PROJECT COORDINATION, Paragraph 1.2.B., for utility locates before starting work. Protect the utilities exposed during the work and prevent damaging underground utilities adjacent to excavations. Immediately notify the utility owner of any construction damage. Repairs of damage to marked utilities are at the expense of the Contractor.

3. Re-locate existing water mains, sanitary sewers, and storm drains shown on the plans that conflict with new pipelines or structures, as indicated in the contract documents. No separate payment will be made for this work unless shown as a payment item. If the Owner authorizes the relocation of mains or sewers, which are not indicated in the bid documents, and the Engineer determines the work was not included in the original contract, payment will be made under the applicable sections of the General Conditions.

4. Cut and replace existing service lines interfering with trenching operations only with the Engineer's permission and at the Contractor's expense.

5. Show all repaired and/or adjusted water and sewer lines on the As-Built Plans.

6. Protect existing water and sewer mains and water and sewer services from freezing at all times during construction.

B. Privately Owned Utilities

1. If any existing private utility interferes with the work in either alignment or grade and has to be moved, the work will be performed by the appropriate Utility Owner unless otherwise specified in the contract documents. Such private utilities may include gas mains, underground electrical and telephone cables, telephone poles, light poles, etc.

2. If, however, such private utility relocation is performed by the Contractor, and the relocation is not a separate payment item, payment will be made under the Section 02221 conditions covering such changes.

3. Such payment will be made only if the work is determined by the Engineer to be a change from the original contract work scope.

C. Existing Structures

1. Prevent damage to existing buildings or structures in the work area. Repair all construction related damage to the satisfaction of the Owner.

D. Existing Overhead Utilities

1. Use extreme caution to avoid conflict, contact, or damage to overhead utilities during the work.

E. Exploratory Excavation

1. The location of existing buried public utilities may need to be verified by exploratory excavation before construction.

2. Where authorized by the Engineer, the Contractor will be reimbursed for exploratory excavation work at the unit price bid per hour for a backhoe/excavator with an operator and a laborer to assist. Use a backhoe/excavator having at least 60 horsepower (45kw), as rated by the manufacturer.

3. The unit price per hour includes the backhoe/excavator, operator, and one laborer based upon the actual time, to the nearest one-half hour, that the equipment and personnel are used in actual excavating and backfilling operations, including standby time between excavation and backfilling, which allows the Engineer to make the necessary survey of the underground utilities.

4. Exercise care to prevent damaging all utilities and repair any utility damage caused by exploratory excavation.

F. Pavement Removal and Stripping

1. Where trench excavation or appurtenant structure excavation requires removing curb and gutter, concrete sidewalks, asphalt concrete pavement, or Portland cement concrete pavement, cut the concrete or pavement in a straight line parallel to the excavation's edge using a spade-bitted air hammer, concrete saw or other suitable equipment to produce a straight, square and clean break. Re-cut edges broken during construction, before concrete or paving operations.

2. For trenches passing through the existing pavement, cut the pavement along a neat vertical line at least 12 inches (30cm) from the trench edge. Where the neat line cut is less than 3 feet (0.9m) from the edge of the existing pavement, remove and replace the entire pavement section between the trench and edge of the pavement.

3. Dispose of the asphalt concrete and/or Portland cement concrete debris off-site according to applicable state and local regulations.

G. When excavating across existing gravel streets or other developed surfaces, remove the surfacing material full depth and stockpile for inclusion in the trench backfill or legally dispose of the surfacing material.

H. When excavating across cultivated or sodded areas, remove full topsoil depth or a maximum 12-inch (30cm) depth, whichever is less, and stockpile for possible project use.

I. Re-sod or reseed, as specified in the contract documents, all established lawn areas cut by trenching or damaged during the construction, according to Section 2910 and/or 2920, to the Engineer's satisfaction.

3.2 MAINTENANCE OF FLOWS

A. Maintain the flow of sewers, drains, and watercourses encountered during construction. Restore culverts, ditches, fences, crosswalks, and structures disturbed by construction to their original condition upon completion of the work.

3.3 TRENCH EXCAVATION

A. General

1. Meet current OSHA Safety and Health Standards for all excavation, trenching, shoring, and related work.

2. Excavate at the specified locations for pipeline installations and appurtenant structures.

3. Crossings under sidewalks or curbs may be made by tunneling if approved by the Engineer. If a portion of a sidewalk or curb is removed, use a concrete saw to make joints, compact the backfill as specified, and replace the removed Section with a new concrete sidewalk or curb.

4. During excavation, stockpile backfill materials away from the trench banks to assure trench wall stability. Stockpile excavated materials on only one side of the trench without obstructing existing fire hydrants, valves, manholes, and other appurtenances. Assure surface drainage of adjoining areas is unobstructed.

5. Remove and dispose of all excess or unsuitable excavated materials.

6. Prevent surface water from flowing into excavations. Promptly remove all water accumulating in trench excavations. Do not permit water to accumulate in any open trench. Remove and re-lay all pipe out of alignment or grade caused by trench flooding.

7. Grade the trench bottoms to the specified lines and grades. Assure bedding material provides uniform bearing and support for each pipe section along its entire length. Excavate for bell and joints after the trench bedding is graded, limiting the excavation to the required length, depth, and width for making the particular type of joint used. Backfill over-excavations with Type 2 Bedding Material.

8. No classification of trench excavated materials will be made. Excavation and trenching work includes the removal and subsequent handling of all earth, loose or cemented gravel, loose or solid rock, and other materials excavated or otherwise removed in the performance of the contract work, regardless of the type, character, composition, or condition thereof. All materials excavated or otherwise removed, including asphalt, curb, gutter, sidewalk, soils, etc., will become the property of the Contractor, who will be responsible for environmentally sound disposal of said material in accordance with state and federal regulations.

9. The use of trench digging machinery is permitted, except in places where its operation is likely to cause damage to existing structures or features, in which case hand methods are to be employed.

B. Trench Dimensions

1. Excavate to the trench dimensions specified below.
2. Width
   a. Excavate to provide room to install and join the pipe as specified. The minimum trench width is 3'-6" (1.1m), for outside pipe diameters of 18 inches (0.5m) or less. The minimum trench width is 2'-0" (0.6m) plus the outside pipe diameter, for pipe sizes exceeding 18 inches (0.5m). Maximum trench width may be specified in the contract documents.

   b. If the trench is excavated wider than the specified minimum, provide Type 1 Pipe Bedding for the additional width to yield a consistent backfill for the entire width of the trench or take such other measures as the Engineer may direct to protect the pipe against the crushing forces of trench backfill at the Contractor's expense.
3. Depth
   a. Excavate the trench as required for the invert grade or pipe bury as specified in the contract documents, plus 4 inches (10cm) for the Type 1 Pipe Bedding. If bedrock, boulders, or large stones are encountered at the bottom of the trench, excavate at least 6 inches(15cm) below the bottom of the pipe for backfilling with Type 1 Pipe Bedding.

C. Soft or Unsuitable Trench Subgrade

1. When soft or unstable material is encountered at the trench subgrade, which will not uniformly support the pipe, excavate the material to the depth directed by the Engineer and backfill to trench subgrade elevation with Type 2 Pipe Bedding.

D. Blasting

1. Blasting will not be allowed for excavation

E. Pavement Damage Cause by Equipment

1. Equip all track-mounted equipment operated on pavement surfacing with pads to prevent pavement damage.

2. Remove and replace all pavement damaged during construction by the Contractor's equipment, or the use thereof, to at least a depth of 1 inch (25 mm). Patches will not be allowed less than 1 inch (25 mm) in thickness.

3. Replace all asphalt pavement damaged during construction outside of restoration pay limits in conjunction with asphalt restoration and as otherwise required by the Engineer. Provide asphalt meeting the requirements of Section 02510: Asphalt Concrete Pavement, and place asphalt to produce a final surface uniform in texture and consistent with the line and grade of adjacent pavement or as directed by Engineer. No compensation will be allowed for removal and replacement of damaged pavement outside of the pay limits for asphalt restoration.

4. Assure work and materials for pavement restoration is in accordance with Section 02510: Asphalt Concrete Pavement.

F. Shoring, Bracing, and Sheeting

1. Provide all shoring, bracing, and tight sheeting required to prevent caving and protect workers, meeting current Occupational Safety and Health Act Requirements, and to protect adjacent property and structures. The cost of this work is included in the price of trench excavation.

G. Excavation for Appurtenances

1. Make excavations for manholes, hydrants, structures, and other appurtenances of the size and depth to permit compacting of backfill on all sides to the specified density. The requirements for removing water and other applicable portions of these specifications apply to excavation for appurtenances.

3.4 DEWATERING

A. General

1. Furnish all necessary labor, equipment, and incidentals necessary to dewater the project site during construction.

2. Keep all excavation dry and free from water during construction and the placement of materials. Do not place pipe, bedding, or backfill materials below the groundwater elevation established by dewatering operations. Do not allow groundwater or stormwater to enter or flow through the underground piping during installation.

3. The cost of dewatering operations will be incidental to the cost of pipeline and appurtenance installation, and no additional payment will be made for dewatering. Consider shifts in the groundwater level caused by changing seasons or local conditions in estimating the cost of dewatering operations, as no additional payments will be made for fluctuating groundwater levels.

4. Protect all structures that could be potentially impacted by dewatering operations. Repair any damage to structures caused as a result of dewatering at Contractor's expense.

B. Discharge

1. Do not discharge or dispose of water from dewatering operations in such a manner as to flood existing landscaped areas, graveled areas, or structures unless approved by Engineer. Written permission from the appropriate landowner shall also be required for discharge or disposal on private property.

2. It is the Contractor's responsibility is to comply with requirements and regulations of federal, state, and local agencies that govern areas affected by dewatering of the construction site and application for and maintenance of any required permits.

3.5 EXCAVATION STABILITY AND SAFETY

A. The stability of construction excavations and associated worker safety, including slope geometry and shoring/bracing considerations, are the Contractor's responsibility. Meet current OSHA regulations. This may require the design of temporary slopes and/or shoring by a licensed professional engineer.

3.6 TRENCH FILLING AND BACKFILLING

A. General

1. Backfill all trenches as specified immediately after grade, alignment, and pipe jointing has been inspected and approved by the Engineer. Conduct any pipe testing as specified in the respective water distribution, sewerage/drainage sections. Correct all defects discovered by tests prior to backfilling.

2. Storage of all imported backfill materials, including protecting said materials from adverse conditions that would disqualify them from use under these specifications, is the responsibility of the Contractor.

B. Pipe Bedding Placement

1. Type 1 Bedding.

a. Place Type 1 Pipe Bedding material 4 inches (10 cm) under, around the pipe, and to a point 6 inches (15 cm) above the top of the pipe in 6 inch (15 cm) lifts, using hand or other compaction methods without damaging or disturbing the pipe including mains and service lines and all appurtenances.

b. Place bedding material in equal lifts on both sides of the pipe for the full trench width. Thoroughly compact each lift of pipe bedding by tamping, vibration, slicing with a shovel, rodding, or by a combination of these methods. Take special care to assure complete compaction under the haunches of the pipe.

2. Type 2 Pipe Bedding

a. Use Type 2 Pipe Bedding described in PRODUCTS SECTION as specified or as directed by the Engineer to replace unsuitable material encountered in the trench bottom, placing it from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.

3. Separation Geotextile

a. Place Separation Geotextile where shown on the plans or where directed by the Engineer.

C. Trench Backfill

1. After the pipe bedding materials are placed and compacted as specified, backfill the trench.

a. Use backfill material free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious material.

b. From the top of the Type 1 Bedding to 6 inches (15 cm) below the ground surface, or the subgrade elevation, material containing stone up to 8 inches (20 cm) in the greatest dimension may be used.

c. Cost of screening, drying, or moistening excavated backfill to comply with specifications will be considered incidental to the Contractor's bid price per linear foot of pipe and service lines and unit prices for appurtenances, and no additional payment will be made for such work.

2. Trench backfill from the top of the pipe bedding to ground surface or to the street subgrade is separated into three classifications.

a. Type A Trench Backfill is compacted backfill typically used in streets or paved areas.

b. Type B Trench Backfill is typically used for unpaved alleys, cultivated areas, borrow pits, unimproved streets or other un-surfaced areas, and other areas where compaction is less critical.

c. Type C Trench Backfill is typically used in open and unimproved areas outside of the public right-of-way.

3. Meet the backfill and compaction requirements for all of the backfill types described in the contract documents.

4. Watering

a. Apply uncontaminated water, when required, at the locations and in the amounts required to compact the backfill material to the specified requirements. Maintain an adequate water supply during the work.

Assure the equipment used for watering is of the capacity and design to provide uniform water application.

b. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with these contract documents.

c. Water required for compacting trench backfill may be obtained from the municipal system if approved by the Owner or from other sources.

5. Remove, replace, and re-compact backfill in trenches where settlement has occurred as directed by the Engineer at the Contractor's expense.

6. Trench backfill types are designated as follows:

a. Type A Trench Backfill. Place trench backfill in maximum 8 inch (20 cm) compacted lifts within 3% of optimum moisture content and compact to at least 95% of maximum dry density determined by AASHTO T99 or by ASTM D698. For materials that do not exhibit a typical well-defined moisture-density curve, compact backfill to 70% relative density as determined by ASTM D4253 and D4254.

b. Type B Trench Backfill. Place trench backfill in maximum 8 inch (20 cm) compacted lifts within 3% of optimum moisture content, and compact to at least 90% of maximum dry density determined by AASHTO T99 or by ASTM D698. For materials that do not exhibit a typical well-defined moisture-density curve, compact backfill to 50% relative density as determined by ASTM D4253 and D4254.

c. Type C Trench Backfill. Place and compact Type C Trench Backfill in maximum 12-inch (30 cm) lifts at densities equal to or greater than the densities of adjoining undisturbed soil. Mound earth over the trench top, if directed by the Engineer. In cultivated areas, place stripped topsoil uniformly over the backfilled trench to the original depth. Do not compact the topsoil, but grade to provide a smooth surface conforming to the adjoining ground surfaces.

d. Flowable Fill. Place flowable fill as trench backfill as shown in the contract documents or as directed by the Engineer. Flowable fill may also be used as a construction expedient, substituting for any type of trench backfill, subject to approval by the Engineer, and at the expense of the Contractor.

D. Replacement of Unsuitable Backfill Material

1. Remove and dispose of excavated soils that are saturated, contain deleterious materials, or have characteristics that, in the opinion of the Engineer, render the soils unsuitable as backfill and/or which cannot be readily conditioned or dried to be made suitable.

2. Replace unsuitable soils with material obtained from trench excavations within the project limits at the expense of the Contractor.

3. If suitable replacement material is not available within project limits, notify the Engineer. The Engineer will quantify the extent of any unsuitable soils to be removed and replaced with material from an approved source, to be paid for as Imported Backfill Material, and provide written notification of the approved quantities to the Contractor. Payment for Imported Backfill Material will not be approved if the Contractor fails to notify the Engineer and/or proceeds with removal and disposal of unsuitable material prior to receiving written notice from the Engineer.

4. Provide imported backfill material with a gradation as follows and a maximum plasticity index of 10, determined by AASHTO T89 and T90 or by ASTM D4318. Imported backfill may not contain rock measuring greater than 6 inches (15 cm) in the greatest dimension.

Percent by Weight Passing	
Sieve Size	% Passing
1" (25 mm)	70 -100
No. 4 (4.75 mm)	40 - 80
No. 10 (2.00 mm)	25 - 60
No. 200 (0.075 mm)	2 - 35

5. Place and compact all imported material according to the applicable backfill specification requirements.

E. Backfill of Appurtenances

1. Place and compact backfill for appurtenances to finished grade around manholes, inlets, valve boxes, and other underground items without disturbing appurtenance alignments.

2. Meet the backfill material, placement, and compaction requirements specified for the adjoining trench.

F. Detectable Buried Warning Tape

1. Provide warning tape, as described in this Section. Bury tape a maximum of 18 inches (45 cm) below finish surface grade.

3.7 SURVEY MARKERS AND MONUMENTS

A. Protect all survey markers and monuments. Protection includes marking with flagged high lath and supervising work near markers and monuments. Do not disturb monuments without prior approval from the Engineer.

B. Replace all Contractor-disturbed or destroyed survey markers or monuments not approved during construction, using a licensed land surveyor. See Section 01050 for details on survey marker protection/disturbance.

3.8 CLEANUP

A. As work progresses, remove debris and complete to finish grade each portion of the work. Once the work is complete, clear debris and finish the entire site to smooth, uniform slopes presenting a neat and workmanlike appearance. Remove and dispose of all rocks brought to the surface during excavation or backfilling.

B. Dispose of vegetation; coarse debris resulting from pavement or sidewalk removal; stones, junk, debris, and other materials encountered in excavation work; and other similar waste materials away from the site of the work at the Contractor's expense.

3.9 TIME AND DISTANCE OF OPEN TRENCHES

A. Perform the work so that trenches will remain open the minimum time required to accomplish the work.

B. Do not begin trench excavating until appropriate compaction equipment is at the excavation site.

C. The maximum permissible distance between backfilling/compaction operations and the end of newly installed pipe is 100 feet (30 m) in existing streets (and/or alleys) and 200 feet (60 m) in all other areas.

D. The maximum distance between the newly installed pipe and the excavator is to be 100 feet (30m) in existing streets (and/or alleys) and 200 feet (60m) in all other areas.

E. For each workgroup consisting of a trench excavator, a pipe laying crew, and a backfilling/compaction crew, the maximum allowable open ditch at any time is 200 feet (60 m) in existing streets (and/or alleys) and 400 feet (120 m) in all other areas.

F. The maximum distance behind the end of the new pipe is 1,500 feet (460m) for gravel surfacing replacement, base placement, or pavement replacement.

G. At the completion of each working day, fill all trenches and/or provide safety netting, Jersey barrier, and other barricades required for public safety.

3.10 DRAINAGE CROSSINGS

A. Where trenches are constructed in or across roadway ditches or other watercourses, protect the backfill from surface erosion by adequate means. Where the grade of the ditch exceeds 1 percent, prevent erosion by a suitable method approved by the Engineer. Backfill trenches in such a manner that water will not accumulate in unfilled or partially filled trenches.

B. Remove all material deposited in roadway ditches or other water courses crossed by the trench immediately after backfilling is completed and restore the section, grades, and contours of such ditches or watercourses to their original conditions, in order that the surface drainage is obstructed no longer than necessary.

END OF SECTION

SECTION 02225

FLOWABLE FILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and placing Flowable Fill to the lines and grades shown on the plans as backfill in trenches and/or at other locations. Flowable Fill is a self-compacting cementitious material using mineral aggregates (sand and/or gravel), native or processed materials, fly ash/cement, water, air-entraining solution, and (optionally) other admixtures. Flowable Fill is also known as Controlled Low-Strength Material (CLSM) and Controlled Density Fill (CDF).

1.2 REFERENCES

A. The current publications listed below form a part of the specification.

ASTM D4832	Preparation/Testing of Soil-Cement Slurry Test Cylinders
ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM D6023	Standard Test Method for Unit Weight
ASTM C150	Specification for Portland Cement
ASTM C618	Specification for Fly Ash
ASTM C494	Specification for Chemical Admixture for Concrete
ASTM E329	Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction
ASTM C1064	Temperature of Freshly Mixed Portland Cement Concrete
ASTM C136	Sieve Analysis of Fine & Coarse Aggregate
ASTM C117	Materials Finer Than No. 200 (0.075 mm) Sieve in Mineral Aggregates by Washing
ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM C94	Ready Mix Concrete
ACI 301	Standard Specifications for Structural Concrete for Buildings
ACI 304	Guide for Measuring, Mixing, Transporting and Placing Concrete

1.3 TESTING

A. Complete Quality Control tests on the flowable fill consisting of slump, air content measurements, and casting 3 cylinders for compressive strength test. The required compressive strength test method and required range are described in section 2.4, Compressive Strength below. Furnish the results or the testing to the Contracting Officer's Representative daily for slump and air content and within 3 days of completing compressive strength testing. Complete one set of tests for every 150cubic yards of flowable fill placed.

B. The Contractor is to provide the Contracting Officer with a mix design by either trial batch or field experience methods to verify the required compressive strength of the flowable fill at the 28 day age. Mix design requirements are described in Section 2.3, Proportions; and in Section 2.4, Compressive Strength. Proportions shall be selected on the basis of unconfined, air-cured compressive strength test specimens.

PART 2 - PRODUCTS

2.1 MIXTURE OF MATERIALS

A. Provide a mixture of the materials described below to produce a self-compacting cementitious material batched on a per cubic yard basis.

2.2 MATERIALS

A. Portland Cement. Portland Cement shall conform to the requirements of ASTM C150, Type II.

B. Fly Ash. Fly Ash shall conform to ASTM C618, Class C or F.

C. Coarse Aggregate, Fine Aggregate, and Native Materials. Any aggregate gradation which produces performance characteristics of the flowable fill specified herein will be accepted, except as follows: The amount of material passing the #200 sieve shall not exceed 20 percent. Also, liquid limit and plasticity index shall not exceed 25 and 5, respectively.

D. Water. Water used in mixing shall be free of oil, salt, acid, alkali, sugar, vegetable matter, or other substances injurious to the finished product.

E. Chemical Admixtures. Chemical Admixtures shall conform to the requirements of ASTM C494.

2.3 PROPORTIONS

A. A variety of sand/gravel aggregate materials meeting the above requirements in conjunction with appropriate amounts of Portland Cement and fly ash, air-entraining solution, and (optionally) other admixtures may be used to produce the required mix properties described herein.

B. The Contractor shall submit to the Contracting Officer a mix design based upon a trial batch or field experience, including the proportions and sources of all constituent materials, air- entraining, and (optionally) other admixtures, expressed as cubic yard batch weights. The mix shall contain a minimum of 50 pounds of cement and up to 250 pounds fly ash per cubic yard, with the remainder of the volumes composed of aggregates, water, and any approved admixtures. Measured compressive strength, air content, and yield for the mix design trial batch (or for the field experience based mix design) shall be submitted.

2.4 COMPRESSIVE STRENGTH

A. Flowable Fill shall be designed to achieve a 28-day compressive strength of 30 to 150 psi when tested in accordance with ASTM C39. Test specimens shall be made in accordance with ASTM D4832.

2.5 CONSISTENCY

A. Consistency of the fresh mixture shall be such that the mixture may be readily placed without segregation. High flowability material has a slump greater than 8 inches. As an alternative to slump testing, desired consistency may be approximated by filling an open-ended 3 inch diameter cylinder, 6 inches high, with the mixture and cylinder immediately pulled straight up. The correct consistency of the mixture will produce an approximate 8 inch diameter circular type spread without segregation. Adjustments of the proportions of constituents may be made to achieve proper solid suspension and optimum flowability. However, strength requirements and proper yield shall be maintained for the actual batch weights.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Comply with ACI 304 and ASTM C94 for Measuring, Mixing, Transporting, and Placing the Flowable Fill, and as herein specified.

3.2 LIMITATIONS OF PLACEMENT

A. Do not place Flowable Fill on frozen ground. Mix and place only when the air temperature is at least 35 degrees Fahreneheit (2°C) and rising. At the time of placement, Flowable Fill shall be at least 40 degrees Fahreneheit (4°C). Stop mixing and placement when the air temperature is 40 degrees Fahreneheit (4°C) and falling.

B. Flowable backfill shall be placed by methods that preserve the quality of the material in terms of compressive strength, flow, homogeneity, plasticity, and workability. The material shall be transported, placed, and/or consolidated to flow easily around, adjacent to, and under structures. It shall have the flow, consistency, and workability such that the material is self-compacting.

C. Protect freshly placed Flowable Fill from premature drying, excessive cold, or hot temperatures. The air in contact with the backfill surface shall be maintained at temperatures above freezing. Begin curing immediately following placement before the backfill has dried. Continue with curing until the backfill has attained the 28-day strength requirement.

END OF SECTION

SECTION 02230

STREET EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is the clearing and grubbing, excavation, filling or backfilling, and subgrade preparation to the specified lines, grades and cross sections as preparation for overlying base course or other courses as shown in the contract documents. Also included are the removal and disposal of debris and excess soil, the furnishing and placement of fill materials, and compaction.

1.2 REFERENCES

A. The current publications listed below are a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
ASTM D698	Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft^3)(600 kN-m/m^3)
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by the Sand-Cone Method
AASHTO T310	In-Place density and water content of the soil and soil aggregate
(ASTM D6938)	by Nuclear Method (Shallow Depth)
AASHTO T11 (ASTM C117)	Materials Finer Than No. 200 (0.075mm) Sieve in Mineral Aggregates by Washing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

1.3 DENSITY CONTROL TESTING

A. Field Density Testing
   1. Meet the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Quality Assurance.
   2. In-place field density tests for quality assurance are at Owner expense meeting ASTM D1556A (ASHTO T191), Sand Cone Method; or ASTM D2922 and ASTM D3017 (AASHTO T238 and T239) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the discretion of the Engineer.
   3. Retesting of failing areas is at the expense of the Contractor.

B. Laboratory Maximum Density and Optimum Moisture
   1. Quality assurance tests will be made by the Engineer for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content under AASHTO T99 or ASTM D698.

C. Material Submittals
   1. Submit to the Engineer results of gradation tests for Sub-excavation/Replacement Below Subgrade pitrun gravel/sand.
   2. Submit to the Engineer samples of soils and/or aggregates for laboratory moisture-density relationship testing by the Engineer.

PART 2 - PRODUCTS

2.1 ON-SITE EMBANKMENT

A. Fill and backfill materials are to consist of natural soils free from organic matter, frozen material, refuse, construction debris or other man-made items. Obtain approval of the Engineer for all fill before placing and use only the fill from designated borrow areas.

2.2 IMPORTED BORROW MATERIALS (FOR EMBANKMENTS IN-PLACE)

A. If required, obtain borrow soil for embankments from areas off the project site. Furnish imported borrow at Contractor expense. Obtain Engineer approval of borrow areas. Imported borrow is to meet the requirements of Section 2.1, On-Site Embankment.

2.3 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE

A. Sub-excavation consists of removing and disposing of unstable material from below planned subgrade elevation in cut sections or from below the natural ground line in embankment sections.

B. Replacement material for sub-excavations consists of either:

1. Suitable materials from within the project limits if suitable material is present within the project limits, or

2. Imported materials if suitable material is not present within the project limits. Where imported pitrun gravel is used, furnish replacement material meeting the following gradation requirement:

Sieve Opening	% Passing
3 Inch	100
No. 4	25 - 60
No. 200	12 Max.

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING

A. Perform clearing and grubbing including the excavation, removal and disposal of roots, stumps, sod, or any organic material and buried debris from within construction limits. Construction limits are defined by all areas within the cut/fill limits and extending 1 foot (0.3 m) beyond the back of sidewalk and/or curb and gutter, or 2 feet (0.6 m) beyond the edge of pavement if no sidewalk or curb and gutter is present. Remove unsuitable material to at least 12 inches (30 cm) below subgrade elevation.

B. Stockpile for project use any topsoil removed by clearing and grubbing.

C. Dispose of all clearing and grubbing material as specified.

3.2 EXCAVATION STABILITY AND SAFETY

A. Meet OSHA requirements for excavations and excavated material stockpiles. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

3.3 PROTECTION OF PROPERTY

A. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, fences, and vegetation. Any disturbed or damaged facilities will be suitably restored or replaced consistent with condition(s) which existed prior to construction.

3.4 EXCAVATION

A. Excavate to the specified lines and grades or as directed by the Engineer. Excavate without causing rutting, pumping or other disturbance to underlying materials.

B. Excavation made outside the specified grade limits is not measured for paymentin the Excavation or Embankment In-Place quantities.

1. Restore sub-excavated areas as directed by the Engineer. Correct subgrade disturbance by removing the disturbed soil and replacing and compacting to reach at least 95 percent of the maximum laboratory dry density determined by AASHTO T99 or ASTM D698.

2. Correct subgrade disturbance before placing overlying fill, backfill, base course or other courses. Disturbed soils may be replaced with imported material approved by the Engineer and compacted to 95% of maximum laboratory dry density determined by AASHTO T99 or ASTM D698.

C. Maintain the subgrade to drain at all times. Construct side ditches or gutters from cuts to embankments to prevent erosion damage to embankments.

D. Construct and maintain temporary drainage where existing surface drainage, sewers, or under-drainage are disturbed during the work until permanent drainage facilities are completed. Protect and preserve all existing drains, sewers, sub-surface drains, conduits, gas lines, and other underground structures which may be affected by the work. Repair all damage to these facilities or structures resulting from the work, to the satisfaction of the Engineer.

E. Excavate to minimize foundation soil and/or subgrade soil exposure to erosion, drying or infiltrating moisture. Perform excavation to provide drainage away from foundation/subgrade soils and minimize the potential for surface runoff to enter the foundation/subgrade soils.

F. Grade all intersecting streets and approaches within the project limits asspecified or as directed using suitable materials on the surfaces to produce smooth riding and satisfactory approaches to the intersections.

3.5 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of debris and unused excavated materials off the project site in accordance with all applicable state and local regulations. Locate and provide suitable disposal areas.

3.6 DUST CONTROL

A. Furnish dust control meeting Section 01500, Construction and Temporary Facilities, requirements.

3.7 SUBGRADE PREPARATION AND COMPACTION

A. General

1. Assure the subgrade beneath pavements, curb, or sidewalks is natural soil free of topsoil, organic material or refuse. Place pavement components, curb and sidewalk over the prepared subgrade as soon as practical. Do not place pavement components on frozen subgrade. No separate payment is made for subgrade preparation since it is considered incidental to construction of overlying pavements/structures.

2. If the surface of a previous roadbed or pavement surface matches the surface of the finished subgrade scarify the top 6 inches (15cm) of the previous surface the full width of the subgrade to permit uniform reshaping and compaction.

B. Fine Grading

1. Assure the finished surface does not deviate not more than 0.1 foot (3cm) at any point from the staked elevation; and that the sum of the deviations from true grade of any two points less than 30 feet (9m) apart does not exceed 0.1 foot (3cm).

C. Compaction

1. Compact the upper 8 inches (20cm) of the subgrade to at least 95% of the laboratory maximum, determined by AASHTO T99 or ASTM D698. Proof roll the subgrade surface for observation by the Engineer. Compact all soft, yielding or otherwise unstable areas to provide adequate support of construction equipment as determined by the Engineer. Also compact the subgrade to meet the specified density requirements. Remove and replace any unstable or otherwise unsuitable subgrade as specified under Section 3.9, Sub-excavation/Replacement Below Subgrade.

3.8 EMBANKMENT PLACEMENT AND COMPACTION

A. General

1. Place fill materials (embankment) to the specified lines and grades. Place fill in uniform layers not exceeding 8 inches (20cm) in loose thickness. Once placed, moisten or aerate, mix, and compact each layer as specified. Work clay soils to maximum 2-inch (5cm) nominal size before compacting. Do not begin fill placement until the subgrade construction has been approved by the Engineer. Do not place fill on wet or frozen areas. Do not operate heavy equipment for spreading or compacting fill within 4 feet (1.2m) of structures.

2. If grading operations are suspended due to weather, blade the entire area until it is smooth, free of depressions and ruts, and crowned to drain water.

B. Compaction

1. Control the fill moisture content to assist in obtaining the specified field density. Maintain the moisture content of fill soils within ± 3% of optimum moisture. Compact each fill layer and the top 8 inches (20cm) of subgrade soil to at least 95 percent of maximum laboratory density as determined by AASHTO T99 or ASTM D698. Compact areas within 4 feet (1.2m) of structures in maximum 8-inch (20cm) loose lifts using power-driven hand-held tampers.

2. Apply water, when required, at the locations and in the amounts required to compact the material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with Section 1500. Water required for compacting subgrade and/or embankments may be obtained from the municipal system if approved by the Owner, or from other sources.

3. Do not place fill or embankment when moisture content prevents effective compaction or causes rutting. Dry all embankments having excessive moisture by scarifying and blading the affected areas before compacting or placing succeeding layers.

3.9 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE

A. Sub-excavation consists of removing and disposing of unsuitable material from below planned subgrade elevation in cut sections or from below the natural groundline in embankment sections.

B. Soil is unsuitable if, in the opinion of the Engineer, it contains excessive organics, refuse, construction debris, or other objectionable material; or if it unstable, rutting or yielding; or if it contains excessive moisture. Generally, soils will be sub-excavated and replaced only if they are unable to adequately support equipment typically used for excavation and soil transport.

C. Assure the Engineer has measured the area where unstable materials have been removed before backfilling. Do not backfill any area where unstable foundation soils have been excavated until authorized by the Engineer. Backfill placed without approval may be ordered removed and replaced at Contractor expense.

D. Backfill with either suitable soils from within the project limits or imported pitrun gravel complying with the requirements of Section 2.3, Sub-excavation/Replacement Below Subgrade. Different measurement and payment items are used for the on-site soil and pitrun gravel replacements.

E. Compact the replacement material to 95% of the maximum laboratory density as determined by AASHTO T99 or ASTM D698.

3.10 PROTECTION OF THE WORK

A. Repair damaged embankments to the specified elevations and grades. Maintain ditches and drains along the subgrade to drain the subgrade. Assure the finished grade does not deviate more than 0.1 (3cm) foot at any point from the staked elevation and the sum of the deviations from true grade of any two points not more than 30 feet (9m) apart does not exceed 0.1 foot (3cm). Do not place any surface course or pavement until the subgrade has been checked and approvedby the Engineer.

END OF SECTION

SECTION 02235

CRUSHED BASE COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is the placing of one or more base courses composed of crushed gravel, stone or other similar materials meeting the gradation and other quality criteria specified herein.

1.2 REFERENCES

AASHTO T11	Materials Finer than No. 200 (0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T89	Determining Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176	Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
AASHTO T96	Resistance to Degradation of Small-Size Coarse Aggregate By Abrasion and Impact in the Los Angeles Machine
AASHTO T99 (ASTM D698)	Moisture-density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5 kg) Rammer and 12-Inch (305 mm) Drop
ASTM D5821	Determining the Percentage of Fractured Particles in Coarse Aggregate
AASHTO T191 (ASTM D1556)	Density of Soil In-Place By Sand Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth)

1.3 DENSITY CONTROL TESTING

A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in section 01400, Contractor Quality Control and Owner Quality Assurance.
2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556) Sand Cone method or AASHTO T310 (ASTM D6938) Nuclear Densometer method. Quality assurance field density testing frequency is at the discretion of the Engineer.

3. Retesting of failing areas is at the expense of the Contractor.

B. Laboratory Maximum Density and Optimum Moisture
1. Moisture density curves will be provided by the Contractor for each base material provided. These will be provided at the expense of the Contractor.

1.4 MATERIALS SUBMITTALS

A. Submit to the Engineer gradations, moisture density curves and other test results for sources to be used for base materials prior to delivery to the site for approval by the Engineer. If recycled materials are proposed, CBR test data must be submitted to the Engineer to assure consistency with design requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish aggregate base material meeting the applicable aggregate quality requirements.

2.2 CRUSHED BASE MATERIAL

A. Consists of both fine and coarse fragments of crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with sand, finely crushed stone, crusher screenings, recycled concrete and/or asphalt or other similar materials. Where recycled materials are permitted, project specifications shall state the minimum required CBR value (design minimum) of the Crushed Base Course.

B. Use crushed stone or gravel consisting of hard, durable particles of fragments of stone, free of excess of flat, elongated, soft or disintegrated pieces, dirt, or other deleterious matter, and having a percent of wear of not exceeding 50 at 500 revolutions when tested under AASHTO T96.

C. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 50% of the material retained on the No. 4 sieve has at least one fractured face.

D. Incorporate all material produced in the crushing operation and passing the No. 4 mesh sieve into the base material necessary to meet the gradation requirements.

2.3 GRADATION

A. As determined by AASHTO Methods T11 and T27, furnish material for the grading specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

TABLE OF GRADATIONS

PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE

Passing	1½" Minus	1" Minus	¾" Minus
1½ Inch	100		
1 Inch	—	100	
¾ Inch	—	—	100
½ Inch	—	—	—
No. 4 Sieve	25 - 60	40 - 70	40 - 70
No. 10 Sieve	—	25 - 55	25 - 55
No. 200 Sieve	0 - 8	2 - 10	2 - 10

B. Up to 5% "oversized" material is permitted provided that the "oversized" material passes the screen size immediately larger than the top size specified. The produced material between the maximum screen opening and the No.4 sieve shall be reasonably well graded.

C. Suitability of the aggregate is based on samples obtained during placement in the project within limits allowed in the table for the particular grading specified.

D. That portion of the fine aggregate passing the No. 200 sieve must be less than 60% of that portion passing the No. 40 sieve.

E. The liquid limit for that portion of the fine aggregate passing a No. 40 sieve cannot exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

2.4 WATERING:

A. Use water from an approved source.

PART 3 - EXECUTION

3.1 GENERAL

A. Before placing the base course, smooth and shape the surface of the underlying subgrade, sub-base or base course to the cross section shown on the plans before placing the base course.

B. Do not place base course on a wet or muddy subgrade or sub-base course. Complete at least one area of finished and accepted subgrade, sub-base or underlying base before the placing of any base course.

3.2 PLACEMENT AND SPREADING

A. Mix and place the material in maximum 8 inches (20 centimeters) compacted layers unless otherwise approved. Deposit and spread each load of material on the prepared subgrade, or on a completed sub-base or base course layer continuously without interruption. Discontinue operating haul units over subgrade, or over any sub-base or base course completed if the haul units damage the subgrade, sub-base or base course.

B. Deposit and spread the material in a uniform layer, without segregation, to a loose depth so that when compacted, and making allowance for any filler to be blended on the road, the layer has the specified thickness.

C. Spread material using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. The material may be deposited in windrows mixed and spread as described below.

D. Construct each layer meeting these requirements. Blade smooth and thoroughly compact each layer as specified before placing the succeeding layer.

E. If segregation or moisture problems exist, or if the material was placed on the road in windrows, thoroughly blade-mix the material of the affected layer by alternately blading to the center and back to the edges of the street.

F. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.

G. Apply water during the work to control dust and to maintain the base course in a damp condition in accordance with Section 01500 under Dust Control.

H. Uncontaminated water required for compacting base gravel may be obtained from the municipal system if approved by the owner, or from other sources.

3.3 FIELD DENSITY REQUIREMENTS

A. Compact placed material the full width by rolling with suitable tamping equipment or power rollers. Correct all irregularities or depressions that develop during rolling by loosening the material in these places and adding or removing material, as required.

B. Perform blading and compacting alternately as required or directed, to maintain a smooth, even, uniformly compacted surface until the final inspection. Along curbs, headers, manholes, and similar structures, and at all places not accessible to the roller, compact the base course material with suitable mechanical tampers or hand tampers to reach the compaction requirements.

C. Provide the watering and rolling required to obtain a minimum field density of 95% of maximum dry density as determined by AASHTO T99. No separate compensation is made

for rolling and watering the base course other than the base course bid item or items listed on the contract documents.

3.4 SURFACE TOLERANCES

D. The base course surface when finished and tested with a 10-foot (3.0 meter) straight edge placed on the surface with its center line parallel to the center line of the street, will not have a surface deviation from the straight edge exceeding 3/8- inch (1.0 centimeter). Additionally, the finished grade cannot deviate more than 0.05 feet (1.5 centimeters) at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.05 feet (1.5 centimeters).

E. For base course receiving asphalt concrete surfacing, the finished grade cannot deviate more than 0.02 feet (0.6 centimeters) at any point from the staked elevations, and the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.02 feet (0.6 centimeters).

F. If patching of the base course is necessary to meet the tolerances, perform patching using methods and aggregates approved by the Engineer. Payment for patching aggregate is at the unit price bid for the base course material.

CONSTRUCTION SPECIFICATIONS

DIVISION 2 - SITE WORK
SECTION 02348
ENCASEMENT AND CARRIER PIPE

1. GENERAL.

Crossing MAFB perimeter fence shall be made utilizing jack and bore methods and shall be constructed as shown on the Construction Drawings. Contractor must utilize the necessary equipment and procedures required to achieve specified tolerances.

New encasement pipe shall be constructed of smooth wall steel pipe. The water carrier pipe shall conform to the materials specified in Section 02660. The installation shall be in accordance with the requirements of the specifications and applicable Construction Drawings.

2. APPLICABLE PUBLICATIONS.

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

2.1 American Association of State Highway and Transportation Officials (AASHTO).

AASHTOT-99	Moisture-Density Relation of Soils Using a 5-lb. Rammer and a 12-In. Drop

2.2 American Society for Testing and Materials (ASTM).

ASTMA-53	Specifications for Pipe, Steel, Black and Hot Dipped Zinc-Coated Welded or Seamless
ASTM C-270	Specification for Mortar for Unit Masonry
ASTM C-404	Specification for Aggregate for Masonry Grout

3. MATERIALS.

3.1 Smooth Wall Encasement Pipe. Smooth wall steel encasement pipe shall conform to the requirements of ASTM A-53 with minimum yield strength of 35,000 psi and have a wall schedule as follows:

CARRIER PIPE DIAMETER (INCHES)	ENCASEMENT PIPE DIAMETER (INCHES)	MINIMUM WALL THICKNESS FOR NON-COATED (INCHES)
8 inches	16 inches	0.375

3.2 Water Main Carrier Pipe. Water main carrier pipe shall be as shown in the Construction Drawings and shall comply with Section 02660.

3.3 Casing End Seals. Casing end seals shall be EPDM with T-304 stainless steel bands and manufactured by Garland or approved equal.

3.3 Casing Spacers. Casing spacers shall be of the bolt-on-clamp style consisting of a stainless steel shell lined with a 0.09 inch thick PVC liner. Connection flanges shall be ribbed for extra strength. Runners shall be made of ultra high molecular weight polymer supported by risers made of heavy stainless steel, Type 304. Supports shall be welded to the shell and all welds passivated. The supports shall keep the carrier pipe fully restrained from movement in any direction more than 1.0 inch. The supports shall be manufactured to maintain the grade specified on drawings even if the encasement pipe is installed off grade. For the carrier pipe, acceptable vertical tolerances are 0.05 feet per 100 foot, acceptable horizontal tolerances are 0.25 feet per 100 foot of pipe length. Casing spacers shall be equal to those manufactured by Cascade Waterworks Manufacturing Company or Government approved equal.

4. CONSTRUCTION.

4.1 Placing Encasement Pipe. Qualified and experienced personnel shall be employed on all encasement work. Frequent checks shall be made for both grade and alignment during the boring and jacking operation and open trench excavation. Ground water and surface water disposal shall meet all local, state, and government regulations.

4.2 Encasement Pipe and Carrier Pipe by Boring and Jacking. A jacking and boring pit shall be excavated large enough to accommodate the equipment and provide for alignment check. Smooth wall encasement pipe shall be placed by jacking and boring methods. The Contractor is responsible for selecting the appropriate method to achieve the specified tolerances prior to bid. The Contractor shall conduct any and all investigation needed to determine the means and methods required. The boring excavation diameter must not exceed the outside diameter of the pipe. Adequate timber guides shall be placed in the bottom of the trench to start the pipe on grade. Frequent check shall be made for both grade and alignment. The joints for the steel pipe shall be full penetration butt welded. Any voids which occur around the encasement pipe shall be filled with concrete mortar.

4.3 Placing Carrier Pipe in Encasement Pipe. The carrier pipe shall be placed within the encasement pipe as shown on the Construction Drawings and details.

The carrier pipe shall be supported on casing spacers as shown on the Construction Drawings. The pipe shall be laid on a true grade and alignment grade. All sections of pipe shall be carefully placed, supported and centered, and joined to form a water pipeline that will have a uniform invert grade. The pipe shall be protected against impact shock and free fall during handling. Prior to being placed in the encasement pipe, pipe shall be inspected and any damaged sections shall be rejected.

4.4 Alignment Requirements. Horizontal deflections in excess of 0.25 feet from the centerline of the proposed pipe alignment will be cause for rejection of the encasement pipe installation. Casing vertical alignment must be such that the carrier pipe can be installed to the elevations and grade shown on the Construction Drawings. If the carrier pipe cannot be installed to the elevations shown on the Construction Drawings, the casing installation will be rejected. Casing spacers shall be tapered as required to allow for installation to grade of the carrier pipe inside the encasement pipe should the encasement pipe have a minor vertical deflection.

Any encasement pipe bore holes abandoned shall require that the encasement pipe be left in place to prevent settlement unless an alternate method is proposed by the Contractor and approved by the Government.

If the installation is rejected, encasement pipe shall be installed at a new location approved by the Contracting Officer's Representative. The cost for rehabilitation of bore holes, additional bore pipe, and re-drilling of new holes shall be borne by the Contractor.

4.5 Backfill of Pits and Cleanup. Backfill of the jacking and boring pits shall be compacted to 95% of maximum dry density at optimum moisture content as determined by AASHTO T-99. The slope and contour of the area shall be returned to the original contour. All equipment and debris used or caused by the construction shall be removed from the site.

END OF SECTION

CONSTRUCTION SPECIFICATIONS

DIVISION 2 - SITE WORK
SECTION 02348
ENCASEMENT AND CARRIER PIPE

1. GENERAL.

Crossing MAFB perimeter fence shall be made utilizing jack and bore methods and shall be constructed as shown on the Construction Drawings. Contractor must utilize the necessary equipment and procedures required to achieve specified tolerances.

New encasement pipe shall be constructed of smooth wall steel pipe. The water carrier pipe shall conform to the materials specified in Section 02660. The installation shall be in accordance with the requirements of the specifications and applicable Construction Drawings.

2. APPLICABLE PUBLICATIONS.

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

2.1 American Association of State Highway and Transportation Officials (AASHTO).

AASHTOT-99	Moisture-Density Relation of Soils Using a 5-lb. Rammer and a 12-In. Drop

2.2 American Society for Testing and Materials (ASTM).

ASTMA-53	Specifications for Pipe, Steel, Black and Hot Dipped Zinc-Coated Welded or Seamless
ASTM C-270	Specification for Mortar for Unit Masonry
ASTM C-404	Specification for Aggregate for Masonry Grout

3. MATERIALS.

3.1 Smooth Wall Encasement Pipe. Smooth wall steel encasement pipe shall conform to the requirements of ASTM A-53 with minimum yield strength of 35,000 psi and have a wall schedule as follows:

CARRIER PIPE DIAMETER (INCHES)	ENCASEMENT PIPE DIAMETER (INCHES)	MINIMUM WALL THICKNESS FOR NON-COATED (INCHES)
8 inches	16 inches	0.375

3.2 Water Main Carrier Pipe. Water main carrier pipe shall be as shown in the Construction Drawings and shall comply with Section 02660.

3.3 Casing End Seals. Casing end seals shall be EPDM with T-304 stainless steel bands and manufactured by Garland or approved equal.

3.3 Casing Spacers. Casing spacers shall be of the bolt-on-clamp style consisting of a stainless steel shell lined with a 0.09 inch thick PVC liner. Connection flanges shall be ribbed for extra strength. Runners shall be made of ultra high molecular weight polymer supported by risers made of heavy stainless steel, Type 304. Supports shall be welded to the shell and all welds passivated. The supports shall keep the carrier pipe fully restrained from movement in any direction more than 1.0 inch. The supports shall be manufactured to maintain the grade specified on drawings even if the encasement pipe is installed off grade. For the carrier pipe, acceptable vertical tolerances are 0.05 feet per 100 foot, acceptable horizontal tolerances are 0.25 feet per 100 foot of pipe length. Casing spacers shall be equal to those manufactured by Cascade Waterworks Manufacturing Company or Government approved equal.

4. CONSTRUCTION.

4.1 Placing Encasement Pipe. Qualified and experienced personnel shall be employed on all encasement work. Frequent checks shall be made for both grade and alignment during the boring and jacking operation and open trench excavation. Ground water and surface water disposal shall meet all local, state, and government regulations.

4.2 Encasement Pipe and Carrier Pipe by Boring and Jacking. A jacking and boring pit shall be excavated large enough to accommodate the equipment and provide for alignment check. Smooth wall encasement pipe shall be placed by jacking and boring methods. The Contractor is responsible for selecting the appropriate method to achieve the specified tolerances prior to bid. The Contractor shall conduct any and all investigation needed to determine the means and methods required. The boring excavation diameter must not exceed the outside diameter of the pipe. Adequate timber guides shall be placed in the bottom of the trench to start the pipe on grade. Frequent check shall be made for both grade and alignment. The joints for the steel pipe shall be full penetration butt welded. Any voids which occur around the encasement pipe shall be filled with concrete mortar.

4.3 Placing Carrier Pipe in Encasement Pipe. The carrier pipe shall be placed within the encasement pipe as shown on the Construction Drawings and details.

The carrier pipe shall be supported on casing spacers as shown on the Construction Drawings. The pipe shall be laid on a true grade and alignment grade. All sections of pipe shall be carefully placed, supported and centered, and joined to form a water pipeline that will have a uniform invert grade. The pipe shall be protected against impact shock and free fall during handling. Prior to being placed in the encasement pipe, pipe shall be inspected and any damaged sections shall be rejected.

4.4 Alignment Requirements. Horizontal deflections in excess of 0.25 feet from the centerline of the proposed pipe alignment will be cause for rejection of the encasement pipe installation. Casing vertical alignment must be such that the carrier pipe can be installed to the elevations and grade shown on the Construction Drawings. If the carrier pipe cannot be installed to the elevations shown on the Construction Drawings, the casing installation will be rejected. Casing spacers shall be tapered as required to allow for installation to grade of the carrier pipe inside the encasement pipe should the encasement pipe have a minor vertical deflection.

Any encasement pipe bore holes abandoned shall require that the encasement pipe be left in place to prevent settlement unless an alternate method is proposed by the Contractor and approved by the Government.

If the installation is rejected, encasement pipe shall be installed at a new location approved by the Contracting Officer's Representative. The cost for rehabilitation of bore holes, additional bore pipe, and re-drilling of new holes shall be borne by the Contractor.

4.5 Backfill of Pits and Cleanup. Backfill of the jacking and boring pits shall be compacted to 95% of maximum dry density at optimum moisture content as determined by AASHTO T-99. The slope and contour of the area shall be returned to the original contour. All equipment and debris used or caused by the construction shall be removed from the site.

END OF SECTION

SECTION 02502

ASPHALT PRIME AND/OR TACK COAT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is the single application of asphalt material as specified in the contract documents on a prepared sub-grade, sub-base, base or asphalt surface meeting the plans and specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless otherwise specified, furnish asphalt material grade and typed as specified below.
   1. Furnish Liquid Asphalt, MC-70 meeting the requirement of Section 702 of the MDT Standard Specifications for all asphalt prime coat applications.
   2. Furnish Liquid Asphalt, MC-800 and/or MC-3000 meeting the requirement of Section 702 of the MDT Standard Specifications for all chip seal applications on gravel roads.
   3. Furnish Emulsified Asphalt, SS-1 meeting the requirements of Table 1 in this section for all asphalt tack coat applications.
   4. Furnish Emulsified Asphalt, CRS-2 or CRS-2P meeting the requirements of Table 2 in this section for all asphalt chip seal applications.

B. Furnish Blotter Sand as specified below meeting the requirements of MDT 407.02.2.
   1. Blotter material shall be 100% passing the ½-inch (12.5 mm) screen having a PI of 6 or less.

TABLE 1
SPECIFICATIONS FOR ANIONIC EMULSIFIED ASPHALTS

TYPE	RAPID SETTING				MEDIUM SETTING						SLOW SETTING			
GRADE	RS-1		RS-2		MS-1		MS-2		MS-2h		SS-1		SS-1h	
Test of Emulsions:	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt-Furol at 77°F (25°C)	20	100	…	…	20	100	100	…	100	…	20	100	20	100
Viscosity, Saybolt-Furol at 122°F (50°C)	…	…	75	400	…	…	…	…	…	…	…	…	…	…
Demulsibility*, 35ml, 0.02N $CaCl_2$, percent	60	…	60	…	…	…	…	…	…	…	…	…	…	…
Residue by Distillation, percent	55	…	63	…	55	…	65	…	65	…	57	…	57	…
Test on Residue from distillation tests														
Penetration, 77°F (25°C), 100g, 5s	100	200	100	200	100	200	100	20	40	90	100	200	40	90
Ductility, 77°F (25°C), 5cm/min, cm.	40	…	40	…	40	…	40	…	40	…	40	…	40	…
Solubility in Trichloroethylene	97.5	…	97.5	…	97.5	…	97.5	…	97.5	…	97.5	…	97.5	…
Suggested Uses:	Surface treatment penetration macadam and tack coat		Surface treatment and penetration macadam		Plant or road mixture with course aggregate, substantially all of which is retained on a No. 8 (2.36 mm) sieve and practically none of which passes a No. 200 (0.075 mm) sieve, tack		Plant or road mixture with course aggregate, substantially all of which is retained on a No. 8 (2.36 mm) sieve and practically none of which passes a No. 200 (0.075 mm) sieve.				Plant or road mixture with graded and fine aggregates, substantially quantity of which passes a No. 8 (2.36 mm) sieve and a portion of which may pass a No. 200 (0.075 mm) sieve. Slurry seal treatment.			

* The demulsibility test shall be made within 30 days from the date of shipment.

TABLE 2
SPECIFICATIONS FOR CATIONIC EMULSIFIED ASPHALTS ASSHTO M208

TYPE	RAPID SETTING				MEDIUM SETTING						SLOW SETTING		
GRADE	CRS-1		CRS-2		CMS-1		CMS-2h		CSS-1		CSS-1h		
Test of Emulsions:	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
Viscosity, Saybolt-Furol at 77°F (25°C)	...	...	...	...	...	...	...	...	...	20	100	20	100
Viscosity, Saybolt-Furol at 122°F (50°C)	...	20	100	100	400	50	450	50	450	...	...	...	...
Demulsibility[A] 35ml, 0.08% sodium dioctyl sultrosuccinate, %	40	...	40	...	...	...	...	...	...	...	...	...	...
Particle Charge Test	Pos	...	Pos	...	Pos	...	Pos	...	Pos [B]	...	...	...	Pos [B]
Distillation: Oil distillation by volume of emulsion, percent	...	...	3	...	3	...	12	...	12	...	...	...	...
Residue, percent	60	...	...	65	...	65	...	65	...	...	57	...	57
Test on Residue from distillation tests													
Penetration, 77°F (25°C), 100g, 5s	100	250	100	250	100	250	40	90	100	250	40	90	...
Ductility, 77°F (25°C), 5cm/min, cm.		40	...	40	...	40	...	...	40	...	40	...	40
Solubility in Trichloroethylene	97.5	...	...	97.5	...	97.5	...	97.5	...	...	97.5	...	97.5
Suggested Uses:	Surface treatment, penetration macadam and tack coat		Surface treatment and penetration macadam		Plant or road mixture with course aggregate, substantially all of which is retained on a No. 8 (2.36 mm) sieve and practically none of which passes a No. 200 (0.075 mm) sieve.				Plant or road mixture with graded and fine aggregates, a substantial quantity of which passes a No. 8 (2.36 mm) sieve and a portion of which may pass a No. 200 (0.075 mm) sieve. Slurry seal treatment.				

[A] The demulsibility test shall be made within 30 days from the date of shipment.
B If the particle charge test result is inconclusive, material having a maximum pH value of 6.7 will be acceptable.

PART 3 - EXECUTION

3.1 DISTRIBUTORS

A. Use a pressure distributor for prime and tack coats that distributes the required amount of asphaltic material at the specified temperature in a uniform spray, without atomization. Assure the distributor is pneumatic tired and does not rut or otherwise damage the surface being sprayed. Equip it with a bitumeter having a dial visible to the truck driver for maintaining the constant speed required for application at the specified rate.

B. Assure the pump is operated by a separate power unit or by the truck power unit. Equip the pump with a tachometer having a dial readily visible to the operator, registering gallons per minute passing through the nozzles.

C. The distributor shall be designed so that the normal width of application shall be not less than 12 feet (3.66 m), with provision for the application of lesser or greater width when necessary. The distributor shall be designed or equipped so that the height of the spray bar above the surface to be sprayed, may be set and maintained within a tolerance of 1/2 inch (13 mm) (plus or minus) of the height required to provide a uniform application.

D. Assure the distributor is equipped and operated so that the asphaltic material is circulated or agitated throughout the entire heating system. Provide a means for constant, accurate temperature indication of the asphaltic material is provided. Assure the thermometer well is placed without contacting the heating tube.

3.2 ASPHALT PRIME COAT

A. Asphalt prime coat will be applied only if specified in the plans or special provisions. See section 02502.4.

B. Apply MC-70 at a rate of 0.20 gallons per square yard (0.91 L/m^2) on all asphalt prime coat application.

C. Immediately before applying the prime coat, clean the surface to be primed of all dirt and loose materials using blowers or a power broom, supplemented by hand brooming if necessary. Finish the surface to receive the asphalt material to the specified requirements for smoothness, compaction, and grade. Apply prime coat when the surface is dry or slightly damp and when the air temperature in the shade is not less than 50° Fahrenheit (10° C).

D. Apply asphalt material using a pressure distributor at the rate or rates directed by the Engineer.

E. Before spraying, spread building paper over the surface from the joint back, for the distance required for the spray bar to begin spraying and operating at full force when the surface to be treated is reached. Once the asphalt is applied, remove and dispose of the building paper. Assure the spray bar is shut off instantaneously at each construction joint to assure a straight line and full application of asphalt prime up to the joint. If required to prevent dripping, insert a drip pan under the nozzle where the application ends. Use a hand sprayer to apply primer material to touch up all spots missed by the distributor.

F. Protect the surfaces of structures and trees adjacent to the area being treated from being spattered or marred. Do not discharge asphalt material into borrow pits or gutters.

G. After the prime coat has been applied, assure it is left undisturbed for at least 24 hours or until it is cured or blotted. Blot all excess asphalt material remaining on the surface after 24 hours with sand before opening the surface to traffic. Maintain the primed or tacked surface until the surfacing has been placed. Maintenance includes spreading any additional sand required to prevent asphalt material adhering to the tires of vehicles using the surface and patching all breaks in the surface with additional bituminous material. Any area of surface disturbed by traffic or otherwise, is to be cleaned before the next course is placed. Before placing the surface course, sweep all excess and/or loose sand used for blotter from the surface.

3.3 ASPHALT TACK COAT

A. The asphalt tack coat is the application of a diluted, slow-breaking, SS-1 asphalt emulsion to ensure bond between the surface being paved and the overlying course. Immediately before applying the tack coat, clean the surface to be tacked of all dirt and loose materials using blowers or power brooms, supplemented by hand brooming if necessary.

B. Apply tack coat when the surface is dry or slightly damp, and when the air temperature in the shade is at least 50° Fahrenheit (10° C).

C. Dilute the asphalt emulsion, SS-1, with water at one part emulsion to one part water. Apply the diluted emulsion using a pressure distributor at the rate of 0.1 gallon per square yard (4.5 liters per square meter).

D. Before application, spread building paper over the surface, from the joint back, for the required distance for the spray bar to begin spraying and operating at full force when the surface to be treated is reached. Once the asphalt is applied, remove and dispose of the building paper. Shut off the spray bar instantaneously at each construction joint to assure a straight line and full application of asphalt tack up to the joint. If required to prevent dripping, insert a drip pan under the nozzle where the application is stopped. Use a hand sprayer to apply primer material for touching up all spots missed by the distributor.

E. After the tack coat has been applied, assure it is undisturbed until the asphalt emulsion has “broken”, generally within 30 minutes of application. Place the next paving course after the emulsion has broken.

F. Schedule operations so that all tack coats are placed with the asphalt-paving course in the same day.

SECTION 02510

ASPHALT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Work is the production and placement of plant mix asphalt concrete pavement.

B. Hot plant mix asphalt concrete is a mineral aggregate and asphalt material mixed at a hot plant meeting these specifications and placed in one or more courses on a newly prepared or existing street roadway in accordance with the contract documents.

1.2 REFERENCES

AASHTO T11 (ASTM D1140)	Amount of Material Finer than No. 200 (0.075 mm) Sieve in Aggregate
ASTM D5361	Standard Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89 (ASTM D4318)	Determining Liquid Limit of Soils
AASHTO T90 (ASTM D4318)	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T283 (ASTM D4867)	Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
AASHTO T176 (ASTM D2419)	Plastic Fines in Graded Aggregates and Soils by Use of The Sand Equivalent Test
AASHTO T96 (ASTM C131)	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T312 (ASTM D6925)	Standard Test Method for Preparation and Determination of the Relative Density of Asphalt Mix Specimens by Means of the Superpave Gyratory Compactor
ASTM D2041	Theoretical Maximum Specific Gravity and Density of Bituminous Mixtures
ASTM C1097	Hydrated Lime for Use in Asphalt Cement or Bituminous Paving Mixtures
ASTM D3666	Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

ASTM D5821	Percentage of Fractured Particles in Coarse Aggregate
ASTM C123	Lightweight Particles in Aggregate
ASTM D6307	Asphalt Content of Asphalt Mixture by Ignition Method
ASTM C142	Clay Lumps and Friable Particles in Aggregates
MS-2	Asphalt Institute – Mix Design Methods

PART 2 - PRODUCTS

2.1 GENERAL:

A. The Asphalt Concrete Surface Course must have at least a 3-bin separation, when continuous flow mixing types of plants are used. When a drum dryer is used with a weight batching system from dry bins, separate and stockpile the crushed aggregate into two sizes.

B. Unless otherwise specified, furnish Type B or B-Modified aggregate meeting the requirements of Table 1 in this section for all asphalt pavement applications.

C. Unless otherwise specified, furnish (PGAB) PG58-28 Asphalt Binder Material meeting the requirements of Table 2 in this section for all asphalt pavement application.

D. Prepare pavement course to conform to the lines, grades, thickness and typical cross sections shown in project documents and plans, and shall be rolled, finished, and approved by the Engineer before the placement of the next course.

2.2 PLANT MIX AGGREGATES

A. Furnish aggregates from acceptable sources approved by the Engineer.

B. Furnish test data as outlined in this section on each source to be used for acceptance by the Engineer.

C. Designation of the source of supply and the acceptability of the material there from, does not extend to the grading of the material as it may naturally come from the pit or crusher. Adjust the crusher and screens to remove certain portions of the material as may be necessary to furnish gravel that will comply with the specifications in the contract. No additional compensation will be allowed for such adjustment of the equipment or the rejection of waste. It is understood that the Engineer may order procurement of material from any portion of any area designated as a pit site and may reject portions of the deposit as unacceptable.

D. Aggregate materials shall not contain more than 1.5% by weight of clay lumps, shale, or coal, nor shall light weight particles exceed 3.5% by weight. No combination of clay, shale, coal, or lightweight particles shall exceed 3.5% by weight. Do not use Scoria (fired clay). Aggregate materials shall conform to the grading stipulated in the contract documents. Use reasonable care in the selection of material in a pit so that uniform product will be produced at all times. No compensation will be allowed for such stripping of the pit as may be required in order that satisfactory material may be secured.

E. Aggregate used shall consist of gravel, crushed to the specified size, crushed stone, composed of hard durable pebbles or stone fragments, reclaimed asphalt pavement, and finely crushed stone filler, sand or natural clean material, or other fine mineral material. The portion of the material retained on the No. 4 sieve (4.74 mm) will be called coarse aggregate and that passing the No. 4 sieve (4.74 mm) and retained on the #200 sieve (0.075 mm) will be call fine aggregate. The material Passing the #200 (0.075 mm) will be called mineral filler. The reclaimed asphalt pavement shall be removed from its original location and reduced by suitable means to such particle size as may be required for use in hot plant mix asphalt concrete.

F. For all gradings of fine aggregate, including any blended fine aggregate and mineral filler, passing a No 40 sieve (0.425 mm), shall have a liquid limit not exceeding 25 and a plasticity index of not more than 6.

G. Produce coarse aggregate retained on the No. 4 sieve (4.75 mm) having a minimum of 75% by weight of particles with at least two mechanically fractured faces. When fractures are contiguous, assure the angle between the fracture planes is at least 30 degrees to count as two fractured faces.

H. Preliminary acceptance of aggregates proposed for use may be made at the point of production. Final acceptance will be made only after tests of the aggregates are complete and in place.

I. Surface Course Asphalt Plant Mix Aggregate:

TABLE 1

REQUIREMENTS FOR GRADING OF SURFACE COURSE AGGREGATE

Percentage by Weight Passing Job Mix Target Bands						
Sieve Size	A 1”	B ¾”	C ½”	D 3/8”	E #4	Job Mix Tolerances
1” (25.0 mm)	90 - 100	100				---
¾” (19.0 mm)	90 Max	90 - 100	100			+/- 5
½” (12.5 mm)		90 Max	90 - 100	100	100	+/- 5
3/8” (9.5 mm)			90 Max	90 - 100	95 - 100	+/- 5
No 4 (4.75 mm)				90 Max	90 - 100	+/- 5
No 8 (2.36 mm)	19 - 45	23 - 49	28 - 58	32 - 67		+/- 4
No 30 (0.600 mm)						+/- 3
No 200 (0.075 mm)	1 - 7	2 - 8	2 - 10	2 - 10	6 - 13	+/- 2

1. The above gradation bands represent the job mix target limits, which determine the suitability of aggregate for use. The final job mix target gradation must be within the specified bands and uniformly graded from coarse to fine and not vary from the low limits on one screen to the high limits on the adjacent screen, or vice versa. The final job mix gradation limits are established by applying the job mix tolerances to the job mix targets.
2. The job mix formula establishes target values. During production of the mix, the gradations shall lie within the job mix gradation limits specified in Table 1. For example, "Type A, No. 200" band is "1-7". QA job mix target of 5 has been selected for the final mix. The job mix gradation limits is 5, plus and minus 2. Therefore, the job mix gradation limits for production is 3-7.

2.3 ASPHALT BINDER MATERIAL

A. Furnish asphalt binder material to be used as specified in the contract documents that meet the type and grade specified requirements in this section in Table 2.
   1. Grades:
      a. (PGAB) PG 58-28
      b. (PGAB) PG 64-22
      c. (PGAB) PG 64-28 (Polymer Modified)
      d. (PGAB) PG 70-28 (Polymer Modified)

B. The percentage of asphalt by weight, to be added to the aggregate will be, generally, between 4 and 8% of the weight of the total mix. A minimum effective asphalt binder content of 4.5% is required for ¾" for Type B and ½" mixes, 5.0% for ½" for Type C mixes. The mix design will establish the exact percentage of asphalt in the mix, based upon preliminary laboratory tests, sieve analysis and grading and character of the aggregate furnished within the specification limits. No claim is allowed for the payment for rejecting any batch or load of mixture containing an excess or deficient amount of asphalt binder varying more than 0.4 of a percent from the fixed mix design percentage.

C. Obtain Engineer approval of the asphalt material source before shipments are made to any project. The source of supply cannot change after work is started unless approved in writing by the Engineer. The Engineer is not liable for the quantity shipped.

D. Samples of asphalt binder material may be taken, as directed by the Engineer, and placed in uncontaminated one-quart containers. When sampled, these shall be taken from the tanker car or truck at the point of delivery on the project and submitted to the Engineer.

E. All transport vehicles must be equipped with a spigot or gate valve installed in either: (1) the unloading line, (2) in the tanker at the centerline on the tank, (3) in the pressure line from the unloading pump, or other locations approved by the Engineer. Assure the spigot or gate valve has a diameter of between 3/8 inch (1 cm) and 3/4 inch (2.5 cm). The spigot valve must be located to prevent contamination from plant dust or other contaminants.

F. The supplier furnishing the asphalt binder material shall inspect each tanker car or truck before it is loaded and ship only in clean, uncontaminated, fully insulated cars or trucks, sealed after loading by the supplier.

G. The material supplier shall issue, in duplicate, a certificate showing full compliance with the specifications for the designated grade of material, together with the following information. Project number, date of shipment, source of the material, car or truck initial and number, destination, gross quantity loaded, loading temperature, and net quantity in gallons at 60° F (15.5° C) or tons, whichever unit of measurement is stipulated. Assure the certificate of compliance accompanies the shipment and is furnished to the Engineer. The certificate, signed by the supplier representative, must also certify that the conveyance vessel was inspected and found to be free of contaminating material.

H. The certificate of compliance is the basis for tentative acceptance and use of the material. Samples taken according to applicable sampling methods and retained by the Engineer may be tested at the Engineer's discretion. Failure of the asphalt material to meet these specifications may result in rejection of the entire, associated work. If rejected, removed and replace rejected work.

I. Apply asphalt material at temperatures that assure uniform mixing or spreading. Application temperature ranges for each grade of material should be accompanied with the mix design. Application temperature for mixing applications will be in accordance with the mix design.

J. Upon request by the Engineer, furnish the Engineer and/or laboratory (responsible for completing the mix design) with data or a report showing the temperature-viscosity relationship of each asphalt binder used on the project. Assure this data covers the range of temperatures used for mixing and compaction. In addition, the Engineer may request a complete set of test results from Table 2 for each grade used on the project.

TABLE 2
PERFORMANCE GRADED ASPHALT BINDER (PGAB)

Performance Grade	PG 58	PG 64		PG 70	Test Methods
	-28	-22	-28	-28	
Average 7-day Maximum Pavement Design Temperature, °C	<58	<64		<70	
Minimum Pavement Design Temperature, °C	>-28	>-22	>-28	>-28	
Original Binder					
Flash Point Temp.: Minimum °C	230				AASHTO T48
Viscosity: Maximum, 3 Pa ·s (3000 CP), Test Temp, °C	135				ASTM D4402
Dynamic Shear: G* / sin delta, Minimum, 1.00 kPa Test Temp @ 10 rad / s, °C	58	64		70	AASHTO T315
Rolling Thin Film Oven (AASHTO T240) or Thin Film Oven (T179) Residue					
Mass Loss, Maximum, %	1.0				AASHTO T240
Dynamic Shear: G* / sin delta, Minimum, 2.20 kPa Test Temp @ 10 rad / s, °C	58	64		70	AASHTO T315
Pressure Aging Vessel Residue (AASHTO PP1)					
PAV Aging Temp, °C	100	100		100	AASHTO R28
Dynamic Shear: G* / sin delta, Maximum, 5000 kPa Test Temp @ 10 rad / s, °C	19	25	22	25	AASHTO T315
Creep Stiffness [a]: S, Minimum, 300 MPa m-value, Minimum, 0.300 Test Temp, @ 60 sec, °C	-18	-12	-18	-18	AASHTO T313
Direct Tension [a]: Failure Strain, Minimum, 1.0%, Test Temp @ 1.0 mm/min. °C	-18	-12	-18	-18	AASHTO T314

1. If creep stiffness is below 300 MPa, the direct tension test is not required. If the creep stiffness is between 300 and 600 MPa the direct tension failure strain requirement can be used in lieu of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

2.4 HYDRATED LIME FOR ASPHALT CONCRETE.

A. Mineral filler may be incorporated in the asphalt concrete mixture. Furnish hydrated lime as filler when specified. Assure it is free of lumps and extraneous material and meets the following gradation requirements as per ASTM D242:

Sieve	Percent Passing
No. 30 (0.60 mm) Sieve	100
No. 80 (0.180 mm) Sieve	95-100
No. 200 (0.075 mm) Sieve	70-100

B. Assure the hydrated lime meets paragraph 2 (chemical composition) and paragraph 7 (a) requirements (chemical analysis) of ASTM C1097.

C. Where required, the mineral filler will be effectively mixed with the hot plant mix asphaltic concrete.

2.5 COMPOSITION OF MIXES:

A. General

1. Submit to the Engineer for approval a mix design for each mix required on the project. Assure the job-mix formula is within the gradation limits in Part 2 Products in this section.
2. Have the job-mix formula prepared by an independent testing laboratory approved by the Engineer and performed under the supervision of a Professional Engineer. The requirements of ASTM D-3666 are the guidelines for testing laboratory approval. The cost of the job-mix formula(s) is at Contractor expense.
3. Keep the job mix formula current and contain the following minimum information:
    a. Gradation of all constituent aggregates.
    b. Specific gravity of constituent aggregates and asphalt cement.
    c. Source of supply of all materials and grade of asphalt cement.
    d. Marshall design curves for stability, unit weight, flow and volumetric requirements (VMA and total voids) at asphalt contents below and above optimum (four points minimum).
    e. Measured void less (Rice's) specific gravity used in voids computations.
    f. Composite aggregate grading.
    g. Recommended asphalt cement content.
    h. Marshall or gyratory compactive effort.
    i. Date of mix design (job mix formula).
    j. Index of retained strength.
4. In addition to the job mix formula, all asphalt concrete surfacing mix submittals will have laboratory tests indicating that the Tensile Strength Ratio (TSR) as determined by AASHTO T-283 is at least 70%. Test shall be performed at 7.0 +/- 0.5% air voids and shall include the freeze cycle. Mixtures that fail to meet this minimum criteria may be resubmitted with and approved anti-strip agent meeting the same 70% criteria.

B. Asphalt Concrete Surface Course

1. The maximum permissible variation from the job-mix formula within the specification limits is as follows:
    a. Aggregate gradation within job mix tolerances
    b. Asphalt ± 0.4%*

c. Temperature of mix ± 20°F.

* This tolerance will be permitted only if the job mix parameter curves indicate that the corresponding design limits are not exceeded.

2. Produce Hot Plant Mix Asphalt Concrete Surface courses having the following characteristics as measured by AASHTO T245, ASTM D6726 & D6927 "Resistance to Plastic Flow of Bituminous Mixtures by Means of the Marshall Apparatus":

a. Number of compaction blows, each end of specimen 50.
b. Stability, minimum 1500.
c. Flow 8 – 18.
d. Air voids, percent 3-5.
e. Percent voids in mineral aggregate (minimum)

All type B-modified asphaltic concrete surfacing shall meet the following Marshall Design criteria as determined by ASTM D1559.

a. Number of Compaction Blows, Each End of Specimen 75
b. Stability, Minimum 1500 lbs.
c. Flow 8 – 16
d. Air Voids, Percent 3 - 5
e. Percent Air Voids Filled with Bitumen 65-75

3. As an alternative to Marshall mix production, SuperPave Hot Plant Mix Asphalt Concrete Surface courses can be produced having the following characteristics as measured by AASHTO R 35 and M 323.

TABLE 3
SUPERPAVE GYRATORY COMPACTION EFFORT

20-Year Design ESALs" (in millions)	**Compaction Parameters**			**Typical Roadway Applications**
	$N_{initial}$	N_{design}	$N_{maximum}$	
< 0 .3	6	50	75	Applications include roadways with very light traffic volumes, such as local roads, county roads and city streets where truck traffic is prohibited or at a very minimal level. Traffic on these roadways would be considered local in nature, not regional, intrastate or interstate. Special-purpose road ways serving recreational sites or areas may also be applicable to this level.
0.3 to< 3	7	75	115	Applications include collector roads or access streets. Medium- trafficked city streets and the majority of county roadways may be applicable to this level.

a. Air voids, percent . . . . . 3-5.
b. Voids Filled with Asphalt. 65-80
c. Dust to Effective Binder ratio 0.6-1.4

d. N_{Max} 98
e. N_{Min} 91.5
f. N_{Design} 95-97
g. Percent Voids in Mineral Aggregate . . . . . See Table 4.

TABLE 4 REQUIRED VOIDS IN MINERAL AGGREGATE (VMA)	
Nominal particle size (table 2)	Voids in Mineral Aggregate, Min.
No 4 (4.75 mm) 3/8 – inch (9.5 mm) ½ - inch (12.5 mm) ¾ - inch (19.0 mm) 1 – inch (25.0 mm)	16 15 14 13 12
Nominal maximum particle size is one size larger than the first sieve to retain more than 10 percent.	

PART 3 - EXECUTION

3.1 CRUSHING:

A. Crushing Equipment
1. Fit crushing plant-screening equipment, when required, with blowers or other devices capable of removing excess and undesirable fines.

B. Screening Plants
1. Screening plants consist of a revolving trommel screen, shaker screen, vibrating screen, or other devices capable of removing oversize material, excess and undesirable fines.

C. Scales
1. Furnish scales, when required, satisfactory to the Engineer. Test and certify scales prior to their use on the project and as often thereafter as the Engineer may consider necessary to ensure their accuracy. Have on hand not less than ten, 50-pound weights for testing scales.
2. House the recording devices of the scales in a suitable manner. Place the scales in a location suitable to facilitate accurate weighing of loads. The scales shall be accurate to one-half of one percent at any weight. Alternate methods or devices for weighing may be acceptable, provided that these methods or devices produce the same degree of accuracy as required of platform scales.

3.2 MATERIAL HANDLING:

A. All work involved in clearing and stripping pits and quarries, including handling unsuitable material encountered, are performed with no additional compensation being allowed for this work. The pits as utilized shall immediately be opened so as to expose the vertical faces of the various strata of acceptable material and, unless otherwise directed, the material shall be secured in successive vertical cuts extending through all the exposed strata.

B. Provide, unless otherwise specified, material containing as large a proportion as possible of crushed aggregate. Combine the crushed material with the screened material to obtain a uniform product.

C. No material will be accepted which is loaded into hauling units in a segregated condition or which does not meet the required grading. In case the material deposit contains sand or other material in excess of the specification gradation requirements, or of an unacceptable quality, such excess or undesirable material shall be removed and disposed of prior to crushing, or during screening operations, if crushing is not required.

D. Provide a storage bin of ample capacity to ensure uniform quality and delivery of material. Loading of trucks directly from the conveyor belt, from the crusher or screening plant will not be permitted.

3.3 STOCKPILES:

A. Grub and clean sites for aggregate stockpiles prior to storing aggregates. Assure the site is firm, smooth and well drained. Maintain a bed of aggregate suitable to avoid the inclusion of soil or foreign material.

B. Build up coarse aggregate stockpiles in tiers of not more than 4 feet (1.2 m) in thickness. Assure each tier is completely in place before the next tier is placed. Do not allow material to “cone” down over the next lower tier.

C. Dumping, casting or pushing over the sides of stockpiles will be prohibited, except in the case of fine aggregate stockpiles.

D. Space stockpiles of different gradations of aggregate far enough apart, or separated by suitable walls or partitions, to prevent the mixing of the aggregates.

E. 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 and failure of such samples to meet all grading requirements for the aggregate discontinuance of such stockpiling procedures.

F. Transfer the aggregate from the stockpiles in such a manner that uniform grading of the material is preserved.

3.4 CONVEYOR STOCKPILING:

A. Materials stockpiled by conveyors shall be deposited in a succession of merging-cone piles. Do not drop material over 12 feet (3.66 m) nor allow cones to exceed 12 feet (3.66 m) in height. Cones should be leveled to a thickness of approximately 4 feet (1.2 m) prior to starting another tier.

3.5 TRUCK STOCKPILING:

A. Materials stockpiled by trucks shall construct the stockpile in tiers approximately 4 feet (1.2 m) in thickness. Complete each tier before the next tier is started.

3.6 ASPHALT MIXING PLANTS:

A. Use mixing plants of either the weight batching type, the continuous flow mixing type, or drum dryer type. Use drum dryer mixers specifically designed and constructed for producing hot mix.

B. Equip all plants with approved conveyors, power units, aggregate handling equipment, aggregate screens and bins that are coordinated and operated to produce a uniform mixture within the specified job mix tolerances.

C. Use batch-type plants having a minimum batch production capacity of 2,000 pounds (900 kg). Use continuous flow or drum dryer plants having a minimum production capacity of 60 tons per hour (27 kg per hour). These capacity requirements may be modified if specified in the Contract Documents.

D. Stop production and remove from the project mixing plants that fail to continuously produce a mixture meeting requirements as specified.

3.7 INSPECTION AND CONTROL OF ASPHALT MIXING PLANT:

A. For verification of weights and measures, character of materials and determination of temperatures used in the preparation of the paving mixes, the Engineer or Engineer's authorized representative will, at all times, have access to all portions of the mixing plant, aggregate plant, storage yards and other facilities for producing and processing the materials for the work. All sampling and testing of processed and unprocessed material is performed in accordance with the provisions of the Contract Documents.

3.8 MIX DESIGN:

A. The Owner's acceptance testing agency may make gradation analyses of the completed mix to assure that the materials being produced and used are within the tolerances of the mix design and the specifications of the mix being used.

3.9 SAMPLING AND TESTING FOR ACCEPTANCE:

A. Sampling and testing of aggregates or other constituent materials may be performed by the Owner's testing agency at a frequency determined by the Owner or the Owner's representative. Field control is performed under AASHTO T245, ASTM D6926 & D6927, and ASTM D6925. Field density testing is by core testing for acceptance purposes. Densities to conform to Section 2510,3.28. Gradations to be within the job mix gradation limits. Oil content to be within 0.4% of the Mix Design.

B. Samples will be used to verify compliance with the requirements set forth in this Section. If there is a dispute, a third party testing firm may be retained by the contractor for additional retesting.

3.10 WEATHER LIMITATIONS:

A. When the moisture in the stockpiled aggregate or the dryer adversely effects the quality of mix production, normal plant operations, or when pools of water are observed on the base, mixing and placing of hot-mix asphalt is prohibited.

B. Do not place asphalt hot-mix surface course mixture when the air temperature is less than 40° F (4° C) and rising. Do not place asphalt hot-mix base course mixtures of compacted lifts 4 inches (10 cm) or more when the air temperature is less than 30° F (-1° C) and rising. Do not place asphalt upon a surface which is frozen or that has a temperature of less than 32° F (0 ° C). Do not place paving during rainfall or in standing water.

3.11 SURFACE PREPARATION:

A. Assure the area to be paved is true to line and grade and has a dry and properly prepared surface before starting paving operations. Assure the surface is free from all loose screenings and other loose or foreign material.

3.12 NEW WORK:

A. For new work, meet the surface preparation requirements in Sections 02230, 02234 or 02235 of these specifications. Prime prepared soil or aggregate bases if indicated as a bid item in the Contract Documents.

B. Before paving, proof-roll the base with equipment having at least one 18 kip single axle load or equivalent. Excavate and replace areas that yield or crack under these wheel loads as directed. This does not replace or relax the base or subgrade compaction requirements.

C. Paint the surfaces of curbs and gutters, vertical faces of existing pavements and all structures in contact with asphalt mixes with a thin coating of asphaltic material to provide a water-tight joint.

3.13 OVERLAYS OVER EXISTING PAVEMENTS AND OLD BASE:

A. Where a base is rough or uneven, place a leveling course using a paver or motor grader and compact before the placing of subsequent courses.

B. When specified, place construction fabric to control reflective cracking, as detailed, meeting Section 02110.3.4 Pavement Overlay Applications.

C. When a leveling course is not specified, patch or correct all depressions and other irregularities, subject to the Engineer's approval, before starting other paving operations. Remove all rich and unsuitable patches, excess crack or joint filler, and all surplus bitumen from the area to be paved. Do not blot excessive deposits of asphalt with sand or stone.

D. Apply a tack coat when the surface to be paved is an existing Portland Cement concrete, brick or asphalt pavement. When a tack coat is required, use the asphalt material indicated, at the rate specified in Section 02502.

E. Coat the surfaces of curbs and gutters, vertical faces of existing pavements and all structures in actual contact with asphalt mixes with a thin, complete coating of asphalt material to provide a water-tight joint.

3.14 PATCHING:

A. Weather Limitations
   1. Follow procedures set out in section 3.10.

B. Surface Preparations
   1. Assure the area to be paved is true to line and grade, is dry and properly prepared surface before starting paving operations. Clean the surface of all loose screenings and other loose or foreign material.
   2. Before paving, proof roll the base. Areas that yield excessively or crack under such wheel loads will be excavated and replaced, to correct yielding and cracking problems. This does not replace the base or subgrade compaction requirements. Cut the edge of existing pavements against which additional pavement is to be placed straight and vertical.
   3. Minimum standards for patching new or existing pavement include the following:
      a. Neatly cut all asphalt edges using an asphalt saw.
      b. Cut asphalt edges to form as regular a patch shape as practical and should, in general, approximate a rectangle.
      c. Cut asphalt edges at least 30 cm (12 inches) wider than the trench width on each side of trench excavations; and, in general, be cut parallel to the street centerline for mainline construction and perpendicular to the street centerline for service lateral construction.
      d. Skin patches will not generally be considered a satisfactory method of repair.
      e. Tack coat all existing edges prior to placing new asphalt concrete.
   4. Remove and replace asphalt surface widths of less than 3 feet (90 cm).

C. Compaction

1. Compact to a density equal to or greater than 92% of Maximum Theoretical Density (RICE) as determined by ASTM D2041.

3.15 TRANSPORTATION OF MIX:

A. Transport the mix in vehicles cleaned of all foreign material which may affect the mix. The truck beds must be painted, or sprayed with a lime-water, soap or detergent solution at least once a day or as often as required. After this operation elevate the truck bed and thoroughly drain it, with no excess solution being permitted. Dispatch the vehicles so that all material delivered is placed in daylight, unless the Engineer approves artificial light. Deliver material to the paver at a uniform rate and in an amount well within the capacity of the paving and compacting equipment.

3.16 SPREADING AND FINISHING:

A. Spread and finish meeting the following requirements

1. The minimum lift thickness shall be no less than three times the Nominal Maximum Aggregate Size for gradations above the Maximum Density Line, and no less than four times the Nominal Maximum Aggregate Size for gradations below the Maximum Density Line.
2. The maximum lift thickness is 3 inches (6.5 cm) for surface courses and 6 inches (13 cm) for base courses.

3.17 MECHANICAL PAVERS:

A. Spread and strike off the base and surface courses with a mechanical paving machine. Operate the paving machine so that material does not accumulate and remain along the sides of the receiving hopper.

B. Do not use equipment which leaves tracks or indented areas, which cannot be corrected in normal operation, produces flushing or other permanent blemishes, or fails to produce a satisfactory surface.

C. Construct longitudinal joints and edges to true line markings. Establish lines for the paver to follow in placing individual lanes parallel to the centerline of the proposed roadway. Position and operate the paver to follow closely the established lines.

D. When using pavers in echelon, assure the first paver follows the marks or lines with the second paver following the edge of the material placed by the first paver. To assure a hot joint and obtain proper compaction, assure the pavers work as close together as possible not exceeding 100 feet (30 m) apart. In backing trucks against the paver, take care not to jar the paver out of its proper alignment.

E. As soon as the first load of material has been spread, check the texture of the unrolled surface to determine its uniformity. Segregation of materials is not permitted. If

segregation occurs, suspend spreading operation until the cause is determined and corrected.

F. Offset transverse joints in succeeding courses at least 2 feet (0.6 m). Offset longitudinal joints at least 6 inches (15 cm).

G. Correct all irregularities in alignment left by the paver by trimming directly behind the machine. Immediately after trimming, thoroughly compact the edges of the course by tamping. Avoid distorting the pavement during this operation.

H. Assure edges against which additional pavement is to be placed is straight and approximately vertical. Use a lute or covered rake immediately behind the paver, when required, to obtain a true line and vertical edge. Correct all irregularities in the surface of the pavement course directly behind the paver. Remove excess material forming high spots by a shovel or lute. Fill low areas with hot mix and smooth it with the back of a shovel being pulled over the surface. Fanning of material over such areas is not permitted.

3.18 MOTOR GRADER:

A. When motor graders are used for the spreading of leveling courses, place the material on the roadbed so that the proper amount of material is available. Spread the mix to the required thickness, line and grade, with a uniform surface texture, while at a workable temperature.

3.19 HAND SPREADING:

A. In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand, if so directed by the Engineer. Wood or steel forms, approved by the Engineer, rigidly supported to assure correct grade and cross section, may be used. In such instances, measuring blocks and intermediate strips must be used to obtain the required cross-section. Perform hand placing carefully. Uniformly distribute the material to avoid segregation of the coarse and fine aggregate. Broadcasting of material is not permitted. During the spreading operation, loosen and uniformly distribute all material using lutes or covered rakes. Reject material that has formed into lumps and does not break down readily. Following placing and before rolling, check the surface with templates and straightedges and correct all irregularities.

B. Maintain on the project heating equipment for keeping hand tools free from asphalt. Exercise caution to prevent heating that may burn the material. Assure the temperature of the tools when used is not greater than the temperature of the mix being placed. Use heat only to clean hand tools; petroleum oils or solvents are not permitted.

3.20 COMPACTION:

A. Furnish the number of rollers necessary to provide the specified pavement density. During rolling, keep the roller wheels moist to avoid picking up the material.

B. After the longitudinal joints and edges have been compacted, start rolling longitudinally at the sides and progress toward the center of the pavement. For transverse graded streets, begin rolling on the low side and progress to the high side, overlapping passes by at least one-half the width of rollers and uniformly lapping each preceding pass. Operate the rollers at a slow, uniform speed with the drive roll or wheel nearest the paver. Do not exceed 3 miles per hours (4.8 km per hour).

C. Do not quickly change the line of rolling reversing direction suddenly. If rolling displaces the material, re-work the area using lutes or shovels and restore to the original grade of the loose material before re-rolling. Do not permit heavy equipment or rollers to stand on the finished surface before it has been compacted and has thoroughly cooled.

D. When paving in single width, roll the first lane placed as follows:
   1. Transverse joints
   2. Outside edge
   3. Initial or breakdown rolling, beginning on the low side and progressing toward the high side
   4. Second rolling, same procedure as 3
   5. Finish rolling

E. When paving in echelon, or abutting a previously placed lane, perform the longitudinal joint rolling the same as transverse joint rolling.

F. When paving in echelon, leave 2 or 3 inches (5 to 7.5 cm) of the edge unrolled, which the second paver can match unrolled. Then the joint between the lanes can be rolled together. Do not leave edges exposed more than 15 minutes without being rolled.

G. In laying a surface mix adjacent to any finished area, place it high enough so that, when compacted, the finished surface is true and uniform.

H. On slight grades, check gutters with a straightedge and test with running water to assure drainage to the planned outlet.

I. The average density shall be equal to or greater than 93% of the maximum density as determined by ASTM D2041 and no individual sample shall be less than 92% of maximum density.

3.21 TRANSVERSE JOINTS:

A. Construct and compact transverse joints to provide a smooth riding surface. Joints will be straight edged and string lined to assure smoothness and true alignment.

B. Joint formed with bulkheads to provide a straight line and vertical face will be checked with a straightedge before fresh material is placed against it to complete the joint. If bulkheads are not used to form the joint and the roller is permitted to roll over the edge of the new material, locate the joint line in back of the rounded edge the distance required to provide a true surface and cross-section. If a joint has been distorted by traffic

or by other causes, trim it to line. Paint the joint face with a thin coating of asphalt before the fresh material is placed against it.

C. Place the material against the joints vertical face with the paving machine positioned so that the material overlaps the edge of the joint 1 to 2 inches (2.5 to 5 cm). Maintain a uniform depth of the overlapped material. Remove and dispose of the coarse aggregate in the overlapped material that dislodged during raking.

D. Position rollers on the previously compacted material transversely so that no more than 6 inches (15 cm) of the rolling wheel rides on the edge of the joint. Operate the roller to pinch and press the mix into place at the transverse joint. Continue rolling along this line, shifting position gradually across the joint, in 6-to 8-inch (15 to 20 cm) increments, until the joint has been rolled by entire width of the roller wheel.

E. Keep the number of transverse joints to a minimum. When paving single width and maintaining traffic, pave one lane no farther than one block. Complete all lanes to the same station at the end of each paving day. When paving in echelon, bring the lanes up even as is practical.

3.22 LONGITUDINAL JOINTS:

A. Roll longitudinal joints directly behind the paving operation. Assure the first lane placed is true to line and grade and has a vertical face. Place the material in the lane being paved up firmly against the face of the previously placed lane. Position the paver during spreading to assure the material overlaps the edge of the lane previously placed by 1 inch to 2 inches (25 to 50 mm). Uniformly maintain the width and depth of the overlapped material at all times. Keep the paver aligned with the line or markings placed along the joint for alignment purposes. Before rolling, remove and dispose of the coarse aggregate in the material overlapping the joint.

B. Shift rollers onto the previously placed lane so that not more than 6 inches (15 cm) of the roller wheel rides on the edge of the fine material left by brooming. Operate the rollers to compact the fines gradually across the joint. Continue rolling until a compacted, neat joint is obtained. When the abutting lane is not placed in the same day, paint the joint with a very thin coating of asphalt before placing the abutting lane. If the joint is distorted during the day's work bytraffic or by other causes, carefully trim the edge of the lane to a neat line.

3.23 EDGES:

A. Roll the pavement edges concurrently with or immediately after rolling the longitudinal joint.

B. Exercise care in consolidating the course along the entire length of the edges. In rolling pavement edges, extend the roller wheels 2 to 4 inches (5 to 10 cm) beyond the pavement edge.

3.24 BREAKDOWN ROLLING:

A. Immediately begin breakdown rolling following the rolling of the longitudinal joint and edges. Operate rollers as close to the paver as required to obtain density without causing undue displacement. Operate the breakdown roller with the drive roll or wheel nearest the finishing machine. The Engineer may make exceptions when working on steep slopes or super-elevated curves.

3.25 SECOND ROLLING:

A. Assure the second rolling follows the breakdown rolling as close as possible while the paving mix is still at a temperature that will provide the specified density.

3.26 FINISH ROLLING:

A. Perform the finish rolling while the material is still warm enough to remove roller marks. If necessary, the Engineer may require using pneumatic-tired rollers. Complete finish rolling the same day the mixture is placed.

B. In places inaccessible to standard rollers, perform compaction using trench rollers or others to meet the specified compaction requirements. Operate the trench roller as directed until the course is compacted. Hand, manual or mechanical tamping, may be used in such areas if it is proved to the Engineer that the operation will provide the specified density.

3.27 SHOULDERS:

A. Where paved shoulders or curbs are not specified, do not place the shoulder material against the pavement edges until the surface course rolling is completed. Take care to prevent distortion of the pavement edge from specified line and grade. When shoulders are paved (except in conjunction with the traveled way paving), cold joint construction procedure is required to assure a tight bond at the joint.

B. When the rolling of the surface course has been completed and the edges have been thoroughly compacted, immediately place shoulder material against the edges and roll it.

3.28 DENSITY AND SURFACE REQUIREMENTS:

A. The average mat density shall be equal to or greater than 93% of the maximum density as determined by ASTM D2041 for single lift applications. For two lift applications, the first lift on base course shall be a minimum of 92% of the maximum density and the second lift shall be a minimum of 93% of the maximum density. In both cases individual sample shall be no less than 92% of maximum (Rice's) density, prepared as specified in

Part 2-Products in this section and made from plant mix meeting the job-mix formula. Verification of maximum density as determined by ASTM D2041 from plant produced material during production is recommended.

B. The longitudinal joints shall be compacted to a target density of 91 percent of the theoretical maximum specific gravity as determined by ASTM D2041 and no individual sample shall be less than 89 percent of maximum (Rice's) density. The theoretical maximum specific gravity used to determine the joint density will be the average of the daily theoretical maximum specific gravities for the material that was placed on either side of the joint.

C. Produce a final surface that is uniform in texture and meets the line and grade specified. Before final acceptance of the project or during the progress of the work, the Engineer will determine the thickness of all courses. Repair or replace all unsatisfactory work.

D. Assure density and thickness meets the plans and specifications. During compaction, preliminary tests to aid in controlling the thickness, may be performed by inserting a flat blade, correctly graduated, through the material to the top of the previously placed base, or by other approved methods.

E. In checking compacted depth, the cutting of the test holes, refilling with acceptable materials and proper compaction may be performed by the Owner's testing agency.

F. For testing the surface on all courses, a 10-foot (3 m) straightedge will be used with the centerline of the straightedge placed parallel to the roadway centerline.

G. Any variations that exceed 5/16-inch (0.8 cm) in 10 feet (3 m) for base course and 1/4-inch (0.64 cm) in 10 feet (3 m) for surface course must be corrected. Correct irregularities that may develop before the completion of rolling by loosening the surface mix and removing or adding materials as is required. If any irregularities or defects remain after the final compaction, remove the surface course and place and compact new material to a true and even surface. All minor surface projections, joints and minor honeycombed surfaces must be rolled smooth to grade, as directed

H. Remove and replace areas of new pavement requiring patching as directed. Patching material will be tested for meeting specifications. The cost of testing is at Contractor expense.

3.29 PAVEMENT AND MATERIAL TESTING REQUIREMENTS:

A. Contractor will produce their own core samples of the asphalt surface courses under the supervision of the Owner's testing agent and give completed cores to the Owner's testing agency to check in place density and compacted depth. The cores are 4-inch (10 cm) diameter. Materials and acceptance tests will be made by the Owner's testing agency to determine the Contractor's compliance with the specifications.

B. Materials failing to meet the tests specified may be retested if approved and as directed by the Engineer. The Contractor shall pay the costs of any required re- testing for

acceptance purposes. Re-testing will be performed by the Owner's testing agency unless otherwise approved by the owner. If there is a dispute, a third party testing firm may be retained by the contractor for additional retesting for the Engineer's review and consideration.

C. The costs of the following tests are at Contractor expense:
   1. Initial aggregate quality tests
   2. Job-mix formula
   3. Any tests the Contractor requires to control his crushing, screening or other construction operations
   4. Retesting of failing tests as provided above

D. Correct all pavement composition, field density, or thickness, deficiencies at Contractor expense.

E. The field density and thickness of the pavement is determined by measuring the cores tested. The actual thickness must be no less than 1/4-inch (6.5 mm) from the specified thickness.

F. When the measurement of any core is less than the plan thickness by more than the allowable deviation, the actual thickness of the pavement in this area may be determined by taking additional cores at intervals parallel to the centerline in each direction from the affected location. Continue in each direction until a core is found which is not deficient by more than the allowable deviation. The Engineer will evaluate areas found deficient in thickness and determine which areas warrant removal. Remove and replace the areas with asphaltic concrete of the thickness shown on the plans. Additional coring is considered as re-testing of failing areas.

END OF SECTION

SECTION 02515

PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is constructing Portland Cement concrete pavement to the lines, grades, thicknesses, and cross sections on the plans on a prepared subgrade or base course.

1.2 REFERENCES

ASTM C-143	Slump of Hydraulic Cement Concrete
ASTM C-231	Air Content of Freshly Mixed Concrete
ASTM C-138	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C-39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C-78	Flexural Strength of Concrete
ASTM C-150	Standard Specification for Portland Cement
ASTM C-595	Standard Specification for Blended Hydraulic Cements
ASTM C-157	Standard Performance Specification for Hydraulic Cement
ASTM C-33	Standard Specification for Concrete Aggregates
ASTM C-94	Standard Specification for Ready-Mixed Concrete
AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 183	Standard Specification for Structural Steel
AASHTO M 157	Standard Specification for Ready-Mixed Concrete
AASHTO M 213	Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M 182	Standard Specification for Sheet Materials for Curing Concrete
AASHTO M 148	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish materials meeting the following, section requirements:

1. Portland Cement Section 3310
   a. Use Portland Cement for paving meeting AASHTO M 85, ASTM C150 Types I, II, III and V or ASTM C-595 Type IP or ASTM C-1157 Types GU, MS, HE, and HS. The Engineer will specify the type of cement to be used.
2. Air Entraining Agents Section 3310
3. Admixtures Section 3310
4. Water Section 3310

5. Fine Aggregate for Concrete
    a. Use fine aggregate for concrete meeting ASTM C33.
6. Coarse Aggregate for Concrete
    a. Use coarse aggregate for concrete meeting ASTM C33.
7. Reinforcing Steel
    a. Use reinforcing steel meeting Section 03210 and the following.
    b. Dowels
        1) Use dowel bars for Rigid Pavement Expansion Joints or Devices meeting AASHTO M1 83 (ASTM A36). Assure dowel bars are plain and free from burring or other deformations that prevent slippage in the concrete. Paint one-half the bar length with one coat of zinc or tar paint.
    c. Sleeves
        1) Use metal sleeves for dowel bars of standard manufacture that cover 2-in mm), plus or minus 1/4-inch (6-5 mm), of the dowel, having one closed end and internal stop that holds the dowel bar at least 1-inch (25 mm) from the end. Avoid collapsing the sleeve during construction.

B. Joint Fillers and Sealers
1. Furnish a one-piece joint filler sized the full depth and width of the joint. If a multiple pieced joint filler is approved, fasten the abutting ends following the filler manufacturer's recommendations.
2. Use pourable joint sealer meeting ASTM D3406.
3. Use two-component polyurethane or polysulfide-base sealant meeting A.N.S.I A 116.1-1960 flow and strength requirements where specified.
4. Use either Class A (self-leveling) or Class B (non-sag) sealant for horizontal joints. Use Class B sealant for sloped or vertical joints.
5. Use preformed joint filler meeting, AASHTO M213 requirements, punched to receive the dowels shown on the plans.
6. Use preformed compression joints manufactured to the dimensions specified on the plans, from materials meeting ASTM D 2628.
7. Furnish a certification for each shipment of joints indicating that the material has been sampled, tested, and inspected under ASTM D 2628. Assure each certification furnished is signed by a manufacturer's authorized agent or independent testing agency.
8. If recommended by the manufacturer, use a manufacturer approved lubricant-adhesive to provide lubrication and bond for the joint.

C. Curing and Protective Coating Materials
1. Furnish materials meeting, the following requirements:

AASHTO M182 (Class 3)	Burlap Cloth made from Jute or Kenaf
AASHTO M171 (ASTM C171)	Sheet Materials for Curing Concrete
AASHTO M148	Liquid Membrane-Forming Compounds for Curing Concrete

D. Proportioning

1. Have a qualified independent testing laboratory, approved by the Engineer, determine the mix design to meet flexural or compressive strength of the pavement as specified in the Contract documents. Proportion the concrete mix under Section 03310.2.3 and have a maximum 4" (102 mm) slump and minimum 1.5” (38.5 mm) slump (using slip form method).

PART 3 - EXECUTION

3.1 GENERAL

A. Obtain the Engineer's approval of equipment and tools used for handling, materials and performing all parts of the work. Approval applies to design, capacity, and mechanical conditions. Assure the equipment is on site ahead of the start of construction operations for the Engineer's examination.

3.2 BATCHING PLANT AND EQUIPMENT

A. General

1. The batching plant includes bins, weighing hoppers and scales for the fine aggregate and each coarse aggregate size. Furnish a separate scale, bin, and hopper for cement if cement is used in bulk. Assure the weighing hopper is properly sealed and vented to prevent dust during operation.

B. Bins And Hoppers

1. Provide bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate in the batching plant.

C. Scales

1. Use either beam type or springless-dial type scales for weighing aggregates and cement. Assure the scale is accurate to within 0.5% throughout the range of use. When beam-type scales are used, equip the scale with a "tell-tale" dial or other device for indicating that the required load in the weighing hopper is being approached. The device on weighing beams must clearly indicate critical position. Assure poises are designed to be secured in any position and to prevent inadvertent change. Assure the weigh beam and "tell-tale" device are in full view of the operator as the hopper is charged and operator has convenient access to all controls.
2. Have certified scales. Have on hand not less than ten, 50-pound (22.7 kg) weights for frequent testing of all scales.
3. Batching plants may be equipped to proportion aggregates and bulk cement using automatic weighing devices of an approved type.
4. Obtain the Engineer's approval for any deviations from the above stated batch plant and equipment requirements before concrete manufacture.

3.3 STOCKPILED AGGREGATE

A. This work is storing aggregate material for use on the project at the specified locations.

B. Materials

1. Assure the aggregates meet the applicable requirements of ASTM C-33; AGGREGATES, for the type of material required.

C. Construction

1. Clear and grub the stockpile site. Assure the site is firm, smooth and well drained. Place an aggregate bed to prevent contamination of the stockpiles.
2. Build the stockpiles in maximum 4 feet (1.22 m) layers, with the preceding layer completely in place before starting the next layer. Deposit the material to prevent coning, excluding fine aggregate approximately 90% finer than a No.4 sieve.
3. Do not dump, cast, or push material over stockpile sides excluding fine aggregate specified above.
4. Space or separate using walls, stockpiles of different aggregate types or sizes to prevent intermingling of the aggregates.
5. Submit and obtain Engineer's approval of operational plan for stockpiling any material obtained by wet pit or dredging operations.
6. The Engineer may take random samples from stockpile areas where equipment has been operated. Stop operating equipment over stockpiles if tests show degradation is occurring
7. Remove and transport stockpiled material to prevent segregation.

3.4 MIXING

A. General

1. Mix concrete on site, at a central plant, or wholly or partially in truck mixers. Assure each mixer has a manufacturer's plate showing the drum capacity of mixed concrete and rotation speed of the mixing drum or blades attached in a prominent place.

B. On Site Mixers

1. Mix concrete in an approved mixer able to combine 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. Assure the mixer is equipped with an approved timing device that automatically locks the discharge lever when the drum has been charged and releases at the end of the mixing period.
2. Follow the manufacturer's recommendations for cleaning the mixer. Repair or replace the pickup and throw-over blades in the drum or drums when they are worn down 1 inch (25.4 mm) or more.
3. Have available at the job site a copy of the manufacturer's design, showing blade dimensions and arrangement, and original blade height and depth; or place permanent marks on blades 1 inch (25.4 mm) from the new blade end. Drilled holes of 1/4-inch (6.4 mm) diameter near each end and at the mid-point of each blade are acceptable markings.

C. Truck Mixers And Truck Agitators

1. Assure truck mixers for mixing and hauling concrete, and truck agitators used for hauling central-mixed concrete meet Section 03310.3.3 MIXING requirements.

D. Non-Agitator Trucks

1. Assure bodies of non-agitating, hauling equipment for concrete are smooth, mortar tight metal containers, capable of discharging the concrete at a controlled rate without segregation. Discharge of concrete should be from the bottom of the container. If the equipment body is tilted to discharge concrete, assure baffles slow down the load.

3.5 FINISHING EQUIPMENT.

A. Finishing Machine

1. Use a suitable finishing machine.

B. Vibrators

1. Vibrators may be either the surface pan type or the internal type with immersed tube or multiple spuds. Vibrators may be attached to the spreader, the finishing machine, or mounted on a separate carriage. Do not permit vibrators to come in contact with joints, load transfer devices, subgrade, or side forms. Maintain the surface vibrator frequency at 3,500 or more impulses per minute. Maintain frequency of internal types at 5,000 impulses per minute or more for tube vibrators. Maintain 7,000 impulses per minute or more for spud vibrators.
2. Maintain a minimum frequency of 3,500 impulses per minute when spud-type internal vibrators, either hand-operated or attached to spreaders or finishing, machines, are used adjacent to forms.

C. Concrete Saw

1. When sawing concrete joints, use sawing equipment capable of producing the specified cut producing a straight line. Provide artificial lighting for night work to produce work of daytime quality. Assure this equipment is on the job both before and during concrete placement.

D. Forms

1. Use straight side metal forms having:
   a. a minimum 7/32-inch (5.6 mm) thickness
   b. a minimum 10 feet (3.05 m) length.
   c. a depth at least equal to the prescribed edge thickness of the concrete
   d. no horizontal joints
   e. a base width equal to at least the depth of the forms.
2. Use flexible or curved forms for curves of 100-foot (30.5 m) radius or less. Obtain Engineer approval before using flexible or curved forms. Provide form anchors capable of withstanding, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Assure flange braces extend outward on the base at least two- thirds the height of the form.
3. Do not use forms with battered top surfaces, bent, twisted, or broken forms in the work.

4. Do not use repaired forms until inspected and approved. Use built-up forms only where the total pavement area of any specified thickness on the project is less than 2,000 square yards (1672 m^2). Assure the top form face does not vary from a true plane more than 1/8-inch in 10 feet (3.2 mm in 3.05 m), and the upstanding leg does not vary more than 1/4-inch (6.35 mm). Assure the forms are capable of locking the ends of abutting form sections together tightly providing a secure setting.

3.6 GRADE PREPARATION

A. Once the base and/or subgrade is graded and compacted to the specified requirements, trim the grade to specified elevation.

B. Bring the subgrade or base course to the specified cross section when side forms are set to grade.

C. Fill and compact low areas with approved material or fill with concrete integral with the pavement.

D. Maintain the finished grade until the pavement is placed.

E. Keep the subgrade or base course uniformly moist until the concrete is placed. Do not over wet creating mud or water to pond.

3.7 SETTING FORMS

A. Base Support

1. Prepare the foundation under the forms so that when the form is set, it is in contact for its whole length at the specified grade. Fill and compact to grade with granular material, any grade at the form line found to be below established grade. Correct out of specification grade lines by tamping, or by cutting, as required.

B. Form Setting

1. Set forms in advance of concrete placing to prevent placing delays. Once forms are set to correct grade, compact the grade on the inside and outside edges of the form base. Stake forms with at least three pins for each 10- foot (3.05 m) section. Pin each side of every joint. Assure form sections are tightly locked, free from play or movement in any direction. Assure the forms do not deviate from true line in excess of 1/4-inch (6.35 mm) at any point. Correct all form settlement or springing, under the finishing, machine. Clean and oil forms before placing concrete.

C. Grade and Alignment

1. Check and correct all form alignment and grade elevation immediately before placing concrete.

D. Curbs and Gutters as Forms

1. Edges of previously placed concrete gutter section may be used as a form.

3.8 HANDLING, MEASURING, AND BATCHING MATERIALS

A. Set up the batch plant site, layout, equipment, and transporting material to assure an uninterrupted supply of material to the work. Stockpile aggregates from different sources and of different gradations to prevent co-mingling.

B. Handle aggregates from stockpiles or other sources to the batching plant to prevent segregation. Aggregates that are segregated or mixed with earth or foreign material cannot be used in the work. Stockpile or bin all aggregates produced or handled by hydraulic methods and washed aggregates for at least 12 hours before batching. Rail shipment exceeding 12 hours will be accepted as adequate binning only if the car bodies permit free drainage.

C. Separately weigh the fine and coarse aggregate into hoppers in the amounts specified in the mix. Measure cement by the sack or by weight. Use separate scales and hoppers for weighing the cement, with a device that indicates the complete cement batch discharge into the batch box or container. One sack of bulk cement is 94 pounds (42.64 kg).

D. Measure all admixtures into the mixer within ± 3% accuracy.

3.9 MIXING CONCRETE

A. Mix the concrete at the work site using a central-mix plant or truck mixers.

B. Mixing time is measured from the time all materials, except water, are in the drum. Meet AASHTO M 157 and or ASTM C-94 requirements for ready-mix concrete mixing and delivery.

C. Operate the mixer at the manufacturer's recommended drum speed on the name plate. Remove and dispose of outside the work at Contractor expense, any concrete mixed less than the specified time. Do not exceed the mixer’s nominal capacity, in cubic feet, as shown on the manufacturer's standard rating plate on the mixer. An overload up to 10% above the mixer's nominal capacity may be permitted if concrete tests for strength, segregation, and uniform consistency are satisfactory, and if no concrete spill occurs.

D. Re-tempering concrete by adding water or by other means is not permitted. When concrete is delivered in transit mixers or agitators, additional water may be added to the batch materials and additional mixing time to increase the slump to meet the specified requirements, if permitted by the Engineer, providing the following conditions are met:
   1. maximum allowable water-cement ratio is not exceeded;
   2. maximum allowable slump is not exceeded;
   3. maximum allowable mixing and agitating, time (or drum revolutions) is not exceeded;
   4. concrete is remixed for at least one-half the minimum required mixing time or number of revolutions.

E. Concrete not meeting these requirements will be rejected. Obtain the Engineer's approval for admixtures that increase the workability or accelerate the set.

3.10 LIMITATIONS OF MIXING

A. Do not mix, place, or finish concrete when light conditions prevent meeting the contract requirements. Obtain the Engineer's approval of artificial lighting.

B. Discontinue concrete mix operations when the ambient temperature is 40° F (4°C) and falling. Do not resume concrete work until the ambient temperature is 35°F (2°C) and rising.

C. When concreting work is approved during cold weather, the aggregates may be heated by either steam or dry heat before being placed in the mixer. Assure the material is uniformly heated without injuring it.

D. Maintain the mixed concrete temperature between 50°F (10°C) and 90°F (32°C) during placement in the forms

E. The Engineer may direct heating the water and aggregates if the air temperature is 35°F (2°C) or less at the time of placing, concrete. Heat water and aggregate to between 70°F (21°C) and 150°F (66°C). Do not place concrete on frozen subgrade or use frozen aggregates in the concrete.

3.11 PLACING CONCRETE

A. Each placing/finishing crew must have at least one ACI Flatwork Finisher Technician level or above on site at all times.

B. Place the concrete on the grade, handling it as little as possible. Assure truck mixers, truck agitators, or non-agitating hauling equipment are capable of concrete discharge without segregating the materials. Unload the concrete into an approved spreader and spread on the grade to prevent segregation. Continuously place concrete between transverse joints without the use of intermediate bulkheads. Perform necessary hand spreading, using only shovels. Do not permit workmen to walk in freshly mixed concrete with boots or shoes coated with earth or foreign substances.

C. 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, assure that lane has attained 80% of design strength. If only finishing equipment is carried on the existing lane, paving in the adjoining lanes may be permitted.

D. Thoroughly consolidate concrete against and along the faces of all forms and along the full length and on both sides of all joint assemblies using vibrators. Do not permit vibrators to contact joint assemblies, the grade, or a side form. Do not operate vibrators more than 15 seconds in any one location.

E. Deposit concrete as close to expansion and contraction joints as possible without disturbing them. Do not dump from the discharge bucket or hopper onto a joint assembly unless the hopper is centered on the joint assembly.

F. Immediately remove any concrete spills from completed slab surfaces, using methods approved by the Engineer.

3.12 TESTING

A. Use ACI Grade I or equivalent certified field-testing technicians for all concrete tests.
   1. Furnish the concrete required for testing as per section 01400.
   2. Sample, make specimens, and test concrete under the following:

AASHTO T119 (ASTM C143)	Slump
AASHTO T152 (ASTM C231)	Air Content (Gravel or Stone)
ASTM C-173	Air Content (slag or highly porous Aggr.)
AASHTO T121 (ASTM C138)	Cement Content & Unit Weight
AASHTO T22 (ASTM C39)	Strength (Compressive)
AASHTO T97 (ASTM C78)	Strength (flexural, third point method)
AASHTO T23 (ASTM C-31)	Making and Curing Test Specimens in the Field

   3. Cure beams in the field by the method specified for the pavement.

3.13 STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT

A. Place the concrete, strike it off, consolidate, and finish it to the planned cross section and elevation.

B. When placing reinforced concrete pavement in two layers, strike-off the first layer to plan depth and place the reinforcing full length its final position without further manipulation. Place the second concrete layer, strike it off, and screed. Remove and replace any bottom layer concrete that has been in place more than 30 minutes without being covered with the top layer at Contractor expense. 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.

C. Assure reinforcing steel is free from dirt, oil, paint, grease, mill scale, and loose or thick rust.

3.14 JOINTS

A. Construct joints as specified in the contract documents.

B. Longitudinal Joint
   1. Place deformed steel tie bars of specified length, size, spacing, and material as shown on the plans. Place using approved mechanical equipment or rigidly secured by chairs or other approved supports. Assure tie bars are not painted, coated with asphalt or other material, or enclosed in tubes or sleeves. When adjacent lanes of pavement are constructed separately, use steel side forms that will form a keyway along the construction joint. Tie bars may be bent at right angles against the form of the first lane constructed and straightened into final

position before the concrete of the adjacent lane is placed, or instead of bent tie bars, approved two-piece connectors may be used.

2. Longitudinal formed joints are a groove, or cleft, extending downward from, and normal to, the pavement surface. Make these joints using an approved mechanically or manually operated device to the plan dimensions and line while the concrete is in a plastic state. Seal the groove, or cleft, with either a pre-molded strip or poured material as required.
3. Place the longitudinal sawed joints so that their ends contact with any transverse joints.
4. Cut longitudinal sawed joints using approved concrete saws to the plan depth, width, and line. Use guide lines or devices to assure cutting the longitudinal joint as shown on the plans. Saw the longitudinal joint before the cure period ends or shortly thereafter and before any equipment or vehicles are permitted on the pavement. Thoroughly clean the sawed area using both water and compressed air. Immediately remove from the joint all concrete pieces, aggregate and residue left from the sawing. Assure that the cut depth is uniform. Start sealing as soon as the joint is dry. Form longitudinal joints by placing a continuous strip of plastic or other inert material. Assure the joint insert material is strong, non-stretchable, 3 mil thick, 2-inch (50.8 mm) wide, incapable of bonding with the concrete and will form a weakened plane 2-inch (50.8 mm) minimum depth.
5. Insert the joint material using a mechanical device that places the material in a continuous strip, except where intervening structures break the continuity of paving. Splices in the joint material are permitted if they can maintain the continuity of the joint material as placed. Place the joint material so that the top of the strip is not above, nor more than 1/4-inch (6.35 mm) below, the finished concrete surface. Once placed, assure the vertical axis of the joint material is within 10 degrees of a plane normal to the pavement surface. Assure final strip alignment is parallel with the pavement center line and does not vary more than 1 inch (25.4 mm) from the edge of a 12-foot (3.7 m) straightedge. The installation device must consolidate the concrete about the joint material. Once the joint material is installed, assure the concrete is free of segregation, rock pockets or voids and the finished concrete surface on each side of the joint is in the same plane.

C. Transverse Expansion Joints

1. Place the expansion joint filler continuously from form to form, shaped to the subgrade and the keyway along the form. Furnish preformed joint filler in lengths equal to the pavement width or equal to one lane width. Use damaged or repaired joint filler only with the Engineer's approval.
2. Ensure the expansion joint filler is held vertically. Use an approved installing bar, or other device if required to secure preformed expansion joint filler at the proper grade and alignment during concrete placing and finishing. Assure finished joints do not deviate more than 1/4-inch (6.35 mm) horizontally from a straight line. If joint fillers are assembled in section, no offsets are permitted between adjacent units. No concrete plugs are permitted anywhere within the expansion space.

D. Transverse Contraction Joints

1. Transverse contraction joints are weakened planes created by forming or cutting grooves in the pavement surface and, when shown on the plans, are to include load transfer assemblies.
2. Form transverse strip contraction by installing a parting strip to be left in place.
3. Make formed grooves by depressing an approved tool or device into the plastic concrete. Leave the tool or device in place until the concrete has attained its initial set and then remove it without disturbing the adjacent concrete, unless it is designed to remain in place.
4. Make sawed construction joints by sawing grooves in the pavement surface of the dimensions and spacing and lines on the plans, using an approved concrete saw. Start sawing joints as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling. Saw all joints before uncontrolled shrinkage cracking occurs. When required, continue saw operations both during the day and night, regardless of weather conditions. Do not saw a planned joint when a volunteer crack develops at or near the planned joint location. Discontinue sawing when a crack develops ahead of the saw. Typically, saw all joints in sequence. Saw all contraction joints in lanes and adjacent to previously constructed lanes before uncontrolled cracking occurs. If conditions exist that make it impractical to prevent erratic cracking by early sawing, form the contraction joint groove before initial set of concrete as provided above.
5. When directed, rout or saw random cracks and fill with joint sealer. Thoroughly clean the sawed area using water and compressed air. Immediately remove all pieces of concrete, aggregate and residue from the joint caused by sawing. Take care to maintain uniform cut depth. Seal the joint as soon as it is dry.
6. Make sure transverse formed contraction joints comply with Section 02515 3.14 requirements for the longitudinal formed joint.
7. Construct transverse construction joints if there is an interruption exceeding 30 minutes in the concreting work. Do not construct a transverse joint within 5 feet (1.5 m) of an expansion joint, contraction joint, or weakened plane. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 5 feet (1.5 m.) long, remove and dispose of excess concrete back to the last preceding joint as directed.

3.15 LOAD TRANSFER DEVICES

A. When used, hold dowels in position parallel to the surface and centerline of the slab by a metal device that is left in the pavement.

B. Thoroughly coat, with an approved lubricant, the portion of each dowel painted with one coat of lead or tar paint, as required under Section 02515.2.1; MATERIALS. Furnish an approved metal dowel cap or sleeve meeting Section 02515.2.1; MATERIALS requirements, for each dowel bar used with the expansion joints. Assure the caps or sleeves fit the dowel bar tightly.

C. Instead of using dowel assemblies at contraction joints, dowel bars may be placed in the full pavement thickness using an approved mechanical device.

3.16 FINAL STRIKE-OFF, CONSOLIDATION, AND FINISHING

A. Sequence

1. Sequence the work as follows: strike-off, consolidate, float, and remove latency, straight-edge, and final surface finish.
2. If applying water to the surface is permitted, apply it as a fog spray using an approved spray equipment.

B. Finishing at Joints

1. Place the concrete adjacent to joints, under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement, free of voids or segregation. Mechanically vibrate concrete adjacent to joints meeting Section 02515.3.11; PLACING CONCRETE requirements.
2. Once the concrete has been placed and vibrated adjacent to the joints as required in Section 02515.3.11; PLACING CONCRETE, bring the finishing machine forward, operating it to avoid damage to or misalignment of joints. If uninterrupted operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, lift the finishing machine and set it directly on top of the joint and resume the finishing. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, lift the screed and carry it over the joint. Thereafter, the finishing machine may be run over the joint without the screeds being lifted, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

C. Machine Finishing

1. Vibrate all concrete pavement unless otherwise approved for small areas or for short periods of time due to equipment failure. Assure vibrators for full width vibration of concrete paving slabs meet Section 02515.3.5.B; VIBRATORS requirements. If concrete uniformity and density is not obtained using the vibratory method at joints, along forms, at structures, and throughout the pavement, furnish equipment and methods which will produce pavement meeting specifications.

D. Hand Finishing

1. Hand finishing is permitted under the following conditions:
    a. If mechanical equipment breaks down, hand finishing concrete already deposited on the grade when the breakdown occurs is permitted.
    b. Widths or areas of irregular dimensions where mechanical finishing equipment is impractical.
    c. As soon as concrete is placed, strike it off and screed it. Use an approved portable screed. Provide a second screed for striking off the bottom layer of concrete if reinforcement is used.
    d. Assure the screed for the surface is an approved design, sufficiently rigid to retain its shape, and constructed of metal, and at least 2 feet (.6 m) longer than the maximum width of the slab to be struck off.
    e. Obtain consolidation using a vibrator or other approved equipment.

f. Move the screed forward on the forms with a combined longitudinal and transverse motion, always moving in the direction the work is progressing and operated to ensure that neither end is raised from the side forms during the strike off process. If necessary, repeat this until the surface is uniform in texture, true to grade and cross section, and free from porous areas.

2. Floating

a. Once the concrete is struck off and consolidated, use one of the following methods as specified or approved.

b. Hand Method

1) Use a hand-operated, longitudinal float at least 12 feet (3.7 m) long and 6 inches (152.4 mm) wide, stiffened to prevent flexing and warping. Work the float in a sawing motion, operating from foot bridges resting on the side forms and spanning and not touching the concrete. Move ahead along the pavement centerline in successive sections not exceeding one-half the length of the float. Waste all excess water or soupy material over the side forms on each pass.

c. Mechanical Method

1) Obtain the Engineer's approval of the mechanical float before use. Adjust the float tracks to the required crown. Assure the float is adjusted to the transverse finishing machine to maintain a mortar wave ahead of the float at all times. Ensure the float passes over each pavement area at least twice. Waste all excess water or soupy material over the side forms on each pass.

d. Alternate Mechanical Method

1) As an alternate to item (1) above, the Contractor may use a machine having a cutting and smoothing float, or floats, suspended from and guided by a rigid frame. This frame must be carried by 4 or more visible wheels riding on, and in constant contact with, the side forms.

2) If necessary, following one of the preceding float methods, long-handled floats having blades a minimum 5 feet (1.52 m) long and 6 inches (152.4 mm) wide may be used to smooth and fill in open-textured areas in the pavement. Do not use long-handled floats to float the entire pavement surface in place of, or supplementing, one of the preceding floating methods. When strike-off and consolidation are performed by hand and the pavement crown will not permit using a longitudinal float, float the surface transversely using the long-handled float. Take care to not work the pavement crown during the work.

E. Straight Edge Testing and Surface Correction

1. Once floating is completed, excess water removed, and the concrete is still plastic, test the concrete surface for trueness with a 10-foot (3.05 m) straightedge. Furnish and use a 10-foot (3.05 m) straightedge swung from handles 3 feet (.91 m) longer than one-half the slab width. Hold the straightedge in contact with the surface in successive positions parallel to the road centerline

and the go over the whole slab area, as required. Advance along the road in not to exceed one-half the straightedge length. Immediately fill any depressions with fresh mixed concrete, strike off, consolidate, and refinish. Trim high areas and refinish. Give special attention to assure that surfaces across joints meet the smoothness requirements. Continue straightedge testing and surface corrections until the entire surface meets the required grade and cross section.

F. Final Finish

1. The final finish refers to the type of surface texture as specified in the Contract documents. The following types of surface textures may be specified: Type I - Transverse Tining, Type II - Longitudinal Tining, Type III - Nylon or Artificial Grass Drag, Type IV.- Nylon or Bristle Broom, Type V - Belt Finish, and Type VI - Burlap Drag. When final longitudinal texturing has been completed by the burlap drag, texture the plastic pavement surface to the designated texture as approved by the Engineer. A belt finish does not need to be preceded by a burlap drag.

   a. Type I - Transverse Tining

      1) Produce the mainline finish using mechanical equipment described as follows: The transverse grooving machine must be either a vibrating roller or a comb equipped with steel tines. The machine must be self-propelled and automatically lift the roller or tine comb at the pavement end. Obtain the Engineer's approval of hand grooving methods in those areas where the mechanical equipment is not practical.

      2) Assure the equipment has rectangular or circular shaped spring steel tines that are spaced 1/2- to 1-inch (12.7 - 25.4 mm) center to center. Make the grooves perpendicular to the pavement center line and the transverse grooves being 0.090 to 0. 125 inches (2.3 - 3.2 nun) wide and 1/8- to 3/16-inch (3.2 - 4.8 mm) deep. Acceleration lanes, deceleration lanes, and irregular sections may be finished by methods other than mechanical, if they produce a similar transverse groove.

   b. Type II - Longitudinal Tining

      1) Produce the mainline finish using mechanical equipment meeting the following: The longitudinal grooving machine must be either a vibrating roller or a comb equipped with steel tines, be self-propelled and automatically lift the roller or tine comb at the pavement end. Obtain the Engineer's approval of hand grooving methods in areas where mechanical equipment cannot be used.

      2) Assure the equipment has rectangular or circular shaped spring steel tines that are spaced 1/2- to 1-inch (12.7 - 25.4 mm) center to center. Make the grooves parallel to the pavement center line and the longitudinal grooves 0.090 to 0.125 inches (2.3 - 3.2 mm) wide and 1/8- to 3/16-inch (3.2 - 4.8 mm) deep. Operate the mechanical equipment from a bridge when the pavement is 4.9 m (16 feet) or more in width.

3) Acceleration lanes, deceleration lanes, and irregular sections may be finished by methods other than mechanical, if they produce a similar type of longitudinal groove.

c. Type III - Nylon or Artificial Grass Drag

1) Produce the pavement finish using a nylon or artificial grass drag, approved by the Engineer. Produce a surface by pulling the drag longitudinally. For a pavement width of 16 feet (4.9 m) or more, mount the drag on a bridge that travels on the forms. Use a drag of at least 3 feet (.91 m) wide and maintain full contact the pavements full width. Maintain drags clean and free from encrusted mortar. Replace drags that cannot be cleaned with new ones.

d. Type IV - Nylon or Bristle Broom

1) Apply broom texturing when the water sheen has disappeared. Draw the broom from the center to the edge of the pavement with adjacent strokes overlapping. Perform the brooming so that the surface corrugations are uniform in appearance and have a minimum depth of 1/16-4nch (1.6 mm) and a maximum depth of 1/8-inch (3.2 mm). Complete brooming before the concrete surface will be tom or roughened by the work. Produce a finished surface free from rough and porous areas, irregularities and depressions resulting from poor workmanship. Mechanical brooming, in lieu of the manual brooming, is permitted if the specified results can be obtained.

e. Type V - Belt Finish (Paving with Rigid Forms)

1) When straight edging is complete and the water sheen has disappeared, and just before the concrete becomes non-plastic, belt the surface with a two-ply, canvas belt a minimum 8 inches (203.2 mm) wide and a minimum 3 feet (.9 m) longer than the pavement width. Equip hand belts with handles to permit controlled, uniform manipulation. Work the belt with short strokes transverse to the road centerline advancing parallel to the centerline.

f. Type VI - Burlap Drag

1) Use a drag of seamless strip damp burlap or cotton fabric to produce a roughened surface, dragging it longitudinally along the pavement's full width. For pavement 16 feet (4.9 m) or more in width, mount the drag on a bridge that travels on the rails. Use a drag at least 3 feet (.91 m) wide, maintaining contact with the full pavement width. Maintain drags clean and free from encrusted mortar. Replace drags that cannot be cleaned with new drags.

3.17 EDGING AT FORMS AND JOINTS

A. After the final finish and before the concrete has taken its initial set, round 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

with an approved tool to the specified radius. Produce a radius having a smooth, dense mortar finish. Do not disturb the slab surface with the tool during the work.

B. At all joints, remove all tool marks on the slab adjacent to the joints by brooming the surface. Do not disturb the rounding of the slab comer when brooming the surface. Completely remove all concrete on top of the joint filler.

C. Test all joints with a straightedge before the concrete has set and correct if one side of the joint is higher than the other or if an edge is higher or lower than the adjacent slabs.

3.18 SURFACE TEST

A. As soon as the concrete has hardened to permit testing, test the pavement surface with a 10-foot (3.05 m) straightedge or other approved device. Mark and grind high spots exceeding 1/4-inch (6.35 mm.), but under 1/2-inch in 10 feet (12.7 mm in 3.05 m), using an approved grinding tool to an elevation where the area or spot will not show surface deviations exceeding 1/4-inch (6.35 mm) when tested with a 10- foot (3.05 m) straightedge. Use stacked head, vertical blade grinders that will provide a coefficient of friction approximately equal to that of the un-ground pavement. Keep grinding grooves parallel to the direction of travel. Where the departure from correct cross section exceeds 1/2-inch (12.7 mm)), remove and replace the pavement by hand at Contractor expense.

B. Any area or section so removed cannot be less than 5 feet (1.52m) long the full lane width. When required to remove and replace a section of pavement remove and replace any remaining portion of the slab adjacent to the joints that is less than 5 feet (1 .52 m) long.

3.19 CURING

A. Immediately after the finishing operations are complete and the surface cannot be marred, cover and cure the entire surface of the newly placed concrete meeting one of the following methods. Immediately stop concrete work when insufficient cover material or lack of water would prevent obtaining the specified cure results. Do not leave the concrete exposed for more than 1/2-hour between stages of curing or during the curing period.

1. Cotton or Burlap Mats
    a. Cover the entire pavement surface with mats, extending at least twice the pavement thickness beyond the slab edges. Assure that the entire surface and both edges of the slab are completely covered. Before placing mats, saturate the mats thoroughly with water. Place and weight the mats to remain in contact with the covered surface. Keep the mats wetted and in place for 72 hours after the concrete has been placed.
2. Waterproofed Paper
    a. Cover the pavement top and sides entirely with waterproofed paper. Lap the units at least 18 inches (.46 m). Place and weight the paper to maintain contact with the surface. Assure the paper extends beyond the slab edges at twice the pavement thickness. If laid longitudinally, paper not manufactured in sizes that will provide this width, must be securely

sewed or cemented together with joints being sealed so that they do not open up or separate during the cure period. Maintain the covering in place for 72 hours after the concrete has been placed. Thoroughly wet the pavement surface before placing the paper.

3. Straw Curing
   a. When using this type of curing, initially cure the pavement using burlap or cotton mats, meeting Section 02515.3.19.A.a above, until after final set of the concrete or, in any case, for 12 hours after the concrete is placed. Once the mats are removed, thoroughly wet and cover the surface and sides of the pavement with at least 8 inches (203.2 mm) (wetted thickness) of straw or hay. Repair or replace straw or hay covering displaced during the curing period and saturate with water for 3 days. Thoroughly wet the covering down the morning of the fourth day. Keep this cover in place until the concrete has attained the required strength. When permission is given to open the pavement to traffic, remove and dispose of the covering leaving the right-of-way in a neat and presentable condition. Do not dispose of the covering by burning on, or adjacent to, the pavement.
4. White Pigmented Impervious Membrane
   a. Uniformly spray the entire pavement surface 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.
   b. Do not apply the curing compound during rainfall.
   c. Apply curing compound under pressure at 1 gallon per 150 square feet (3.79 L per 13.95 square meters) using mechanical sprayers. Use spraying equipment of the fully atomizing type equipped with a tank agitator. At the time of use, assure the compound is thoroughly mixed with the pigment uniformly dispersed throughout the vehicle. During application, continuously stir the compound using mechanical means. Hand spraying of odd widths or shapes and on concrete surfaces exposed by the removal of forms is permitted. Do not apply curing compound to the inside faces of joints to be sealed.
   d. Use curing compound producing a film that will harden within 30 minutes after application. Immediately re-apply curing compound damaged from any cause within the required curing period.
   e. Upon removal of side forms, apply curing compound to the exposed slab sides.
5. White Polyethylene Sheeting
   a. Cover entirely the top surface and sides of the pavement with polyethylene sheeting. Lap the pieces at least 18 inches (35 cm). Place and weight the sheeting so it remains in contact with the surface. Lay sheeting so it extends beyond the edges of the slab at least twice the thickness of the pavement. Maintain the covering in place for 72 hours after the concrete has been placed.

B. Curing in Cold Weather

1. When the average daily temperature is below 40°F (4°C), cure by covering the pavement with at least 12 inches (304.8 mm) of loose, dry hay or straw, or equivalent protective covering authorized by the Engineer. Leave covering in place for 10 days.
2. When concrete is placed and the air temperature could drop below 35°F (2°C), provide the volume of straw, hay, grass, or other blanketing material at the work site. Anytime the temperature may be expected to reach the freezing point during the day or night, spread the material over the pavement to the required depth to prevent freezing of the concrete. Maintain the covering for a minimum 10 days. Be responsible for the quality and strength of the concrete placed during cold weather and remove and replace at Contractor expense any concrete injured by freezing.

3.20 REMOVING FORMS

A. Remove forms only after the freshly place concrete has set for 12 hours, excluding auxiliary forms used temporarily in widened areas. Carefully remove forms to prevent damage to the pavement. Once the forms are removed, cure the slab sides as specified herein. Remove and replace major honeycombed areas. The minimum area to be removed is 10 feet in length (3.05 m), the full width of the lane involved. When it is necessary to remove and replace a pavement section, any remaining portion of the slab, adjacent to the joints, less than 5 feet (1.52 m) in length is to be removed and replaced.

3.21 SEALING JOINTS

A. If the joints are to be sealed, fill them with joint sealing material before the pavement is opened to traffic and as soon as practical after completion of the curing period. Just before sealing, thoroughly clean each joint of all foreign material, including membrane curing compound, assuring the joint faces are clean and surface dry when the seal is applied. Stir material for hot applied seal during heating

B. Apply the sealing material to each joint opening meeting the plan details or as directed by the Engineer. Pour so that the material does not spill on the exposed concrete surfaces. Remove and clean from concrete surfaces all excess sealing material. The use of sand or similar material as a cover for the seal is not permitted. Do not place poured joint sealing material when the ambient temperature is less than 50°F (10°C), unless approved by the Engineer.

3.22 PROTECTION OF PAVEMENT

A. Protect the pavement and its appurtenances against both public and Contractor traffic. This includes supplying personnel to direct traffic and the erection and maintenance of warning signs and lights.

B. To protect the concrete against rain before the concrete is sufficiently hardened, have available at all times materials for the protection of the edges and surface of the unhardened concrete. Protective materials consist of standard metal forms or wood plank

having a minimum nominal thickness of 2 inches (50.8 mm) and a minimum nominal width of the pavement thickness 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. Stop paving when rain appears imminent and have all available personnel begin placing forms against the side of the pavement and cover the surface of the unhardened concrete with the protective covering.

C. Repair or replace all damage to the pavement occurring before final acceptance at Contractor expense.

3.23 OPENING TO TRAFFIC

A. Obtain the Engineer's approval to open the pavement to traffic. Pavement cannot be opened to traffic until specimen beams, meeting 3.12; TESTING, have reached the design flexural strength, tested under the third-point method according to Section 3.12; TESTING. If the tests are not performed, the pavement may be opened at the discretion of the Engineer. Clean the pavement before opening to traffic.

3.24 CONCRETE PAVEMENT - SLIPFORM METHOD

A. Pavement may be constructed without using fixed forms. When the slipform method is used, meet the following provisions:

1. Grade
    a. Once the grade or base is placed and compacted to the specified density, cut the grade and areas that will support the paving machine to the required elevation using an approved fine-grading machine. Use a self-propelled or towed fine-grading machine having the weight and power to trim the compacted material without gouging or tearing the surface. Assure the machine is equipped with cutting edges or surface shavers controlled from an independent control reference wire having an automatic control device. To avoid excessive depths of cut, the machine is to fine grade making successive passes, with each pass controlled from the independent reference line through the automatic control. Re-compact to the specified density, all base disturbed by the grading operation, before placing concrete. Maintain the grading operations in advance of concrete placement. Repair damage to the grade caused by traffic before placing the concrete.
2. Placing Concrete
    a. Place concrete using an approved, slipform paver able to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass to the specified line, grade, and cross section with a minimum of hand finishing. Assure the machine is equipped with vibrators, vibrating the concrete the pavements full width and depth. Vibrators must be vibrating tubes or arms working in the concrete, or a vibrating screed or pan operating on the concrete surface. Assure the sliding forms are capable of resisting displacement by the wet concrete.

Use forms that trail behind the paver and prevent slumping of the concrete during the work.

b. Assure the concrete does not exceed a slump of 2 inches (50.8 mm). Operate the slipform paver at a uniform speed. Coordinate all concrete mixing, delivering, and spreading to maintain uniform progress with minimum stopping and starting of the paving work. Immediately stop vibratory and tamping when it is necessary to stop the paver. Do not apply any outside tractive force to the paver not controlled by it.

3. Finishing
   a. Meet the surface smoothness and texture requirements of Section 02515.3.16.F; FINAL FINISH, and Section 02515.3.18; SURFACE TEST.
4. Curing
   a. Perform curing using one of the methods in Section 02515.3.19; CURING.
5. Joints
   a. Construct all joints under Section 02515.3.14; JOINTS.

3.25 TOLERANCE IN PAVEMENT THICKNESS

A. The pavement thickness will be determined by measuring cores. The actual pavement thickness must be within 1/4-inch (6.35 mm) of the specified thickness.

B. When any core is less than the plan thickness by more than the allowable deviation, additional cores will be taken from the area at minimum 10-foot (3-05 m) 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 the allowable deviation. The Engineer will evaluate areas found deficient in thickness by more than the allowable deviation. Remove and replace deficient areas to the specified thickness at Contractor expense.

END OF SECTION

SECTION 02528

CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is constructing combined curb and gutter using structural concrete and meeting the lines, dimensions, and grades shown on the plans and these specifications.

1.2 REFERENCES

AASHTO M 213	Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M 148	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

PART 2 - PRODUCTS

2.1 STRUCTURAL CONCRETE

A. Furnish structural concrete meeting the requirements of Section 03310, STRUCTURAL CONCRETE.

2.2 REINFORCING STEEL

A. Furnish reinforcing steel meeting the requirements of Section 03210, REINFORCING STEEL.

2.3 PRE-FORMED EXPANSION JOINT MATERIAL

A. Furnish pre-formed expansion joint material meeting the requirements of AASHTO M213.

2.4 GRAVEL BASE MATERIAL

A. Furnish gravel base meeting all applicable portions of Section 02235, CRUSHED BASE COURSE, and meeting gradation requirements for 1" minus material.

2.5 CURING AND PROTECTIVE COATING MATERIALS

A. Liquid Membrane-Forming Compounds for Curing Concrete
   1. Furnish liquid membrane-forming compound meeting the requirements of AASHTO M148, Type 1, clear or translucent.
   2. Apply liquid membrane forming compound between April 15 and August 14 of each year unless daily temperatures outside of that date range are between 40 and 90 degrees Fahrenheit.

B. Emulsified Linseed Oil Compound
   1. Assure it meets all requirements of AASHTO M148 and contains at least 2.7 pounds (0.32kg) of linseed oil per gallon (liter). Furnish a manufacturer's certification showing that the formulated weight of linseed oil per gallon equals or exceeds this limit.
   2. Apply water-soluble or emulsified linseed oil compound between August 15 and April 14 of each year.

PART 3 - EXECUTION

3.1 GENERAL

A. Concrete curb and gutter may be machine-laid or hand-formed. Perform work meeting these requirements and the applicable requirements of Section 03310, STRUCTURAL CONCRETE.

3.2 FOUNDATION PREPARATION

A. Excavate the foundation to the specified depth. Assure the subgrade or base course for the concrete has a firm and even surface and is compacted meeting Section 02230, STREET EXCAVATION, BACKFILL, AND COMPACTION.

B. Complete excavation to the lines shown in the contract documents or as specified by the Engineer.

C. Place at least 6 inches (7.5 cm) of gravel base material and compact it to 95% of ASTM D-698. This requirement is waived if curb and gutter is installed on a portion of street base course material of 3 inches (7-5 cm) or more in thickness.

D. For new street construction or street reconstructing, place gravel base course for the street 9 inches beyond back of the curb.

3.3 FORMS

A. Use metal forms unless otherwise approved of the depth equal to the face of the item being constructed. Obtain Engineer approval of in-place forms before placing concrete.

B. Assure forms produce the shape, lines, and dimensions shown on the plans and/or drawings. Assure forms prevent leakage of mortar and maintain position and alignment. Thoroughly clean and oil before placing and do not remove forms until the concrete has hardened sufficiently to prevent damage.

C. Where the curb and gutter is to abut an existing sidewalk, use an approved face-of-gutter form secured to maintain an established gutter grade. Vary the curb height to assure the top of curb matches as nearly as possible the standard curb and gutter cross section. Obtain Engineer approval to hand form lengths not exceeding 10 feet (3m).

D. Form radii using flexible or curved metal forms set to fit the specified curvature. Obtain Engineer approval before using wood forms. Radii may be formed by using segments of straight forms if the length of the straight segment does not exceed 1/10th of the length of the radius.

3.4 REINFORCEMENT

A. Place reinforcement as required. Place and hold in position before placing concrete.

3.5 PLACING CONCRETE

A. Place and compact the subgrade to the specified grade before placing concrete. Dampen the subgrade just before placing the concrete. Spade and tamp the concrete thoroughly into the forms to provide a dense, compacted concrete free of rock pockets. Float, finish, and broom the exposed surfaces. Each placing/finishing crew shall have at least one ACI Flatwork Finishing Technician level or above, on site at all times.

B. Do not place concrete at a rate that exceeds the finishing operation's ability to meet these specifications.

C. Machines or equipment that extrude curb and gutter may be used when approved, provided they produce a finished product matching that obtained by the set-form method. Use slip-form machines that are automatically controlled for longitudinal grade, alignment, and transverse slope by sensing devices operating from string lines set from construction stakes placed by the Engineer or a stringless slip-form machine operating from an integrated machine control model.

3.6 STRIPPING FORMS AND FINISHING

A. Forms

1. Remove forms when the concrete is sufficiently set to prevent chipping or spalling. When forms are removed before the curing period has expired, protect the concrete edges with moist earth or spray edges with curing compound. Clean, oil, and examine all forms for defects before they are used again.

B. Finishing

1. Finish the surface of concrete curbs and gutters true to the lines and grades shown on the plans. Work concrete until the coarse aggregate is forced down into the body of the concrete and no coarse aggregate is exposed.
2. Fill honeycomb or other blemishes in formed surfaces with grout to the specified finish. Tool all edges to a ¼-inch (6.4 mm) radius. Float the surface using a magnesium float to a smooth and uniform surface. When the concrete in the curb and gutter has hardened sufficiently, give the surface a broom finish. Obtain Engineer approval of the broom before use. Broom the surface without tearing the concrete. Broom to produce regular corrugations not exceeding 1/8-inch (3.2 mm) deep.
3. After finishing and brooming, stamp and mark into the concrete to mark sewer and/or water service lines if required by the owner

C. Crew

1. Do not apply additional surface water. The Engineer may permit adding water, but it must be applied by fog spray only. Use of an evaporation retardant, Confilm, or equal, following the manufacturer's directions is permitted.

3.7 CURING

A. Curing meeting Section 03310, STRUCTURAL CONCRETE, requirements.

3.8 JOINTS

A. Place curb and gutter monolithically with no construction joints permitted, except at planned expansion joints.

B. Construct expansion joints at construction joints, junctions with existing concrete, and opposite to or at expansion joints in adjacent concrete, and at maximum 300-foot intervals in a continuous run of concrete being placed. Form expansion joints using ½-inch (12.7 mm) thick, pre-formed expansion joint filler, as specified in Section 02528.2.3.

C. Form or cut contraction joints 1/8-inch (3.2 mm) wide to one-fourth the depth of the concrete being placed. Construct the joints to coincide with the joints in adjacent concrete or in uniform sections 10 feet (3 m) in length. Where required to make a closure, sections less than 10 feet (3 m) in length will be permitted with the minimum length being 4 feet (1.2 m). When contraction joints are made by approved forming or grooving before the concrete has set, tool the edges to the approved radius.

3.9 CURB BACKFILL

A. Complete the curb backfill to 4 inches (10 cm) below the top of curb before final grading of the subgrade and placing the street section base course.

B. Backfill using impervious dirt up to 4 inches (10 cm) below top of curb. Do not use sand or gravel backfill in this area.

C. In areas of existing lawns, use black loam or approved topsoil for the top 4 inches (10 cm) of backfill. Place it out from the curb and in the amount required to replace the turf or lawn removed during installation. Place the backfill to a point level with the top of the curb, immediately adjacent to the curb, and grade and blend to match the existing undisturbed lawn area.

D. Where lawns do not exist, place the top 4 inches (10 cm) of backfill using impervious dirt and conforming to the typical sections shown on the plans.

E. Compact backfill to prevent settlement and level the surface to be free draining. Complete all backfill within 3 days of adequate curing.

3.10 PRIME AND SEAL COAT PREPARATION

A. Paint the edge of the gutter adjacent to the asphalt surfacing with an asphalt prime coat before placing the pavement surface course. When an asphalt seal coat is specified, apply the oil and cover aggregate 3 inches (7.6 cm) on to the gutter to provide a good seal on the joint between the concrete and pavement.

3.11 TOLERANCES

A. Perform the work to produce a curb and gutter meeting the specified line and grade uniform in appearance and structurally sound. Remove and replace at contractor expense curb and gutter having unsightly bulges, ridges, and/or low spots in the gutter, or other defects as directed. Grade cannot deviate more than 1/8-inch (3.2 mm), and alignment not vary more than ¼-inch (6.4 cm) from plan elevation, grade, or alignment. Tolerances may be checked using survey instruments, straight edges, or water puddling. Puddled water cannot exceed ¼- inch (6.4 mm) in depth.

END OF SECTION

SECTION 02529

CONCRETE SIDEWALKS AND MISCELLANEOUS CONCRETE CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is the construction of concrete sidewalk.

1.2 REFERENCES

AASHTO M 213	Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M 148	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

PART 2 - PRODUCTS

2.1 STRUCTURAL CONCRETE

A. Furnish structural concrete meeting the requirements of Section 03310, STRUCTURAL CONCRETE.

2.2 REINFORCING STEEL

A. Furnish reinforcing steel meeting the requirements of Section 03210, REINFORCING STEEL.

2.3 PRE-FORMED EXPANSION JOINT FILLER MATERIAL

A. Furnish joint material meeting the requirements of AASHTO M213.

2.4 GRAVEL BASE MATERIAL

A. Furnish crushed base material meeting applicable requirements of Section 02235, CRUSHED BASE COURSE, and meeting the gradation requirements for 1.5 inch minus material.

2.5 CURING AND PROTECTIVE COATING MATERIALS

A. Liquid Membrane-Forming Compounds for Curing Concrete
   1. Use liquid membrane-forming compounds meeting the requirements of AASHTO M148, Type 1, clear or translucent. Apply the compound between April 15 and August 14 unless daily temperatures outside of that date range are between 40 and 90 degrees Fahrenheit (4-32° C).

B. Emulsified Linseed Oil Compound
   1. Apply water-soluble or emulsified linseed oil compound between August 15 and April 14 as a protective coat. Assure it meets all requirements of AASHTO M148 and contains at least 2.7 pounds of linseed oil per gallon. Furnish a manufacturer's certification showing that the formulated weight of linseed oil per gallon equals or exceeds this limit.

PART 3 - EXECUTION

3.1 GENERAL

A. Construct sidewalks, at the locations shown on the plans, meeting these specifications and the applicable portions of Section 03310, STRUCTURAL CONCRETE.

B. The use of slip form machines is prohibited for items in this section.

C. During periods of cold weather, Contractor must submit to the Contracting Officer a cold weather concreting plan applicable to Section 03310 for approval.

3.2 FOUNDATION PREPARATION

A. Excavate to the specified depth. Assure the concrete subgrade has a firm and even surface and is compacted as specified in Section 02230: Street Excavation, Backfill, and Compaction.

B. Place and compact at least 6 inches of gravel base material compacted to 95% of ASTM D-698

C. Do not remove sidewalks, private driveways, or conduct foundation preparation activities more than 4 days prior to the planned concrete pour.

3.3 FORMS

A. Furnish forms to produce the shape, lines, and dimensions shown on the plans and/or drawings. Assure forms prevent leakage of mortar and are maintained in proper position and accurate alignment. Thoroughly clean and oil forms with an approved form oil before placing concrete and remove forms only after the concrete has hardened sufficiently to support all loads without damage.

B. Form radii using flexible or curved forms set to the required curvature. Radii may be formed by using segments of straight forms if the length of the straight segment does not exceed one-tenth of the length of theradius.

C. Use forms and pre-formed expansion joint filler material for same depth as concrete.

3.4 PLACING CONCRETE

A. Assure the subgrade is compacted and brought to specified grade before placing concrete. Dampen the subgrade immediately before placing the concrete. Spade and tamp the concrete into the forms providing a dense, compacted concrete free of rock pockets. Float, finish and broom the exposed surfaces. Finish the concrete to match the finish of the adjacent sidewalk. Each placing/finishing crew shall have at least one ACI Flatwork Finisher Technician level or above, on site at all times.

B. Assure the rate of concrete placement does not exceed the rate at which the various placing and finishing operations can be performed in accordance with these specifications.

3.5 STRIPPING FORMS AND FINISHING

A. Forms

1. Remove forms when the concrete is sufficiently set to prevent chipping or spalling. When forms are removed before the curing period has expired, spray edges with curing compound. Clean, oil, and examine all forms for defects before they are used again.

B. Finishing

1. Finish the concrete surface true to lines and grades shown on the drawings. Work concrete until the coarse aggregate is forced down into the body of the concrete and no coarse aggregate is exposed. Float the concrete surface using a magnesium float to a smooth and uniform surface. Plastering of the surface is prohibited. Edge all outside edges of the slab and all joints using a ¼ inch radius edging tool.

2. Immediately after the forms have been removed, remove all form bolts and tie wires to a depth of at least ½ inch below the surface of the concrete. Clean and fill all holes and depressions caused by the removal or setting back of form bolts or tie wires with Portland Cement mortar composed of 1 part cement by volume and 2 parts sand. Chip out, clean and fill all rock pockets, honeycombs, and air pockets with mortar. If, in the judgment of the Contracting Officer's Representative, rock pockets are of such an extent or character as to materially affect the strength of the structure, they may declare the concrete defective and order the complete removal and replacement of that portion of the structure so affected.

3. Carefully make all mortar patches using a very dry mortar tamped firmly in the void. Keep the patches wet for a period of 3 days after which it will be inspected for shrinkage cracks. Excessive cracking will require complete removal and replacement of the patch.

4. Screed, float and light broom finish sidewalks and membrane cure. After concrete has hardened sufficiently, give the surface a broom finish to match the adjacent sidewalk.

5. Do not apply additional surface water. The Contracting Officer's Representative may permit adding water, but it must be applied by fog spray only. Use of a film forming evaporation retardant, following the manufacturer's directions, is permitted.

3.6 CURING

A. Cure meeting Section 03310, STRUCTURAL CONCRETE requirements.

3.7 JOINTS

A. Extend isolation joints the full depth of the concrete and fill using3/8-inch thick, pre-formed expansion joint filler material as specified in Section 02529.3.3. Place isolation joints meeting this requirement where new concrete abuts existing concrete. Form isolation joints around all appurtenances, such as manholes, utility poles, etc. extending into and through the concrete.

B. Install pre-formed joint filler between concrete and any fixed structure, such as a building or bridge. Assure all expansion joint materials extend the full depth of the concrete. Place isolation joints at radius points, junctions with existing concrete, and opposite to or at expansion joints in adjacent concrete.

C. Divide sidewalk into sections using contraction joints formed by a jointing tool or other approved methods. Extend the contraction joints into the concrete for at least 25% of its depth and be approximately 1/8-inch wide. Unless otherwise directed, space contraction joints at maximum 5-foot intervals or at a distance equal to the sidewalk width, whichever is less.

3.8 BACKFILL

A. In areas adjacent to existing lawns, backfill the top 4 inches using black loam or good topsoil suitable for lawn growth. Place it out from the sidewalk or driveway to replace turf or lawn removed during installation. Place the backfill to a level to accommodate sod installation, immediately adjacent to the curb, graded and blended to match the existing undisturbed lawn area.

B. Where lawns do not exist, backfill the top 4 inches with dirt and place to meet the typical sections shown on the plans.

C. Compact backfill to prevent settlement and level the surface to a neat appearing and free draining surface within 4 days after concrete is placed. Where required by the contract, topsoil shall be placed to the lines and grades of the work. The addition of topsoil and sod and all finish grading work shall be completed and ready for inspection within 6 days of concrete placement.

3.9 TOLERANCES

A. Assure all items of construction covered by this section present clean, uniform surfaces and lines free of irregularities and distortions. Plane surfaces and vertical tangent lines are tested with a 10-foot straightedge and cannot deviate more than ¼-inch from the straightedge.

3.10 MISCELLANEOUS NEW CONCRETE CONSTRUCTION

A. Construct miscellaneous concrete in accordance with detail drawings, or as directed by the Contracting Officer's Representative.

B. New concrete construction required to maintain or restore existing structures will be considered incidental to the cost of pipe installation and no additional payments made.

END OF SECTION

SECTION 02660

WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all water main pipe and fittings meeting the Contract documents or specified as follows.

B. Furnish and install valves and fire hydrants for water mains, together with related appurtenances.

C. Construct water services, including water service piping, tapping mains, corporation stops, curb stops and related items.

1.2 CERTIFICATION BY MANUFACTURER

A. Furnish a manufacturer's certification covering all pipe and fittings furnished, certifying that the pipe and fittings meet applicable specifications.

1.3 REFERENCES

ANSI B16.1	Tapping Sleeves
ASTM B88-62	Copper Pipe
ASTM PE3406-3408	Polyethylene Pressure Pipe
AWWA B300	Hypochlorite for Disinfecting
AWWA B301	Liquid Chlorine for Disinfecting
AWWA C104	Ductile Iron Cement-Mortar Lining
AWWA C110	Ductile Iron Fittings
AWWA C111	Ductile Iron Joints
AWWA C151	Ductile Iron Pipe
AWWA C153	Ductile Iron Compact Fittings
AWWA C301	Concrete Cylinder Pipe
AWWA C500	Gate Valves
AWWA C502	Fire Hydrants
AWWA C504	Butterfly Valves
AWWA C509	Gate Valves
AWWA C651	Disinfecting Water Mains
AWWA C900	PVC Water Main Pipe

ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Services
AWWA C600	Installation of Ductile-Iron Water Main and Their Appurtenances
ISO 8179	Ductile Iron Pipes – External Zinc-based Coating

1.4 STANDARD DRAWINGS

1. N/A - see plans for detailed drawings

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish water main pipe and fittings as specified in the Contract Documents and meeting the material and testing requirements of this section. Furnish fittings and service line piping of the same material and design as the water main pipe unless specified otherwise. Pipe strength classifications are shown on plan drawings and/or are listed in the Contract Documents.

B. References made to ASTM, ANSI, AWWA, USASI or AASHTO designations are the latest revision at the time of call for bids.

C. Assure all water main pipe, service line pipe, fittings, and appurtenances do not contain more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces.

D. Assure all water main pipe, fittings, valves, fire hydrants, and appurtenances conform to the latest standards issued by the AWWA and ANSI/NSF, where such standards exist.

2.2 PIPE MATERIALS

A. General

1. Furnish the pipe specified in the contract documents meeting the materials and testing requirements as outlined in this section.

2. Assure all pipe is clearly marked showing type, class and/or thickness. Lettering must be legible and permanent under normal handling and storage conditions.

B. Ductile Iron Pipe

1. Furnish meeting AWWA C151, American National Standard for Ductile Iron Pipe for Water.
   a. 3 inches to 12 inches Pressure Class 350
   b. 14 inches to 20 inches Pressure Class 250
   c. 24 inches Pressure Class 200
   d. 30 inches to 64 inches Pressure Class 150

2. Assure the pipe interior is cement mortar lined meeting AWWA C104 requirements. Assure the outside pipe surface for underground service is bituminous coal tar base coated 1 mil thick.
3. Fittings
   a. Furnish fittings meeting one of the following;
      1) Class 250 fittings meeting AWWA C110, latest edition, Gray-Iron and Ductile Iron Fittings For Water And Other Liquids
      2) Compact fittings meeting AWWA C153.
4. Joints
   a. Assure joints are mechanical or push-on joints meeting AWWA C111. Assure the fitting interior is cement mortar lined meeting AWWA C104. Assure the fitting exterior is bituminous tar coated 1 mil thick. All gaskets to be petroleum resistant nitrile. Use compact fittings having a rated working pressure of 350 psi (2410 kPa) following manufacturer recommended laying lengths.
   b. Restrained joint systems and mechanical restrained joint fittings shall be installed where specifically indicated in the drawings. Restrained joints may also be allowed in applications not specifically identified in the drawings in lieu of concrete thrust blocks with Engineer approval.
      1) Restrained joints shall be Flex-Ring or Lok-Ring as manufactured by AMERICAN Ductile Iron Pipe, TR Flex as manufactured by U.S. Pipe, or approved equal.
      2) Restrained joints may also be internally restrained joint systems utilizing restraining gaskets as manufactured by US Pipe (Field Lok 350 Gaskets), American Pipe (Fast-Grip Gaskets), or an approved equivalent.

3) Provide mechanical restrained joint fitting constructed of ductile iron and conforming to the material and performance requirements of AWWA C153. Assure all mechanical restrained joint fittings have seals conforming to ASTM F477 and the physical testing requirements of AWWA C111. Provide mechanical restrained joint fittings coated with fusion bonded epoxy coatings meeting the requirements of AWWA C116. Install all restrained joints in full conformance with manufacturer's recommendation, and assure the assembly of fitting joints does require beveling of the plain end of a cut pipe or the use of jacks or power equipment to force the pipe end past the gasket. Furnish mechanically restrained joint fittings as manufactured by One Bolt, Inc. (OneBolt), EBAA Iron, Inc. (Mega-Lug mechanical joint restraint), or an approved equivalent.

5. Couplings

a. Use pipe couplings meeting one of the following:

1) Cast type with cast iron or ductile iron sleeves and malleable or ductile iron flanges.

2) Gray iron or ductile iron, mechanical joint solid sleeves, with a minimum 12 inch length (30 cm).

3) Limit use of the first type to a maximum 16 inch (40 cm) diameter. Use the manufacturer's standard gasket for use in potable water systems. Use stainless steel bolts and nuts. Coating to be "manufacturer's standard".

b. Field verify material type and size to ensure that couplings will be sized for appropriate material and size.

c. Furnish type (1) above coupling as manufactured by Romac Industries, Dresser Piping Specialties, or an approved equivalent.

C. Polyvinyl Chloride (PVC) Pressure Pipe

1. Furnish PVC water main pipe meeting AWWA C900 requirements, made to ductile iron O.D.'s for "Push-On" joints. Assure pipe joints are bell and spigot having an elastomeric gasket. Use DR 25 Class 165 pipe.

CI. Water Service Pipe

1. Use polyethylene pipe in water service line construction as specified in the contract documents and meeting the following specifications.

a. Furnish service pipe of the size or sizes specified. If not specified, match the size of existing service lines being connected to or replaced. Service lines are considered 2-inch (50 mm) size and under. Service lines over 2 inch (50 mm) size are considered as water mains and are specified under the applicable sections.

b. Furnish and install the service pipe from the main to the property line installing a curb stop and curb box at the property line. Meet the water service installation requirements of the detail drawing on the plans

c. Polyethylene Service Pipe

1) Use pipe meeting AWWA Specification C901, "Polyethylene (PE) Pressure Pipe, Tubing and Fittings, 1/2 inch through 3 inch for Water" and ASTM PE3406-3408. PE pipe to be pressure tubing meeting Table 6 requirements of said specification. Use class 200 with a DR of 7 Polyethylene pipe.

2) For all polyethylene service pipe, assure corporation stops, curb stops, couplings, and all other fittings have pressure connections designed specifically for polyethylene pipe as manufactured by Mueller (Insta-Tite Connection Series) or an approved equivalent.

2.3 TAPPING SLEEVES AND VALVES

A. Use tapping sleeves meeting either:

1. Gray iron or ductile iron, split-sleeve, mechanical joint type with end and side gaskets,

2. Split-body type with circular gasket forming a seal around the circumference of the outlet.

3. Assure both types have a class 125, ANSI B16.1 outlet flange, are rated for a minimum 150 psi (1030 kPa) working pressure and contain a threaded test plug on the neck or body of the tapping sleeve. Assure gaskets are manufacturer's standard for use in potable water systems. Use stainless steel bolts and nuts. Assure mechanical joint type is fusion- bonded, 12-mil thickness, and epoxy coated. Limit the use of mechanical joint type to metal pipe. Assure tapping valves meet the applicable requirements for gate valves, as outlined in this section, with flanged inlets compatible with the flange of the tapping sleeve and mechanical joint outlet.

B. Furnish sleeve (1) above as manufactured by Mueller, Rockwell, Dresser, or an approved equivalent. Provide thrust blocking behind tee flow-through sized per thrust block detail in the drawings. Furnish type (2) above as manufactured by Smith-Blair (Model 622), Ford (FTS), or an approved equivalent.

2.4 CORPORATION STOPS

A. Furnish brass corporation stops with inlet end to meet tapping requirements and outlet with compression coupling for copper tubing or pressure coupling for polyethylene tubing.

2.5 SERVICE CLAMPS

A. Provide service clamps, where required, that are flat, double strap, ductile iron bodied and that have a nylon coating and standard AWWA corporation stop threads. Assure service clamps meet all applicable parts of AWWA C800.

B. Assure service clamps for PVC pipe provide full support around the pipe circumference with a bearing area of sufficient width along the pipe axis, 2 inch (50 mm) minimum, to insure the pipe will not be distorted when the saddle is tightened. Service clamps for PVC pipe, where required, shall be stainless steel full circumference bands with corporation stop threads.

2.6 CURB STOPS

A. Furnish curb stops meeting AWWA C800 with bronze plug, tee head key with Minneapolis pattern, and screw box mount. Assure inlet and outlet connections are compression connections.

B. Furnish compression connections as manufactured by Ford (C22-Q Series 'Quick Joint' connection), Mueller (B-25155), or an approved equivalent.

C. Contractor is advised that existing service lines may be copper piping, galvanized iron piping, or other pipe material, and that the existing pipe material will have to be field verified. Where the outlet of the curb stop is connected to existing galvanized piping, provide either curb stops with an outlet connection for IPS or adapters to compression connections for the galvanized pipe. Have extra materials readily available to avoid delays as no time extensions or extra compensation will be allowed for connections to non-standard service lines, regardless of material.

2.7 CURB BOXES

A. Provide extension type curb boxes having at least a 6.5 foot (1.98 m) extended length and a range between the extended length and retracted length that allows for the curb box to be installed absolutely flush with the sidewalk or finished grade.

B. Furnish curb boxes as manufactured by Ford (EM2-xx-56 or EM2-xx-57 Series), Mueller (H-10300 Series or H-10380 Series), A.Y. McDonald (5614 or 5615), or an approved equivalent.

2.8 VALVES

A. Gate Valves

1. Unless designated otherwise, valves 12 inches (30 cm) in diameter or smaller will be gate valves. Furnish iron body gate valves or resilient seat gate valves with non-rising stems with design, construction, and pressure rating meeting AWWA C509 and the following requirements.

2. Assure stem seals are double "O" ring seals capable of replacing the seal above the stem collar with the valve under pressure in full open position.

3. Furnish gate valves for underground installation equipped with a 2-inch (31 mm) square operating nut for key operation. All valves to open counterclockwise. Valves to be equipped with push-on joints or mechanical joints for pipe connections.

4. Furnish resilient seat gate valves as manufactured by Mueller, Clow, American Darling, or an approved equivalent.

B. Butterfly Valves

1. Unless designated otherwise, all valves larger than a 12-inch (30 cm) diameter will be butterfly valves. Furnish Class 150, rubber seated, butterfly valves for water distribution systems meeting AWWA C504 requirements. Valves are to be equipped with push-on ends and lubricated screw type operators designed for underground service.

2. Rubber valve seats to be replaceable without disassembling the valve and not interrupted by the shafting. Rubber seats may be retained on the disc edge by stainless steel clamping instead of bonding to the valve body. Assure shaft packing is the self-adjusting, permanent type.

3. Assure underground service operators are permanently lubricated, screw type, totally enclosed and watertight constructed. Assure overload protection is incorporated in the operator allowing 450-foot pounds (610 J) input torque at full-open and full-closed positions without damaging the operator or valve. Install valves with the operating mechanism oriented on either the south or west side of the pipeline.

4. Provide a 2 inch (50 mm) square operating nut and valve box for operating the valve. Valves to open counter clockwise. Furnish bonnet and gland bolts and nuts either fabricated from low-alloy steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM A153 is not acceptable.

5. Evenly coat all exterior ferrous surfaces, except the flange faces, with black asphalt varnish in accordance with Section 5.3 of AWWA C509, or epoxy in accordance with AWWA C550. Evenly coat with epoxy all wetted ferrous surfaces in accordance with AWWA C550. Apply epoxy coating to a minimum uniform 4 mil thickness.

6. Furnish performance certification, leakage and hydrostatic tests as specified in AWWA C504. Assure valve manufacturer has at least 5 years experience manufacturing waterworks and distribution valves.

7. Furnish butterfly valves as manufactured by Dresser Industries (450 Valve), Allis-Chalmer (Streamseal), Henry Pratt (Groundhog), or an approved equivalent.

2.9 VALVE BOXES

A. Furnish cast iron valve boxes, 5 1/4-inch (13 cm) diameter, adjustable valve boxes with the required base for the valve size used. Assure valve boxes are screw type and of the specified length for the pipe bury. Assure the valve box cast iron cover has an arrow indicating the opening direction and stamped with the word "Water".

2.10 FIRE HYDRANTS

A. Furnish fire hydrants meeting AWWA C502; "Standard Specifications for Fire Hydrants for Ordinary Water Works Service", and the Contract requirements.

B. Furnish hydrants with 5.25-inch (13 cm) valve openings, 6-inch (15 cm) mechanical joint, flanged or push-on inlet, one pumper connection and two, 2.5-inch (63 cm) hose connections. Assure hose nozzle threads meet ASA Specification B26 for National Standard Fire Hose Coupling Screw Threads, 7.5 threads per inch. Assure pumper nozzle size and threads match owners existing pattern. Furnish National Standard operating nut. Furnish hydrants opening counter clockwise and having an arrow on the hydrant top designating the opening direction.

C. Furnish "Compression" type hydrants with safety flange and safety stem coupling above the ground line permitting repair without shutting off the water. Assure hydrants are of the dry top design with two or more "O" rings sealing the water from the operating mechanism. Assure the operating mechanism is automatically lubricated from a sealed, self-contained lubricating reservoir.

D. Paint the hydrant portion above the ground line meeting the owner's standards. Furnish hydrants for 6.5 foot (2 meters) bury.

2.11 SPECIAL FITTINGS

A. Furnish special fittings meeting the Contract Documents. The Engineer will specify gasket materials for contaminated soil or special groundwater situations.

2.12 POLYETHYLENE ENCASEMENT

A. Furnish polyethylene encasement or V-Bio® enhanced polyethylene encasement in accordance with AWWA C105, "Polyethylene Encasement for Ductile Iron Pipe Systems".

B. Optional for corrosion protection in corrosive soils - Polyethylene encasement for use with ductile iron pipe shall be V-Bio® enhanced polyethylene encasement as manufactured by Balcan Plastics Limited/First Film Extruding or Crayex Corporation.

2.13 WATER MAIN INSULATION

A. Furnish extruded polystyrene rigid foam insulation conforming to ASTM C578, Type IV, with a minimum thermal resistance (R value) of 5.0 per 1 inch of thickness at 75º Fahrenheit mean temperature. Water absorption for the insulation shall not exceed 0.10 by volume as measured by ASTM C272.

B. Materials shall be delivered in their original unopened units, stored off the ground, protected from direct sunlight with a light-colored opaque polyethylene film and ventilated to prevent excessive temperature. Damaged or deteriorated materials shall be removed from the premises.

C. Furnish extruded polystyrene rigid foam insulation as manufactured by Owens-Corning (Foamular 250), or an approved equivalent.

2.14 FLUSHING HYDRANTS

A. Furnish hidden type flushing hydrants with a dry barrel design and a 2.5 inch (63 cm) hose connection with National Standard hose threads for 6.5-foot (2 m) minimum bury.

B. Furnish flushing hydrants complete with shut-off valves with a closed-bottom body, tee head key, and an integral drain to allow hydrant post to drain after use to prevent freeze damage.

C. Furnish a meter box with a minimum width of 18 inches (50 cm) and a minimum depth of 24 inches (60 cm) and a locking lid to house the hydrant outlet.

D. Paint any portions of the flushing hydrant above the ground line to meet the Owner's standard.

E. Furnish flushing hydrants as manufactured by The Kupferle Foundry Company (MainGuard No. 78, Underground Model) or an approved equivalent.

2.15 YARD HYDRANTS

A. Provide frost-proof sanitary yard hydrants designed for a minimum operating pressure of 100 pounds per square inch (689 kPA) and a minimum bury depth of 6.5 feet (2 m) meeting the standard of ASSE Standard 1057.

B. Furnish sanitary yard hydrants complete with backflow protection compliant with Montana standards, brass hydrant ells and tees, locking flange for padlock, and integral drain that allows hydrant barrel to drain after use to prevent freeze damage.

C. Provide a set of spare parts per each four sanitary yard hydrants installed, manufactured by the same manufacturer as the hydrants and specific to the hydrant model.

D. Furnish sanitary yard hydrants as manufactured by Woodford (Model Y2 with Repair Kit) or an approved equivalent.

2.16 BLOWOFF HYDRANTS

A. Provide 2-inch (50 mm) diameter post type blowoff hydrants meeting all applicable parts of AWWA C502.

B. Furnish blowoff hydrants with a dry barrel design, a compression type main valve, and dual bronze drain valves.

C. Assure blowoff hydrants are rated for 150 pounds per square inch (1,034 kPa) maximum working pressure and 300 pounds per square inch (2,068 kPa) test pressure.

PART 3 - EXECUTION

3.1 TRENCH EXCAVATION AND BACKFILL FOR WATER MAINS

A. This work includes all excavation, backfilling, disposal of surplus and unsuitable material, and all other work incidental to trench construction, including excavation for valves, fittings, hydrants, thrust blocks or other pipeline structures and not classified as "Structural Excavation."

B. Perform this work in accordance with Section 02221: TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES.

3.2 PIPE INSTALLATION FOR WATER MAINS

A. General

1. Install pipe following the manufacturer's specifications and instructions. Provide all tools and equipment required to install each type of pipe used.

2. The Contractor is responsible for all contractor furnished material. Replace all defective material or material damaged by handling after delivery by the manufacturer. This includes the furnishing of all materials and labor required to replace installed material discovered damaged or defective before final acceptance of the work, or during the guarantee period.

3. Store all material safely and to prevent damage. Keep pipe interior and other accessories free from dirt and foreign matter at all times. If pipe is stored on site out of doors for more than 7 days, keep ends of pipe sealed against rodent intrusion and cover PVC pipe with protection from ultraviolet radiation from the sun.

4. Deliver and distribute all Contractor furnished pipe at the site. Load and unload pipe, fittings, specials, valves, and accessories to prevent damage. Do not permit pipe handled on skidways to skid or roll against pipe already on the ground. Do not make metal-to-metal contact between pipes or between fittings when moving or in storage, but rather use non-metal materials such as fire-hose. Do not drop pipe under any circumstance.

5. When distributing material at the work site, lay each piece adjacent to its installation point. Repair or replace all damaged pipe at Contractor's expense on the jobsite.

B. Dewatering of Trench

1. Remove all water in the trench during pipe laying and maintain a dry trench until the pipe ends are sealed. Do not permit the pipe to float. Do not allow any trench water to enter the pipe at any time.

C. Laying of Pipe

1. Inspect the pipe and pipe coating for damage or defects before installation. Lay pipe without damaging the pipe coating. Repair all pipe coating damage following the manufacturer's instructions before laying the pipe. When using belt slings to lower the pipe into the trench, remove the slings without damaging the pipe coating.

2. Lay pipe to the specified lines and grades with fittings and valves at the required locations. Plumb all valve stems.

3. Use implements, tools and facilities satisfactory to the Engineer for the safe and convenient prosecution of the work. Carefully lower all pipe, fittings and valves into the trench using a derrick, rope or other tools or equipment, without damaging pipe materials and protective coatings and linings. Do not drop or dump materials into the trench.

4. Take every precaution to prevent foreign material from entering the pipe as it is placed in the line. During laying operations, do not permit debris, tools, clothing or other materials to be placed in the pipe. At times when pipe laying is not in progress, close the open ends of the pipe using a watertight plug or other approved methods to prevent material entering the pipe.

5. Place pipe bedding in the bottom of the trench meeting Section 02221; TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES. Voids may be left in the bedding material to remove pipe slings and for pipe bells to allow support along the full length of the pipe barrel.

6. Long radius curves, either horizontal or vertical, may be laid with ductile iron pipe using deflections at the joints when shown on the drawings. Deflection at the joints is not to exceed 50% of manufacturer's recommended maximum deflection. PVC pipe may be deflected over the length of the pipe or at fittings when shown on the drawings, based upon manufacturer's recommendations. The Contractor shall provide the Engineer all manufacturer's deflection requirements and warranty information that specifically states that deflection of pipe and fittings does not reduce or eliminate warranty coverage or pressure and safety ratings.

7. No additional payment will be made for laying pipe on planned curves, nor for field changes involving standard pipe lengths deflected at the joints or over the length of the pipe.

8. Do not exceed the applicable material and joint specifications of AWWA or the pipe manufacturer's recommendations at pipe joints for various types of pipe. When rubber gasketed pipe is laid on a curve, joint the pipe in a straight alignment and then deflect to the curved alignment. Excavate trenches to accommodate deflections and curves.

9. Construct reaction or thrust blocks at all tees, plugs, reducers, caps and at bends deflecting 22-1/2 degrees or more. Construct thrust blocks at tapping sleeves where the outlet diameter exceeds one-half the diameter of the main being tapped. Limit using metal rods or straps for thrust restraint to those specified on the plans, or where the use of concrete thrust blocks would be impractical. Do not use metal rods or straps without the Engineer's approval. Construct reaction blocks from concrete having a minimum compressive strength of 2,000 pounds per square inch (14,000 kPa) at 28 days. Place blocking between undisturbed ground and the fitting to be anchored, as shown on the detail drawings. Place the blocking so that the pipe and fitting joints are accessible for repair.

10. Cut pipe for inserting valves, fittings or closure pieces in a neat and workmanlike manner without damaging the pipe or coating and leaving a smooth end at right angles to the pipe axis. Do not cut pipe using an oxyacetylene torch.

11. Provide vertical fittings with thrust blocks one and a half times the sizes set forth in the detail drawings and include 2 #5 rebar anchors bent around each fitting and set into the concrete.

D. Pipe Jointing

1. Rubber Gasket, "Push-On" Joints

a. Follow the manufacturer's recommendations for jointing of pipe and fittings with a rubber gasket, "push-on" type. Wipe the rubber gasket and gasket seat inside the bell clean with a cloth. Wipe the plain end of the adjoining pipe clean, lubricate and insert into the bell to make contact with the gasket. Force the plain end "home" using a crow bar, fork tool, or jack assembly.

2. Mechanical Joints

a. Thoroughly brush the bell and the outside of the spigot of the mechanical joint fitting with a wire brush to remove all loose rust or other foreign material just before assembly. Brush the cleaned surfaces with soapy water just before slipping the gasket over the spigot end and into the bell.

b. Center the spigot end of the pipe or fitting in the bell before jointing is begun. Once the gasket is in place, bring the gland 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. Partially tighten the bolts, alternately around the socket, maintaining approximately equal tension until the final tension is reached.

c. Use the following bolt torque range for the joints:

Bolt Size		Range of Torque	
Inch	(millimeters)	Ft.-Lb.	(joules)
5/8	(16)	40 - 60	(54-81)
3/4	(19)	60 – 90	(81-122)
1	(25)	70 – 100	(95-135)
1-1/4	(32)	90 – 120	(122-163)

d. Apply the torque loads with torque measuring or indicating wrenches, or apply using regular socket wrenches, checked with torque wrenches.

e. If the joint is not sealed using the maximum torque indicated above, disassemble and re assemble the joint after thorough cleaning. Do not overstress bolts to provide the seal.

3. Connections to Existing Mains

a. Make all connections to existing water mains in use unless otherwise specified. Furnish the special fittings, as shown on the plans, and all other material required. Make all necessary excavations to assure gradual transition between the new and existing water main, and perform all necessary backfilling.

b. Where the connection of new work to old requires a service interruption and customer notification, the Engineer and the Contractor are to mutually agree upon a date for connections to permit adequate time to assemble labor and materials, and to notify all affected customers. All notifications are the Contractor's responsibility.

3.3 POLYETHYLENE ENCASEMENT

A. Wrap all direct bury cast iron or ductile iron pipe and fittings including hydrants, valve boxes, curb boxes, and all other metal parts and surfaces, in polyethylene encasement.

B. Polyethylene encasement installation shall be per the Ductile Iron Pipe Research Association (DIPRA) Polyethylene Encasement Installation Guide.

3.4 TESTING, CLEANING & DISINFECTING WATER MAINS, VALVES & FITTINGS:

A. Hydrostatic and Leakage Testing

1. Perform hydrostatic and leakage testing in accordance with AWWA C600. Once the pipe is laid and backfilled, test for at least 2 hours, all newly laid pipe, or any valved section, at the highest point along the test section. Test to a hydrostatic pressure 2.0 times the normal operating pressure at the test point, but in no case less than a minimum gage pressure of 125 pounds per square inch (931 kPa) or greater than the pressure rating of the pipe being tested. Do not test more than 1,000 linear feet (305 m) of pipeline at one time, unless otherwise approved by the Engineer.

2. Slowly fill the pipe with water, purging all air, and apply the test pressure using a pump hooked up so that the pressure and leakage can be measured. To purge the pipe of air during the test, it is necessary to tap the pipe at its highest points if permanent air vents, water services, hydrants, etc. are not located at the high points. Use corporation stops for this purpose. Furnish the pump connections, gauges, stops, and all necessary apparatus for testing.

3. Disassemble and reassemble all joints showing leakage after thorough cleaning. Remove and replace all cracked or defective pipes or fittings discovered in during the pressure test with sound material and repeat the test.

4. Conduct the leakage test concurrently with the pressure test for 2 hours. Leakage is defined as the quantity of water supplied into the pipe, or any valved section thereof, necessary to maintain pressure within 5 PSI of the pressure test after the pipe has been filled with water and purged of air.

5. The pipe installation will be rejected if the leakage exceeds that determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

6. In which L equals the allowable leakage in gallons per hour; S is the length of pipe tested, in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

7. Should any test of pipe laid disclose leakage exceeding that specified above, locate and repair the defective joints until the leakage is within the specified allowance.

8. Conduct the pressure and leakage tests with the Engineer present.

9. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallon per hour per inch of nominal valve size is allowed. Repair all visible leaks regardless of the amount of leakage.

10. Pressure test tapping sleeves after installation and before tapping.

B. Cleaning Water Mains

1. Before chlorination, flush the mains thoroughly after the pressure and leakage test are completed. Contractor is responsible for all permits, as may be required, associated with cleaning water mains and the entire disinfection process.

2. It is understood that such flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. Use a minimum flushing velocity in the main of 2.5 feet per second (0.7 meters/second). If no hydrant is installed at the end of the main, provide a tap of the size to produce a velocity in the main of at least 2.5 feet per second (0.7 meters/second). Table 2 shows the rates of flow required to produce a velocity of 2.5 feet per second (0.7 meters/second) in various size pipes.

TABLE 1
REQUIRED FLOW AND OPENINGS TO FLUSH PIPELINES[1]
(40 psi (276 kPa) Residual Pressure in Water Main)

Pipe Diameter Inches (cm)	Flow Required to Produce 2.5 fps (approx.) Velocity in Main gpm (epm)	Size of Tap Inch (mm) Number of Taps on Pipe[2] 1 (25)	1-1/2 (38)	2(51)	Hydrant Outlet Number	Size Inches (mm)
4 (10)	100 (380)	1			1	2-1/2 (63)
6 (15)	200 (760)		1		1	2-1/2 (63)
8 (20)	400 (1510)		2	1	1	2-1/2 (63)
10 (25)	600 (2270)		3	2	1	2-1/2 (63)
12 (30)	900 (3400)			2	2	2-1/2 (63)
16 (41)	1600 (6060)			4	2	2-1/2 (63)

[1]With a 40 psi (267 kPa) pressure in the main with the hydrant flowing to atmosphere, a 2-1/2-inch (63mm) hydrant outlet will discharge approximately 1000 gpm (3786 epm) and a 4-1/2-inch (114mm) hydrant nozzle will discharge approximately 2500 gpm (9463 epm).

[2]Number of taps on pipe based on discharge through 5 feet (1.5 meters) of galvanized iron (GI) pipe with one 90° elbow.

3. Exercise extreme care and conduct a thorough inspection during the water main laying to prevent and detect small stones, pieces of concrete, particles of material, or other foreign material that may have entered the mains. To remove this material, flush and inspect all hydrants on the lines to assure that the entire valve operating mechanism of each hydrant is in good condition.

4. In 24-inch (61 cm) or larger diameter mains, in addition to flushing, broom-sweep the main, removing all sweepings before chlorinating the main.

C. Disinfecting Water Mains

1. General

a. Disinfect the water mains subject to the Engineer's approval in accordance with AWWA C651, "Disinfecting Water Mains", and these specifications, before placing the main in service. Keep the interior of all pipe, fittings and appurtenances free from dirt, heavy and foreign particles.

2. Forms of Chlorine

a. The forms of chlorine that may be used, subject to the approval of the Engineer, are:

1) Liquid chlorine containing 100 percent available chlorine under pressure in steel containers. Meet AWWA B301 requirements and use only in combination with appropriate gas-flow chlorinators and ejectors.

2) Sodium hypochlorite in liquid form containing approximately 5 to 15 percent available chlorine. Meet AWWA B300 requirements.

3. Methods of Chlorination

a. Two (2) methods of chlorination may be used. The continuous feed method gives a 24 hour chlorine residual of not less than 25 parts per million (25 mg/L), and the slug method provides a 3 hour exposure of not less than 50 parts per million (50 mg/L) free chlorine.

1) Continuous Feed Method

a) Before chlorinating, fill the main with water to eliminate air pockets and flush as specified above.

b) Use water from the existing distribution system or other approved source of supply to flow at a constant, measured rate into the newly laid water main. At a point not more than 10 feet (3 m) downstream from the beginning of the new main, assure water entering the new main receives a dose of chlorine fed at a constant rate such that the water will have at least 50 parts per million (50 mg/L) free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular intervals.

c) Appendix B provides information on the amounts of chlorine compound required for various pipe sizes.

d) During chlorine application, position valves so that the chlorine solution in the main being treated does not flow into water mains in active service. Do not stop chlorine application until the entire main is filled with chlorinated water. Retain the chlorinated water in the main for at least 24 hours, operating all valves and hydrants in the section treated to disinfect the appurtenances. At the end of the 24-hour period, the treated water in all portions of the main must have a minimum free chlorine residual of 25 parts per million (25 mg/L).

e) The preferred equipment for applying liquid chlorine is a solution feed vacuum operated chlorinator to mix the chlorine gas in solution water, in combination with a booster pump for injecting the chlorine gas solution water into the main to be disinfected. It is recommended that direct feed chlorinators not be used. Hypochlorite solutions may be applied to the water main with a chemical feed pump designed for feeding chlorine solutions.

f) If approved, an optional continuous feed method utilizing calcium hypochlorite granules may be used. Place the granules in the pipe sections as specified under the Tablet Method.

2) Slug Method

a) Before chlorinating, preliminary flush the main as specified herein.

b) Use water from the existing distribution system or other approved source of supply to flow at a constant measured rate into the newly laid water main.

c) Not more than 10 feet (3 meters) downstream from the beginning of the new main, add chlorine to the water entering the new main at a constant rate that the water will have a minimum 100 mg/L free chlorine. Measure this concentration at regular intervals. Apply the chlorine continuously and for the time required to develop a solid column or "slug" of chlorinated water that will, as it moves through the main, expose all interior surfaces to a 100 mg/L for at least 3 hours.

d) Measure the free chlorine residual in the slug as it moves through the main. If at any time it drops below 50 mg/L stop the flow and relocate the chlorination equipment at the head of the slug, and as flow is resumed, add chlorine to restore the free chlorine in the slug to not less than 100 mg/L.

e) As the chlorinated water flows past fittings and valves, operate related valves and hydrants to disinfect appurtenances and pipe branches.

4. Final Flushing

a. After the retention period, flush the chlorinated water from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that in the system, or is acceptable for domestic use.

D. Bacteriological Tests

1. After final flushing and before the water main is placed in service, test a sample, or samples, collected from the main(s) for turbidity and bacteriological quality. Collect at least one sample from the new main and one from each branch. Collect the samples and have the tests performed at an approved laboratory.

2. Redisinfection

a. If the initial disinfection fails to produce approved bacteriological or turbidity samples, re-flush and resample the main. If check samples show bacterial contamination, re-chlorinate the main until approved results are obtained.

3. Swabbing

a. Where connections are made to existing piping and the connections are not disinfected along with the newly installed main, swab or spray the interior of all pipe and fittings used in making the connections with a 1% hypochlorite solution before installation.

3.5 WATER AND SEWER MAIN SEPARATION

A. Maintain 10 ft. horizontal and 18-inch vertical separation between water mains and sewer mains

3.6 VALVES

A. Set and joint gate valves and butterfly valves to the pipe as specified for pipe laying and jointing. Set valves with operating nut vertical. Center and plumb valve boxes over the operating nut to prevent shock or stress being transmitted to the valve.

B. Valve Boxes

1. Install gate valve boxes such that the tops are 3 inches (76 mm) below the finished grade in aggregate surfaced areas and at finished grade in asphalt surfaced areas. In unsurfaced areas, leave the top of gate valve boxes 6 inches (152 mm) above the existing grade and slope backfill to the top at a 4:1 slope.

3.7 FIRE HYDRANTS

A. Set all hydrants plumb with the pumper nozzle facing the street. Set the hydrant with the ground line at the location indicated by the hydrant manufacturer. Assure 1 to 2 inches (25 to 50 mm) of clearance between the existing ground or sidewalk and the bolt bottom on the hydrant bottom flange. Verify depth and riser length to establish clearance within 1-inch (25 mm) tolerance.

B. Provide drainage at the hydrant base by placing clean gravel under and around it. Place gravel at least 12 inches (30 cm) on all sides from the base of the hydrant to at least 6 inches (15 cm) above the drain opening. Brace the hydrant against unexcavated earth at the trench end with concrete backing as detailed on the drawings. Furnish hydrants with the specified gate valves. The gate valve shall be located three feet from the hydrant unless otherwise staked in the field by the Engineer. Install hydrants in accordance with the detail provided in the drawings, or as located in the field by the Engineer.

3.8 SERVICE LINE INSTALLATION

A. 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 to make the connections to the stops. Bend the service line adjacent to the water main into a figure “S” in a horizontal or vertical plane to avoid a rigid connection. Assure all services have a minimum 6.5 feet (2 meters) of cover.

B. Mark the water service line end at the property line using a steel fence post, 5 feet long (1.5 meters), buried 3 feet (1 meter) in the ground. Paint the post blue. Where applicable, mark the concrete curb to identify the service locations.

C. As the Contractor is constructing the new mains, they will be responsible for locating existing services. Locate new services in the same proximity as the existing services.

3.9 TAPPING

A. Tap the newly installed water mains unless specified otherwise. The Owner will tap any existing water mains not installed by the Contractor. If owner tapped, be responsible for scheduling and coordinating with the Owner. The Contractor will be charged a fee for each Owner made tap.

B. Provide water service clamps for all corporation stops. Set the saddle and corporation stop on the pipe prior to tapping and make the tap through the corporation stop using a standard tapping machine only. Assure taps for water service saddles are full-size taps. Undersized taps will not be allowed. Perform tapping using an approved tapping machine using clean, sharp drill taps for DIP. Use shell cutters for tapping PVC pipe.

3.10 WATER MAIN INSULATION

A. Install insulation on the new water main when crossing under, over, or within 6 feet of culverts that are open to the air, or in cases where less than 6 feet of cover is provided. Install the insulation the full width of the trench excavation.

B. Place a 6 mil thick polyethylene sheeting over the insulation, lapping any joints a minimum of 12 inches (30 cm).

C. Place a 6 inch (15 cm) sand cushion above and below the insulation.

3.11 FLUSHING HYDRANTS

A. Set all flushing hydrants plumb with the hose connection orientated as directed by Owner. Set hydrants with the hose connection with the bury line as indicated by the hydrant manufacturer 8 inches (20 cm) below finished grade in the thermal shell. Install hydrants in accordance with the detail provided in the drawings, or as specified by the Engineer.

B. Provide drainage at the flushing hydrant by placing clean gravel under and around it. Place gravel at least 12 inches (30 cm) on all sides from the base of the hydrant and shut-off valve to at least 6 inches (15 cm) above the drain opening.

3.12 YARD HYDRANTS

A. Set all sanitary yard hydrants plumb with the outlet orientated as directed by Owner. Assure hydrants have a finished height above the final grade as shown in the drawings, if a detail is provided, or as specified by Engineer.

B. Install all sanitary yard hydrants in accordance with manufacturer recommendations.

END OF SECTION

SECTION 02661

WATER METER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all water main pipe and fittings meeting the Contract documents or specified as follows.

B. Furnish and install meter manholes, meters, power unit and meter station for water mains, together with related appurtenances.

1.2 CERTIFICATION BY MANUFACTURER

A. Furnish a manufacturer's certification covering all materials and fittings furnished, certifyingthat the materials meet applicable specifications.

1.3 REFERENCES

ANSI B16.1	Tapping Sleeves
AWWA C502	Fire Hydrants
AWWA C504	Butterfly Valves

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish manhole, meter, meter station and power source as specified in the Contract Documents and meeting the material and testing requirements of this section.

2.2 MANHOLES

A. General

1. Construct manholes from precast concrete sections having frames, covers, and steps meeting the detail drawing.

B. Precast Concrete Sections

1. Furnish manholes meeting ASTM C478; "Precast Reinforced Concrete Manhole Sections", specifically including mandatory rejection requirements.

C. Steps

1. Furnish non-corrosive steps, 12-inches in width, of 1/2-inch steel rod encased with polypropylene. Assure steps withstand 400 pound vertical loads and 1,000 pound pull-out resistance.

D. Frames and Covers

1. Furnish frames and covers meeting the detail drawings.

E. Concrete Base

1. Furnish precast concrete bases.

F. Pipe Connectors

1. Furnish factory installed PSX – Direct Drive, Z-LOK or other approved equal manhole to pipe connector.

2.3 FLOW METER

A. Use tapping sleeves meeting either:

1. Gray iron or ductile iron, split-sleeve, mechanical joint type with end and side gaskets.

2. Split-body type with circular gasket forming a seal around the circumference of the outlet.

3. Assure both types have a class 125, ANSI B16.1 outlet flange, are rated for a minimum 150 psi (1030 kPa) working pressure and contain a threaded test plug on the neck or body of the tapping sleeve. Assure gaskets are manufacturer's standard for use in potable water systems. Use stainless steel bolts and nuts. Assure mechanical joint type is fusion- bonded, 12-mil thickness, and epoxy coated. Limit the use of mechanical joint type to metal pipe. Assure tapping valves meet the applicable requirements for gate valves, as outlined in this section, with flanged inlets compatible with the flange of the tapping sleeve and mechanical joint outlet.

B. Furnish sleeve (1) above as manufactured by Mueller, Rockwell, Dresser, or an approved equivalent. Provide thrust blocking behind tee flow-through sized per thrust block detail in the drawings. Furnish type (2) above as manufactured by Smith-Blair (Model 622), Ford (FTS), or an approved equivalent.

2.4 SOLAR PANEL (POWER SOURCE)

A. Use tapping sleeves meeting either:

1. Gray iron or ductile iron, split-sleeve, mechanical joint type with end and side gaskets.

2. Split-body type with circular gasket forming a seal around the circumference of the outlet.

3. Assure both types have a class 125, ANSI B16.1 outlet flange, are rated for a minimum 150 psi (1030 kPa) working pressure and contain a threaded test plug on the neck or body of the tapping sleeve. Assure gaskets are manufacturer's standard for use in potable water systems. Use stainless steel bolts and nuts. Assure mechanical joint type is fusion- bonded, 12-mil thickness, and epoxy coated. Limit the use of mechanical joint type to metal pipe. Assure tapping valves meet the applicable requirements for gate valves, as outlined in this section, with flanged inlets compatible with the flange of the tapping sleeve and mechanical joint outlet.

B. Furnish sleeve (1) above as manufactured by Mueller, Rockwell, Dresser, or an approved equivalent. Provide thrust blocking behind tee flow-through sized per thrust block detail in the drawings. Furnish type (2) above as manufactured by Smith-Blair (Model 622), Ford (FTS), or an approved equivalent.

2.5 SPECIAL FITTINGS

A. Furnish special fittings meeting the Contract Documents. The Engineer will specify gasket materials for contaminated soil or special groundwater situations.

2.6 POLYETHYLENE ENCASEMENT

A. Furnish polyethylene encasement in accordance with AWWA C105, "Polyethylene Encasement for Ductile Iron Pipe Systems".

2.7 WATER MAIN INSULATION

A. Furnish extruded polystyrene rigid foam insulation conforming to ASTM C578, Type IV, with a minimum thermal resistance (R value) of 5.0 per 1 inch of thickness at 75º Fahrenheit mean temperature. Water absorption for the insulation shall not exceed 0.10 by volume as measured by ASTM C272.

B. Materials shall be delivered in their original unopened units, stored off the ground, protected from direct sunlight with a light-colored opaque polyethylene film and ventilated to prevent excessive temperature. Damaged or deteriorated materials shall be removed from the premises.

PART 3 - EXECUTION

3.1 TRENCH EXCAVATION AND BACKFILL FOR WATER MAINS

A. This work includes all excavation, backfilling, disposal of surplus and unsuitable material, and all other work incidental to trench construction, including excavation for valves, fittings, hydrants, thrust blocks or other pipeline structures and not classified as "Structural Excavation."

B. Perform this work in accordance with Section 02221: TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES.

3.2 PIPE INSTALLATION FOR WATER MAINS

A. General

1. Install pipe following the manufacturer's specifications and instructions. Provide all tools and equipment required to install each type of pipe used.

2. The Contractor is responsible for all contractor furnished material. Replace all defective material or material damaged by handling after delivery by the manufacturer. This includes the furnishing of all materials and labor required to

replace installed material discovered damaged or defective before final acceptance of the work, or during the guarantee period.

3. Store all material safely and to prevent damage. Keep pipe interior and other accessories free from dirt and foreign matter at all times. If pipe is stored on site out of doors for more than 7 days, keep ends of pipe sealed against rodent intrusion and cover PVC pipe with protection from ultraviolet radiation from the sun.

4. Deliver and distribute all Contractor furnished pipe at the site. Load and unload pipe, fittings, specials, valves, and accessories to prevent damage. Do not permit pipe handled on skidways to skid or roll against pipe already on the ground. Do not make metal-to-metal contact between pipes or between fittings when moving or in storage, but rather use non-metal materials such as fire-hose. Do not drop pipe under any circumstance.

5. When distributing material at the work site, lay each piece adjacent to its installation point. Repair or replace all damaged pipe at Contractor's expense on the jobsite.

B. Dewatering of Trench

1. Remove all water in the trench during pipe laying and maintain a dry trench until the pipe ends are sealed. Do not permit the pipe to float. Do not allow any trench water to enter the pipe at any time.

C. Laying of Pipe

1. Inspect the pipe and pipe coating for damage or defects before installation. Lay pipe without damaging the pipe coating. Repair all pipe coating damage following the manufacturer's instructions before laying the pipe. When using belt slings to lower the pipe into the trench, remove the slings without damaging the pipe coating.

2. Lay pipe to the specified lines and grades with fittings and valves at the required locations. Plumb all valve stems.

3. Use implements, tools and facilities satisfactory to the Engineer for the safe and convenient prosecution of the work. Carefully lower all pipe, fittings and valves into the trench using a derrick, rope or other tools or equipment, without damaging pipe materials and protective coatings and linings. Do not drop or dump materials into the trench.

4. Take every precaution to prevent foreign material from entering the pipe as it is placed in the line. During laying operations, do not permit debris, tools, clothing or other materials to be placed in the pipe. At times when pipe laying is not in progress, close the open ends of the pipe using a watertight plug or other approved methods to prevent material entering the pipe.

5. Place pipe bedding in the bottom of the trench meeting Section 02221; TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES. Voids may be left in the bedding material to remove pipe slings and for pipe bells to allow support along the full length of the pipe barrel.

6. Long radius curves, either horizontal or vertical, may be laid with ductile iron pipe using deflections at the joints when shown on the drawings. Deflection at the joints is not to exceed 50% of manufacturer's recommended maximum deflection. PVC pipe may be deflected over the length of the pipe or at fittings when shown on the drawings, based upon manufacturer's recommendations. The Contractor shall provide the Engineer all manufacturer's deflection requirements and warranty information that specifically states that deflection of pipe and fittings does not reduce or eliminate warranty coverage or pressure and safety ratings.

7. No additional payment will be made for laying pipe on planned curves, nor for field changes involving standard pipe lengths deflected at the joints or over the length of the pipe.

8. Do not exceed the applicable material and joint specifications of AWWA or the pipe manufacturer's recommendations at pipe joints for various types of pipe. When rubber gasketed pipe is laid on a curve, joint the pipe in a straight alignment and then deflect to the curved alignment. Excavate trenches to accommodate deflections and curves.

9. Construct reaction or thrust blocks at all tees, plugs, valves, reducers, caps and at bends deflecting 22-1/2 degrees or more. Construct thrust blocks at tapping sleeves where the outlet diameter exceeds one-half the diameter of the main being tapped. Limit using metal rods or straps for thrust restraint to those specified on the plans, or where the use of concrete thrust blocks would be impractical. Do not use metal rods or straps without the Engineer's approval. Construct reaction blocks from concrete having a minimum compressive strength of 2,000 pounds per square inch (14,000 kPa) at 28 days. Place blocking between undisturbed ground and the fitting to be anchored, as shown on Standard Drawing 02660-1. Place the blocking so that the pipe and fitting joints are accessible for repair.

10. Cut pipe for inserting valves, fittings or closure pieces in a neat and workmanlike manner without damaging the pipe or coating and leaving a smooth end at right angles to the pipe axis. Do not cut pipe using an oxyacetylene torch.

11. Provide vertical fittings with thrust blocks one and a half times the sizes set forth in Standard Drawing 02660-1 and include 2 #5 rebar anchors bent around each fitting and set into the concrete.

12. Mechanical Joints
    a. Thoroughly brush the bell and the outside of the spigot of the mechanical joint fitting with a wire brush to remove all loose rust or other foreign material just before assembly. Brush the cleaned surfaces with soapy water just before slipping the gasket over the spigot end and into the bell.

    b. Center the spigot end of the pipe or fitting in the bell before jointing is begun. Once the gasket is in place, bring the gland 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. Partially tighten the bolts, alternately around the socket, maintaining

approximately equal tension until the final tension is reached.

c. Use the following bolt torque range for the joints:

Bolt Size		Range of Torque	
Inch	(millimeters)	Ft.-Lb.	(joules)
5/8	(16)	40 - 60	(54-81)
3/4	(19)	60 – 90	(81-122)
1	(25)	70 – 100	(95-135)

d. Apply the torque loads with torque measuring or indicating wrenches, or apply using regular socket wrenches, checked with torque wrenches.

e. If the joint is not sealed using the maximum torque indicated above, disassemble and re assemble the joint after thorough cleaning. Do not overstress bolts to provide the seal.

13. Connections to Existing Mains

a. Make all connections to existing water mains in use unless otherwise specified. Furnish the special fittings, as shown on the plans, and all other material required. Make all necessary excavations to assure gradual transition between the new and existing water main, and perform all necessary backfilling.

b. Where the connection of new work to old requires a service interruption and customer notification, the Engineer and the Contractor are to mutually agree upon a date for connections to permit adequate time to assemble labor and materials, and to notify all affected customers. All notifications are the Contractor's responsibility.

3.3 POLYETHYLENE ENCASEMENT

A. Wrap all direct bury cast iron or ductile iron pipe and fittings including hydrants, valve boxes, curb boxes, and all other metal parts and surfaces, in polyethylene encasement.

B. Polyethylene encasement installation shall be per the Ductile Iron Pipe Research Association (DIPRA) Polyethylene Encasement Installation Guide.

3.4 VALVES

A. Set and joint gate valves and butterfly valves to the pipe as specified for pipe laying and jointing. Set valves with operating nut vertical. Center and plumb valve boxes over the operating nut to prevent shock or stress being transmitted to the valve.

B. Valve Boxes

1. Install gate valve boxes such that the tops are 3 inches (76 mm) below the finished grade in aggregate surfaced areas and at finished grade in asphalt surfaced areas. In unsurfaced areas, leave the top of gate valve boxes 6 inches (152 mm) above the existing grade and slope backfill to the top at a 4:1 slope.

3.5 TAPPING

A. Tap the newly installed water mains unless specified otherwise. The Owner will tap any existing water mains not installed by the Contractor. If owner tapped, be responsible for scheduling and coordinating with the Owner. The Contractor will be charged a fee for each Owner made tap.

B. Provide water service clamps for all corporation stops. Set the saddle and corporation stop on the pipe prior to tapping and make the tap through the corporation stop using a standard tapping machine only. Assure taps for water service saddles are full-size taps. Undersized taps will not be allowed. Perform tapping using an approved tapping machine using clean, sharp drill taps for DIP. Use shell cutters for tapping PVC pipe.

END OF SECTION

SECTION 02925

SODDING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes furnishing all labor, services, fertilizer, sod and equipment to install and establish sod in the areas described on the drawings and disturbed outside of the designated payment areas.
   1. Furnishing all sod, labor, equipment
   2. Performing all operations to finish grade topsoil
   3. Preparing sod beds
   4. Sod all lawn areas
   5. Maintenance and protection of all sodded areas

1.2 SUBMITTALS

A. Submit, to the Contracting Officer 15 days prior to sod installation, applicable sod certifications, and fertilizer descriptions.

PART 2 – MATERIALS

2.1 SOD

A. General
   1. Sod type, condition and source shall be approved by the Contracting Officer's Representative.

B. Sod Characteristics
   1. Sod shall be well-established Kentucky Blue Grass, procured from a sod farm located within 250 miles of the subject property.
   2. Sod shall be vigorous, well-rooted, healthy turf, well hydrated and possessing excellent color.
   3. Sod shall be free from disease, insect pests, weeds, other grasses, stones, and any other harmful or deleterious matter.
   4. Removed sod must be disposed of off-base and cannot be reused.

C. Sod Handling: Furnish sod in uniformly wide strips, uniformly minimum 1-1/4 inches thick with clean cut edges. Sod shall be rolled or folded prior to lifting. Handling of sod shall be done in a manner that will prevent tearing, breaking, drying, or any other damage. Sod shall be installed in place on the site not more than 24 hours after cutting.

D. Fertilizer shall be furnished by the Contractor and shall be applied at the rates specified below:

Lawn Area
5 lbs. Nitrogen/1,000 S.F.
5 lbs. Phosphate/1,000 S.F.

The commercial fertilizer shall be delivered in standard size bags of the manufacturer showing weight analysis and manufacturer's name.

The Government reserves the right to test the material at any time and to accept or reject the material based on these tests.

If the fertilizer is not used immediately, the Contractor shall store the unused material in a place accepted by the Contracting Officer's Representative and in such a manner that its usefulness will not be impaired.

PART 3 - EXECUTION

3.1 TIME OF SODDING: The sodding will take place after the installation of all other work required by this contract.

3.2 FINISHING

A. Topsoil Spreading: Contractor shall provide a 4-inch minimum compacted, depth of imported topsoil on all lawn areas. Topsoil shall be graded smoothly and evenly. Lawn area sub grade shall be roughed and scarified 6-inch minimum depth to except and bind with the finish layer of topsoil. Topsoil shall be spread in a non-muddy, unfrozen condition. Surface finish shall be +/- 0.1 foot. Compaction of the topsoil layer shall be ±85% maximum dry density.

B. Finish Grading: Grade lawn areas to finish grades, filling as needed or removing surplus dirt and floating areas to a smooth uniform grade. Where no grades are shown, surfaces shall have a smooth and continual grade between existing or fixed controls (such as walks, curbs, catch basins, and elevations at steps or building). Loosen and fine rake areas to receive sod to break up lumps and produce a smooth, even grade, free from unsightly variations, ridges, or depressions. Remove stones one inch or larger, sticks, roots or other debris exposed during this operation. All finish grades shall meet the approval of the Contracting Officer's Representative before sod is placed.

C. Weed Control

1. Prior to application of sod, the bed shall be roughed up to a depth of 1/8th inch.
2. Spray areas showing weed growth with approved herbicides, mow, and remove clippings prior to final grading. Sodding shall be executed 72 hours following application.

3.3 PLACING: After the area has been regraded and the area is free of equipment and debris, the area shall be graded to an elevation approximately 1.5 inches below finished grade. The area shall then be leveled with bedding sand to approximately 1.25 inches below grade. The sod shall be placed uniform and tight together. End overlaps shall be trimmed back, and sod shall butt tightly against existing turf. The Contractor shall coordinate the placing of the turf with the Contracting Officer's Representative. The sod shall be watered daily sufficiently to have free water standing on the surface. It shall be maintained for 45 days.

3.4 REPAIR: If at any time before completion and acceptance of the entire work covered by this contract, any portion of the surface becomes gullied or otherwise damaged following sodding, the affected portion shall be repaired to reestablish the condition and grade of the soil prior to sodding and shall then be sodded as specified above at the Contractor's expense.

3.5 MAINTENANCE:

A. Water will be available on site from the adjacent housing unit exterior hose bib. Provide necessary hoses and other watering equipment required to complete the work. Water per sod suppliers recommendation.

B. Maintain sod areas by watering, weeding, spraying, cleaning, and replacing as necessary to keep sod in a vigorous, healthy condition.

C. Coordinate watering schedules with the Contracting Officer's Representative during installation and until final acceptance.

D. Mowing: Mow newly planted sod area weekly after initial growth reaches 2 1/2 inches.

E. Weeding: Remove weeds and foreign grasses in sod areas at least once per week. Herbicides may be used only when approved by the Contracting Officer's Representative.

F. Contractor is responsible for all landscape maintenance covered in this specification section until final acceptance of work by the Government and until the sod has been mowed a second time a minimum of 7 days after the first mowing.

END OF SECTION

SECTION 02926

SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes ground surface preparation and furnishing and planting seed at the locations shown on the Construction Drawings. This specification applies to areas disturbed by construction.

1.2 SUBMITTALS

Submit to the Contracting Officer applicable seed mixture certifications. Furnish duplicate signed copies of the vendor's statement certifying that each seed lot has been tested by a recognized seed testing laboratory within 6 months of date of delivery. Assure the statement includes: Name and address of laboratory, date of test, lot number for each seed species and the test results including name, percentages of purity and of germination, percentage of weed content for each kind of seed furnished and, for seed mixes, the proportions of each kind of seed.

2. PRODUCTS

2.1 SEED

A. Furnish seed and seed mixture, free of all prohibited noxious weed seed or any other weed seed prohibited by state or local ordinance.

B. Seal and label all seed containers to comply with Montana Seed Law and Regulations or meeting U.S. Department of Agriculture and Regulations under the Federal Seed Act, if shipped in interstate commerce. Do not use wet, moldy, or otherwise damaged seed in the work.

C. Furnish seed mixture of the species described as follows. Seed shall comply with and be labeled in accordance with current Federal and Montana seed quality criteria. Seed shall be certified noxious weed free and have been grown in the North American Continent above 47° North latitude. All seed shall be standard grade adapted to Montana conditions and certified noxious weed-free. Furnish seed in standard containers labeled with the seed name, lot number, net weight, percentages of purity, germination, hard seed, and percentage of maximum weed seed content for each seed species. Percent purity must equal or exceed 95 %. Percent germination must equal or exceed 85 %. Weed seeds cannot exceed 1 % of seed content.

Table 2.1.1 Dry Land Seed Mix for Non-irrigated	
Species	**90% PLS Weight of the Mix**
Critana Thickspike	25%
Slender Wheatgrass	25%
Green Needlegrass	20%
Western Wheatgrass	20%
Secar Bluebunch	10%
Species	**10% PLS Weight of the**
Appar Blue Flax	50%
Purple Prairie Clover	50%

Table 2.1.2 Turf Grass Seed Mix for Irrigated Areas	
Species	**90% PLS Weight of the**
Hard Fescue	25 %
Sheep Fescue	20 %
Fairway Crested	20 %
Turf Type Tall Fescue	20 %
Sodar Streambank	10 %
Canada Bluegrass	5 %

Note: "PLS" means "Percent Live Seed."

D. Seed shall be placed at the following application rates:

8-10 lbs.	Drill Seeding / Acre
16-20 lbs.	Broadcast Seeding / Acre

2.2 TOPSOIL

A. Use topsoil that is loose, friable, loamy soil, free of excess acid and alkali. Assure topsoil does not contain objectionable amounts of sod, hard lumps, gravel, sub-soil or other undesirable material that would form a poor seedbed. Acceptable soil includes locally obtained topsoil and/or subsoil with less than 30% coarse fragments (>5.0mm) by weight.

2.3 FERTILIZER

A. Furnish standard commercial fertilizers supplied separately or in mixtures containing the specified percentages of total nitrogen, available phosphoric acid, and water soluble potash. Apply fertilizer at the specified rate and depth meeting the applicable State and Federal laws. Furnish fertilizer in standard containers clearly labeled with name, weight, and guaranteed analysis of contents. No cyanamide compounds of hydrated lime are permitted in mixed fertilizers.

B. Fertilizers may be supplied in one of the following forms:

A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader or a finely-ground fertilizer soluble in water, suitable for application by power sprayers or a granular or pellet form suitable for application by blower equipment.

Fertilizer will be placed uniformly across all surfaces that have been seeded at the following rates:

10-15 lbs.	Nitrogen /Acre
30-35 lbs.	Phosphorus/Acre

PART 3 - EXECUTION

3.1 TOPSOIL

A. Topsoil shall be stripped from areas to be excavated and stockpiled. If the existing upper soil profile has stones larger than 2 inches in diameter, the soil shall be processed to meet the requirements for topsoil or rejected and replaced with soil that meets topsoil requirements. Topsoil shall be free of all rocks greater than two inches in diameter. Larger rocks shall be removed.

B. Topsoil shall be placed on all areas to be seeded. If topsoil meeting the requirements of this specification is not available from materials excavated during construction, the Contractor shall import suitable topsoil as required from off-site and remove any excess unsuitable material. After the site is properly shaped and graded, acceptable topsoil shall be placed to a finished compacted thickness of 6 inches. The topsoil shall be placed on the prepared surface, graded smooth and uniform. The surface shall then be raked, or an equivalent method used, to loosen the surface and remove all stones or rocks greater than two inches. All debris shall be removed from the area, and the area shall have a clean, neat appearance.

3.2 ALLOWABLE SEEDING MONTHS

A. Perform seeding when the temperature and moisture are favorable to germination and plant growth. Seed between October 1st and May 15 of each year.

3.3 SEEDBED PREPARATION AND SOWING

A. Clear the areas to be seeded of all debris, vegetation, and other material determined by the Contracting Officer to be detrimental to the preparation of a seedbed. Once the area is cleared, disc, harrow, rake, or work the area by other suitable methods, into a smooth, even

seedbed. Assure the prepared seedbed surface is firm enough to prevent seed loss from high winds or normal rainfall.

B. Sow seed in the areas described in the contract documents at the specified application rates.

C. Sow seed using a force feed drill having a grass seed attachment. Seeding depth is 0.25 to 0.50 inches. Areas that are small or inaccessible to drill seeding equipment may be broadcast seeded.

D. Do not sow seed in winds that prevent proper embedment into the surface.

3.4 FERTILIZER

A. Spread and work fertilizer into the soil during the final seedbed preparation. Apply fertilizer at the rate described in this specification.

3.5 CARE OF SEEDED AREAS

A. Keep the seeded area moist until it has germinated and its continued growth is assured. Prevent erosion during watering. The Contractor is responsible to supply water required to establish stand of grass. The Contractor shall provide portable watering equipment when needed.

Adequate moisture must be available at all times during the pre-sprout phase and the top 1-inch of soil should stay moist at all times. The germination time for grass seed ranges from 5 to 30 days depending on the variety. It can be even longer than this in cooler temperatures. Overall technique, frequency and duration of watering shall be determined on –site by the Contractor based on soil conditions, temperature and weather.

The Contractor shall avoid:

- Over watering that results in puddles on the surface;
- Runoff and seed movement on sloping ground;
- Over watering that allows the soil to get soggy and spongy;
- Over watering areas that are shaded;
- Uneven watering due to sprinklers that are clogged, not adjusted or inadequately designed; and
- Under watering new grass seed.

B. Protect all seeded areas with warning barricades or other Contracting Officer approved methods.

C. Provide erosion control blankets for all slopes to be seeded greater than three (3) horizontal to one (1) vertical and as indicated on the plans per the requirements of Section 01 36 00.

D . Maintain the seeded area, performing any required watering and mowing until the seed is established. Prevent weeds and other undesirable vegetation from establishing in the seeded area. The new growth must meet the following condition to be considered established:

- All new grass and forbs must be at least 4-inches tall;
- Vegetative coverage must be restored to at least 70% when compared with the surrounding undisturbed areas; and
- Weeds or other undesirable species cannot exceed 15% of the area planted.

Special watering regimes may cease when these conditions are met.

E. Replace any seeded areas failing to germinate which have died or been damaged by construction activities. Replace such areas to meet the contract requirements. A one-year contract warranty period applies to this item.

F. All weeds, including Spotted Knapweed, Leafy Spurge, Canada Thistle, and all others that are considered noxious, shall be controlled by the Contractor while grass is becoming established and during the full one year warranty period after the project is complete and accepted by the Government. Chemical control may be utilized where permitted by State laws and regulations. Proper chemical chemistries used shall be based on recommendations made by the Montana State University Extension Agent for the county where seeding is being done. Each weed control chemical must be applied according to the manufacturer's requirements. It is illegal to use any weed control chemical in a manner that is inconsistent with the manufacturer's requirements. Weeds shall be removed within 14 calendar days after each written notice from the Contracting Officer to the Contractor stating that weeds must be removed or controlled.

END OF SECTION

SECTION 03210

REINFORCING STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is furnishing and placing reinforcing steel or wire fabric meeting the quality, type and size specified in the contract.

1.2 REFERENCES

ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A705	Age-Hardening Stainless-Steel Forgings
AASHTO M31	Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
AASHTO M32	Steel Wire, Plain, for Concrete Reinforcement
AASHTO M55	Steel Welded Wire, Plain, for Concrete Reinforcement
AASHTO M54	Deformed Steel Bar Mats for Concrete Reinforcement

PART 2 - PRODUCT

2.1 Furnish all new material meeting the following requirements.

A. Bar Reinforcement

1. Furnish deformed reinforcement steel meeting ASTM A615, (AASHTO M31) or ASTM A705, Grade 60. Use only epoxy-coated reinforcement steel supplied by a CRSI certified epoxy-coated reinforcement steel manufacturer.

B. Wire and Wire Mesh

1. Furnish wire meeting cold-drawn steel wire AASHTO M32 (ASTM A82) requirements.
2. Furnish wire mesh for concrete reinforcement meeting AASHTO M 55 (ASTMA A 185).
3. Furnish bar mats meeting AASHTO M54 (ASTM A 184).

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect steel reinforcement from damage at all times. Place steel free from dirt, detrimental scale, paint, oil and other foreign substance. Clean steel reinforcement having easily removed rust, loose scale, and dust using an approved method.

3.2 FABRICATION

A. Furnish four copies of shop details and placing drawings for all reinforcing steel to the Engineer for approval. Once checked, the Engineer will return two marked- up sets of prints or drawings for correction. The Engineer's review is only for general conformity with the plans. Checking the detailed dimensions is the Contractor's responsibility. The Engineer's review does not relieve the Contractor's responsibility to furnish all material meeting the Contract requirements. Detail Reinforcing, steel meeting the ACI "Standard Details and Detailing of Concrete Structures" and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures" published by the American Concrete Institute (ACI 315).

B. Assure all bars are bent cold. Do not field bend any bar partially imbedded in concrete except as specified on the plans.

C. Ship bar reinforcement in standard bundles, tagged and marked meeting the "Details and Detailing of Concrete Structures" (ACI 315) requirements.

D. Concrete reinforcement and accessory details, not covered herein or on the drawings, must meet "Details and Detailing of Concrete Structures" and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures" (ACI 315 and 315R) requirements.

3.3 PLACING AND FASTENING

A. Accurately place and hold firm all steel reinforcement in the plan locations, or as directed by Engineer, as concrete is being placed. Thrusting dowels into freshly poured concrete is prohibited.

B. Support and fasten together all reinforcement to prevent displacement due to construction loads. It is permissible to use on ground, where necessary, concrete support blocks having a minimum 4 square inches (2580 MM2) bearing area and having a compressive strength equal to the concrete being placed. Use approved bar chairs and spacers over form work. For concrete surfaces exposed to the weather in the finished structure, assure the portions of all accessories within ½-inch (12.7 mm) of the concrete surface are noncorrosive or protected against corrosion.

C. Overlap welded wire fabric for successive mats or rolls providing an overlap measured between outermost cross wires of each fabric sheet not less than the greatest spacing of the cross wires plus 2 inches (50 mm) but not less than 6 inches (150 mm), whichever is greater. Extend the fabric across supporting beams and walls to within 4 inches (100 mm) of concrete edges. It may extend through contraction joints. Adequately support the fabric during concrete placement to maintain its position in the slab using the methods previously described or by laying the fabric on a concrete layer of the required depth before placing the upper slab layer.

D. Offset vertical bars in columns at least one bar diameter at lap splices. Furnish templates for all column dowels.

E. Obtain Engineer approval for all splices not shown on the plans. Mechanical connectors for reinforcing bars may be used if approved.

F. Do not use pebbles, pieces of broken stone, concrete rubble, broken brick or building blocks, metal pipe, or wooden block to position the fabric.

G. Follow the minimum concrete protective covering for reinforcement below, unless noted otherwise on the drawings.

1. Concrete deposited against ground: 76.2 mm (3 inches)
2. Formed surfaces exposed to weather or in contact with the ground:
   a. #6 bars or larger 50.8 mm (2 inches)
   b. Smaller than #6 bars 38.1 mm (1-1/2 inches)
3. Interior Surfaces:
   a. Beams, girders and columns 38.1 mm (1-1/2 inches)
   b. Slabs, walls and joists:
      1) #11 bars or smaller 19.05 mm (3/4-inch)
      2) #14 and #18 bars 38.1 mm (1-1/2 inches)

H. For corrosive atmospheres or fire protection, see special provisions for minimum covering requirements.

I. Obtain Engineer approval of reinforcement placement before placing concrete. Remove and replace concrete placed without Engineer approval of reinforcing.

J. Straighten fabric reinforcement shipped in rolls into flat sheets before placing it.

3.4 WELDING

A. When specified or approved, weld reinforcing steel meeting “Reinforcing Steel Welding Code” (AWSD 1 –4). Do not weld at bends in bars. Do not tack weld crossbars without Engineer approval.

END OF SECTION

SECTION 03310

STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish structural concrete meeting all specified requirements that is composed of Portland cement, supplementary cementitious materials, aggregates, chemical admixtures and water. Furnish Ready-mixed concrete meeting ASTM C94 unless otherwise specified.

1.2 REFERENCES

A. References to ASTM, AASHTO, ANSI and ACI designations, means the latest revision at the time of the call for bids

ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C150	Specification for Portland Cement
ASTM C618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989	Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1240	Specification for Silica Fume Used in Cementitious Mixtures
ASTM C595	Specification for Blended Hydraulic Cements
ASTM C1157	Performance Specification for Hydraulic Cement
ASTM C157	Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C33	Specification for Concrete Aggregates
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C494	Specification for Chemical Admixtures for Concrete
ASTM C1017	Specification for Chemical Admixtures for Use in producing Flowing Concrete
ASTM C138	Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C31	Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C172	Practice for Sampling Freshly Mixed Concrete
ACI 301	Standard Specification for Structural Concrete
ACI 305	Hot Weather Concrete
ACI 306	Cold Weather Concrete
ACI 318	Building Code Requirements for Structural Concrete and Commentary

1.3 QUALITY ASSURANCE

A. Codes and Standards: The codes and standards referred to in this section are declared to be part of this specification as if fully set forth herein. In addition, the following ACI Standards are incorporated in their entirety, unless specifically required otherwise:
   1. ACI Standard 301, "Specifications for Structural Concrete," American Concrete Institute, current edition.
   2. ACI Standard 318, "Building Code Requirements for Structural Concrete", American Concrete Institute, current edition.
   3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
   4. International Building Code of I.C.B.O.

B. Employ, at the Contractor's expense, a testing laboratory acceptable to the Engineer to perform material evaluation tests and/or perform the mix design prior to placing any concrete, and all acceptance testing during the onsite placement of the concrete. Retesting or additional testing of concrete or materials failing to meet the requirements of these specifications must be done by the Contractor at no additional cost to the Owner.

PART 2 - PRODUCT

2.1 CLASSIFICATION

Concrete is classified as set forth by aggregates size referenced in ASTM C33, sizes 4 and 467 for Class C concrete and 56, 57, and 6 for Class M concrete. Place the specified class of concrete for each structure element as specified.
   1. Use M-4500 (f'c = 4,500 psi) concrete for curb and gutter, sidewalks, driveways, approaches, curb turn fillets and valley gutters and structural concrete. The maximum allowable water cement (w/c) for this concrete is 0.45.
   2. Use M-3000 (f'c = 3,000 psi) concrete for manholes, storm drain inlets and miscellaneous or C-3000 Concrete Construction class. The maximum allowable w/c for this concrete is 0.50.

B. If concrete strength or durability requirements established by design exceed the above strength classifications, the Engineer may specify additional concrete classifications to meet those requirements.

2.2 COMPOSITION OF CONCRETE

A. Upon receipt of the notice of award of the contract, furnish the Engineer with names of suppliers and locations of sources of materials proposed for use.

1. Materials

a. Cementitious Material: Cementitious material consists of Portland cement meeting ASTM C150 Type I, II, III, or V, with or without the addition of cementitious or pozzolanic mineral admixtures meeting, ASTM C618 or ASTM C989, and ASTM C1240, or blended hydraulic cement meeting ASTM C595 Type 1P, 1S, or 1L, or hydraulic cement meeting ASTM C1157 Type GU, MS, HS, or HE. Unless otherwise specified, assure cementitious material meets ASTM C 150 Type I or Type II. Assure cementitious material used in concrete is the same brand and type and from the same plant of manufacture as the cementitious material used in the concrete represented by the submitted field test date or used in the trial mixtures.

b. Aggregates: Assure aggregates meet ASTM C33. When a single size or a combination of two or more sizes of coarse aggregates are used, assure the final gradation meets the grading requirements of ASTM C33 or provide an optimized combined aggregate gradation plan. Obtain concrete aggregates from the same source and use the same size ranges as the aggregates used in the concrete represented by submitted historical data, or used in trial mixtures.

c. Water and Ice: Use concrete mixing water and water to make ice meeting requirements of ASTM C94.

d. Admixtures: Use admixtures meeting the following requirements:

1)	Air entraining, admixtures -	ASTM C260
2)	Chemical admixtures-	ASTM C494
3)	Chemical admixtures for use in producing, flowing concrete-	ASTM C1017
4)	Calcium Chloride -	ASTM D98

5) Use admixtures in the concrete that are the same as those used in the concrete represented by submitted field test data or in trial mixtures.

2. Change of materials

a. When brand, type, size, or source of cementitious materials, aggregates, water, ice or admixtures are requested to be changed, submit new field data or data from new trial mixtures or furnish evidence that indicates that the change will not adversely affect the relevant properties of the concrete for acceptance before using the concrete.

B. Performance and Design Requirements

1. Assure the cementitious material content is adequate to meet the specified requirements for strength, water-cement ratio and finishing requirements. For concrete exposed to freezing and thawing or concrete exposed to deicers, assure a maximum water-cement ratio of 0.45.

2. Furnish concrete at the point of delivery having a slump of 4 inches (max) (100 mm) determined by ASTM C143. Meet slump tolerances in ACI 117. When a plasticizing admixture is used meeting ASTM C1017 or when a Type F or G high range water reducing admixture meeting ASTM C494 is approved to increase the concrete slump, assure the concrete has a slump of 2 to 4 inches (50-100mm) before the admixture is added and a maximum slump of 8 inches (200 mm) at the point of delivery after the admixture is added.

3. Assure the nominal maximum size of coarse aggregate does not exceed three fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sided of forms or one-third of the thickness of slabs or toppings.

4. Concrete exposed to cycles of freezing and thawing or in the presence of deicers must be air entrained. Montana is considered a "severe" exposure state. Measure air content under ASTM C 138, C 173 or C231. Unless otherwise specified, ASTM C231 shall be used. Table 2.1 lists the required air contents for various nominal maximum size aggregates.

TABLE 2.1
TOTAL AIR CONTENT* OF CONCRETE FOR
VARIOUS SIZES OF COARSE AGGREGATE

Nominal maximum Size of aggregate in.	Total air content, percent
	Severe exposure
Less than 3/8	9
3/8	7.5
1/2	7
3/4	6
l	6
1-1/2	5.5
2	5
3	4.5
6	4

* Measure in accordance with ASTM C 138, C 173, or C 231.
Air content tolerance is plus 2 percent (+2%) to minus 1 percent (-1%).

a. When admixtures are specified in the Contract documents for particular parts of the work, use types specified. Use of calcium chloride or other admixtures containing chloride ions is subject to the limitations in Table 2.2 Chloride Ion Concentration. When approved, use calcium chloride in solution form only, when introduced into the mixture.

1) Assure the maximum water-soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days attributed to the ingredients including water, aggregates, cementitious materials and admixtures do not exceed the limits of Table 2.2. Use tests to determine water soluble chloride ion content meeting AASHTO T260. The type of member described in Table 2.2 applies to the work as indicated in the Contract Documents.

TABLE 2.2
MAXIMUM ALLOWABLE CHLORIDE ION CONTENT

Type of Member	Maximum water soluble chloride (CI) Content in concrete, percent by weight of cement
Prestressed concrete	0.06
Reinforced concrete exposed to chloride in service	0.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	.30

b. When the air temperature has fallen to or is expected to fall below 40oF (4oC) during the protection period, deliver concrete in accordance with minimum temperatures identified in ASTM C94. The protection period is defined as the time required to prevent concrete from being affected by exposure to cold weather.

c. Furnish the compressive strength and the water-cement or water cementitious, material ratio of concrete for each portion of the work as specified in the Contract documents.

1) If cementitious or pozzolanic mineral admixtures meeting, ASTM C618 or ASTM C989, or ASTM C1240 are used, the cement portion of the water-cement ratio must be the total weight of cementitious material.

2) The combined weight of fly ash and other pozzolans, slag cement, silica fume meeting applicable ASTM standards, cannot exceed limits in ACI 318-14, Table 26.4.2.2 (b). The fly ash and pozzolan present in an ASTM Type IP cement meeting ASTM C595 must be included in the calculated percentage.

ACI Table 26.4.2.2(b) – Limits on cementitious materials for concrete assigned to Exposure Class F3

Cementitious Materials	Maximum Percent of Total Cementitious Materials by Mass
Fly ash or other pozzolans conforming to ASTM C618	25
Slag cement conforming to ASTM C989	50
Silica fume conforming to ASTM C1240	10
Total of fly ash or other pozzolans and silica fume	35
Total of fly ash or other pozzolans, slag cement, and silica fume	50

3) Strength requirements are based on the 28-day compressive strength determined on 6" x 12" (150mm x 300mm) (average of two specimens), or 4" x 8" (100mm x 200mm) (average of three specimens) cylindrical specimens made and tested under ASTM C31 and C39 respectively.

2.3 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs.

B. Submit written reports of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until design mixes have been reviewed and approved.

PART 3 - EXECUTION

3.1 CONCRETE MIXES

A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch match mixer. For mixers of 1 cu. yd., or small capacity, continue mixing at least 1-½ minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-½ minutes of mixing time by 2.5 minutes for each additional cu. yd., or fraction thereof. Aggregates or bags of cement containing lumps or crusts shall not be used.

B. Provide batch ticket in compliance with ASTM C94 for each batch discharged and used in work.

C. When air temperature is between 85□F (30□C) and 90□F (32□C), reduce mixing and delivery time from 1-½ hours to 75 minutes, and when air temperature is above 90□F (32□C), reduce mixing and delivery time to 60 minutes, unless a hot weather concreting plan has been approved.

D. The mix may be designed for delayed set time to allow for long haul or other project conditions. Information pertaining to the delayed set admixture needs to be included on the Batch Ticket. Include with the mix design submittal information on the delayed set provisions of the design and specific time to final placement requirements.

3.2 MIXING

A. Thoroughly mix concrete to assure a uniform distribution of the materials throughout the mass. Mix concrete only in quantities required for immediate use and place it within the time limits specified. Waste all concrete which initial set has begun. Retempering of concrete is prohibited. Mix concrete in an approved truck mixer meeting the requirements of ASTM C94 herein.
   1. WATER:
      a. Do not exceed the approved w/c ratio
      b. The addition of water is allowed only one time and a minimum of 30 revolutions at mixing speed are required before discharge of concrete
      c. Do not add water if part of the batch has been discharged as a W/C ratio cannot be determined
      d. Do not add water if the slump is within specified range
   2. ADMIXTURE
      a. Do not exceed manufacturer's recommended dosage rates unless otherwise approved in the mix design stage
      b. Only admixtures included in the approved mix design may be dosed on-site.
      c. A minimum of 30 revolutions at mixing speed are required before discharging of concrete.
      d. Do not add admixtures if any concrete has been discharged from the mixer other than the minimal amount for initial testing

e. When measured plastic air content or slump exceeds the upper test limit and there is time available within the discharge time limit specified, rotate the load at agitation speed and re-test the air content and/or slump.

f. Do not use additives to reduce the air content and/or slump

B. The capacity of the plant and the transportation equipment must ensure delivery at a rate that will permit proper handling, placement and finishing at the point of delivery. Maintain the concrete delivery rate to provide for the continuous operation of placing, handling and finishing concrete as is practical. Maintain the interval between delivery of loads so that layers or lifts of concrete in place do not harden before succeeding layers or lifts are placed. In general, no lift or layer of concrete can remain exposed for more than 20 minutes before being covered by fresh concrete.

C. The volume of mixed concrete in the mixing drum shall not exceed the manufacturer's rating, on the capacity plate.

D. A recording water metering device is always required at the primary point of the batching operation.

E. Do not add water to concrete in transit. Water may be introduced into the mixer at the job site, one time only, under direction of the Engineer, if the specified water-cement ratio is not exceeded. Water must be added in accordance with ASTM C94, Assure the drum revolves continuously after the introduction of the cement and water until the concrete is discharged.

F. Begin mixing immediately after introduction of the cement and water and continue for at least 70 revolutions of the drum at mixing speed. This minimum revolution count will be waived when the concrete is produced at a central mixing plant. Not more than 100 drum revolutions can exceed 6 revolutions per minute. All other revolutions must be at agitating speed of not less than 2 or more than 6 revolutions per minute.

G. Provide a revolution counter on each truck that registers the number of revolutions of the drum.

H. Mount the counter so it can be easily read by both the operator and the Engineer.

3.3 PLACING CONCRETE

A. Thoroughly consolidate concrete into its final position. Assure it is thoroughly consolidated around fittings and embedded items. Assure all reinforcement and embedded items are accurately placed as shown on the plans and are clean and free from coatings of dried mortar, detrimental rust, scale, oil or foreign matter. Place concrete meeting the applicable requirements of Sections 02528 and 02529.

3.4 CURING CONCRETE

A. Protect freshly placed concrete from freezing, high temperature, large temperature differentials, premature drying, excessive moisture, and moisture loss for a period of time necessary to develop the desired concrete properties.

B. Thoroughly cure concrete surfaces by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap and sand or other satisfactory materials and keep concrete moist. If the concrete surfaces are not covered, keep them moist by flushing or sprinkling. Continue curing for at least 7 days after placing the concrete. Concrete surfaces placed against forms may be cured by leaving the forms in place for at least 7 days, when approved.

C. Protect concrete against freezing or other conditions detrimental to strength development meeting the applicable requirements of this specification.

D. To aid finishing, side forms on ornamental work, curbs and sidewalks, railing and parapets may be removed after 12 hours, not to exceed 48 hours, depending on weather conditions. Continue moist curing during the concrete finishing operation.

E. Untreated forms and existing concrete must be kept continuously wet for at least 1 hour before any concrete is placed. Keep wet until covered with concrete except that adequately treated forms must be thoroughly washed with a water spray immediately before placing the concrete.

F. The curing of concrete, by either water curing or membrane curing, must be as follows unless otherwise approved by the Engineer.

1. Water Curing
    a. Keep all concrete top surfaces continuously moist after finishing, with a fine water spray, until the concrete has set. Cover the moist concrete with water or an approved curing covering.
    b. Cure concrete deck slabs and concrete floors for at least 7 days. Cure by placing burlap, cotton mats or other absorptive material as close behind the finishing operation as possible without marring the finished surface. Keep the absorptive material continuously moist for the full time it is used. The absorptive material may be kept in place for the entire curing period or it may be removed as soon as practical and the entire surface covered with approximately 1-1/2 inches (38.1 mm) of sand, kept continuously moist for the entire curing period.
    c. Remove forms and repair surface irregularities without interfering with any of the curing requirements. As soon as the vertical forms have been removed and the surface irregularities repaired, cover the concrete with absorptive material, kept continuously wet for the balance of the curing period.

2. Impervious Membrane Curing

a. Assure membrane curing compounds are delivered to the job in the manufacturer's original container, clearly labeled to show the name of the manufacturer and the contents. The clear curing compound must be sufficiently transparent and free from permanent color that would change the color of the natural concrete. Use clear compound containing a fugitive dye having color sufficient to render the film visible on the concrete for at least 4 hours after application. The concrete surface must maintain its natural color after curing.

b. Use a compound ready for use as shipped by the manufacturer. Dilute following the manufacturer's recommendations. Use curing compound only with written approval. Sampling will not be required if manufacturer's certification is available. Apply the curing compound under pressure with a spray nozzle to cover the entire exposed surface thoroughly and completely with a uniform film not exceeding manufacturer's specifications. Maintain the required pressure in the spray machine to force the material to leave the nozzle in a fine mist. Keep all concrete surfaces moist with a fine water spray or with wetted burlap until the sealing compound is applied. Keep the curing compound application close to the finishers of the top surface of concrete at all times. Seal the concrete immediately after the finishing operations have been completed, to the satisfaction of the Engineer.

c. If it is necessary to allow workers or equipment on the surface before the 7 day curing period is completed, protect the concrete from damage and maintain the curing environment.

d. Keep concrete, which has not completed its curing period, continuously moist during the stripping and surface repair operations. Remove all surface irregularities, repair all depressions, voids or holes, including those formed by trapped air, to the satisfaction of the Engineer. Immediately apply the curing compound before the surface has had an opportunity to dry out. Keep concrete, from which forms have been stripped, continuously moist until surface repair and finishing are completed and the impervious membrane curing has been applied.

3.5 WEATHER AND NIGHT LIMITATIONS

A. General

1. Stop concreting operations when darkness prevents obtaining the specified placing, and finishing work. Night operations may be conducted with written approval and when approved artificial lighting is provided.

2. Cold weather concreting is governed by ACI 306.1 unless otherwise specified herein. Cold weather exists when the ambient air temperature has fallen, or is expected to fall below 40^{o}F during the protections and curing period. The protection and curing period is defined as the time required to prevent concrete from being affected by exposure to cold weather.

3. When cold weather conditions are expected, all concreting operations will be suspended unless authorized by the Engineer. Contractor may receive authorization from concrete placement in cold weather by submitting a cold weather concreting plan for review and approval. The plan shall include detailed procedures to protect the fresh concrete from freezing during placement and maintaining the concrete surface temperature at a minimum of 55oF during the curing period.
4. Assume all risk of placing concrete in cold weather. Placing concrete during cold weather does not relieve the Contractor of the responsibility for obtaining the specified results. Remove and replace all concrete injured by frost at Contractor expense.
5. Before any concrete is placed, remove all ice, snow and frost completely from the formwork receiving the concrete. The subgrade must be frost free and above freezing before any concrete can be placed. Increase the temperature of formwork, reinforcement, subgrade, and base gravel to a minimum of 35°F (2°C).
6. Concrete shall be mixed, placed, and maintained according to Table (306-R10 5.1) 3.1.
7. Protection of Concrete
    a. Unless otherwise approved, Maintain the surface temperature of the concrete in place between 55° F and 75° F for a minimum of 7 days using approved heating devices or enclosures during the protection and cure period. The minimum 7 day protection and cure period is intended only to protect the concrete from the effects of cold. A longer protection period may be needed for the concrete to gain additional strength to support the loads it will experience when in service. Contractor may, bearing all expenses, field cure concrete test cylinders with the in-place concrete and discontinue protection and curing when the field test cylinders reach 3500 psi. Contractor shall monitor the concrete temperature daily throughout the protection and cure period and make adjustments as needed to maintain the temperature between 55° F and 75° F. Forms shall be kept in place for the duration of the protection and cure period. When the protection and cure period has ended reduce the heat gradually so the concrete surface temperature does not decrease faster than 15° per hour until the concrete temperature is the same as the outside temperature. Modifications may be allowed if approved by Engineer and in conformance with ACI 306.1.
    b. A Contractor may, at their expense, determine the in-place strength of the concrete using appropriate test methods and discontinue protection when those test methods indicate the concrete has reached 3500 psi.

3.6 TESTING

A. All concrete quality assurance testing must be performed by an ACI Grade I certified testing technician. Unless otherwise specified, the Engineer shall be responsible for all quality assurance testing during the on-site placement of the concrete.

1. Materials
    a. The Engineer or their representative must have access to the ready mix production facility for sampling constituent materials during production to assure the materials meet these specifications and represent those stated on the approved mix design.
2. Standard Slump Tests
    a. The Engineer shall, during each day's placement, check the consistency of the concrete by slump test. A slump test will also be made each time that strength specimens are made. Slump tests are performed meeting ASTM C143 "Method of Test for the Slump of Portland Cement Concrete".
3. Air Content Tests
    a. The Engineer shall during each strength test, check the air content by either the "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C231), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C173) or "Method of Test for Unit Weight, Yield and Air Content (Gravimetric) of Concrete" (ASTM C138).
4. Compressive Strength Tests.
    a. A minimum of three specimens, 6 inch (150 mm) diameter or four 4 inch (100 mm) diameter, shall be made and tested for every concrete placement. Mold and test 1 set of test cylinders for every 50 cubic yards of concrete or fraction thereof placed each day or once per class of concrete supplied per day. On a given project, if the total volume of concrete is such that frequency of testing required above would generate less than 5 strength tests for a given class of concrete, make tests from at least 5 randomly selected batches or from each batch if fewer than 5 batches are used. Cure these cylinders under laboratory conditions except that additional test cylinders cured entirely under field conditions may be required by the Engineer to check the adequacy of curing and protection of the concrete.
    b. Take samples for strength tests in accordance with ASTM C172, entitled "Standard Practice for Sampling Freshly Mixed Concrete".
    c. Mold test cylinders and laboratory-cure in accordance with ASTM C31. Test cylinders in accordance with ASTM C39, entitled " "Method of Test for Compressive Strength of Cylindrical Concrete Specimens", ASTM C39, using an independent testing laboratory, as approved by the Engineer.
    d. Each set of cylinders cast per placement, test 1 for information strength at 7 days and test the remaining cylinders for acceptance strength at 28 days. To meet this specification, average strength of 28-day cylinders from the same sample is classified at the compressive strength test result. Strength level of an individual class of concrete is considered satisfactory if both of the following requirements are met:

1) The average of all sets of 3 consecutive tests equal or exceed the specified strength.
2) No individual strength test (average of 28-day cylinders) falls below specified strength by more than 500 psi (3400 kPa).

e. Cure field cylinders under field conditions meeting the provisions of “Field Curing” of the Standard Practice for “Making and Curing Concrete Test Specimens in the Field" (ASTM C31).

f. Mold field cured test cylinders at the same time and from the same samples as laboratory cured test cylinders. Improve procedures for protecting and curing concrete when strength of field cured cylinders at the test age designated for measuring specified strength is less than 85% of that of companion laboratory cured cylinders. When laboratory cured cylinder strengths are appreciably higher than the specified strength, field cured cylinder strengths need not exceed the specified strength by more than 500 psi (3400 kPa) even though the 85% criterion is met.

g. The strengths of any specimens cured on the job are to indicate the adequacy of protection and curing of the concrete and may be used to determine when the forms may be stripped, shoring removed or the structure placed in service. When the strengths of the job cured specimens are below those specified above, the Contractor must improve the procedures for protecting and curing the concrete. The strengths of any field cured specimens should never be used solely for concrete acceptance purposes.

h. When concrete fails to meet the requirements above or when tests of field cured cylinders indicate deficiencies in protection and curing, the Owner’s representative may order tests on the hardened concrete in accordance with ACI-301 for that portion of the structure where the questionable concrete has been placed. In the event the core tests also indicate that the structure is unsatisfactory, make all modifications as directed by the Engineer to make the structure sound. If the core tests indicate the concrete is satisfactory, all cost of testing shall be paid by Owner.

5. Temperature
   a. Performed each time a set of compressive strength test specimens is made.
6. Testing Reports
   a. In addition to the reports provided to the Owner and Engineer, the Contractor shall ensure that the concrete producer is provided copies of all reports of tests performed on concrete samples taken to determine compliance with the specification requirements. Reports shall be provided on a timely basis.

PART 4 - SUBMITTALS

4.1 REQUIRED SUBMITTALS

A. The submittals required to become an approved source of supply for Portland Cement concrete:

1. Complete concrete mix design meeting all specification requirements. Meet the mix proportions specified in ACI 301. Submittals will include the following:

MIX PROPORTIONS	
-cement in lbs	Type and source of supply
-coarse aggregate	Size and source of supply
-fine aggregate	Source of supply
-water, gallons	City or well
-admixtures, oz/yd3	Brand and description*

*description as retarder, accelerator, air entraining, etc.

2. Items directly affecting a facility's ability to properly proportion, transport, and deliver concrete may be reason for disqualifying that facility as a source of supply until such deficiencies are corrected. Examples would include cement and aggregate scales that will not accurately weigh materials or mixer units which will not thoroughly mix concrete materials

B. MATERIALS INFORMATION

1. Specific gravity (bulk s.s.d. Basis) of coarse and fine aggregate and 1% absorption-coarse aggregate unit weight (dry-rodded)-ASTM C33 quality tests including the following:
   a. Fine aggregate
      1) gradation AASHTO, T27 and T11 deleterious substances soundness (AASHTO T104) organic impurities (AASHTO T21) mortar-making properties (AASHTO T71)
   b. Coarse aggregate
      1) Deleterious substances gradation (AASHTO T27 and T11) soundness (AASHTO T104) percentage of wear (AASHTO T96)
   c. Current chemical analysis of mixing water (if well)
   d. Current cement and fly ash mill analyses
2. CONCRETE MIX DATA
   a. slump
   b. % air content
   c. unit weight
   d. 7 day and 28 day compressive strength

3. VARIATIONS

a. The following variations will be cause for submittal of a new mix design.

1) Change of aggregate source
2) Change of cement content
3) Addition or exclusion of certain admixtures including, but not limited to, pozzolans, accelerators, retarders and water reducers
4) Change in aggregate size
5) Change in type of cement
6) Failure to attain strength requirements as outlined in ACI 301 or ASTM C94

b. A variation in any of the following will require informing the Engineer and Owner.

1) Change of cement supplier
2) Change of admixture brands or dosages (not types)
3) Minor adjustments of aggregate proportions accompanying materials changes or to accommodate placement conditions (same w/c ratio).

C. Certification of Ready Mixed Concrete Production Facilities

a. Concrete producers are to allow access to their facilities by Engineer or the Owner representatives for inspecting their facilities and/or sampling materials. All facilities should meet the requirements of the "National Ready-Mix Concrete Association" check list for concrete production facilities.

b. Items directly affecting a facility's ability to properly proportion, transport and deliver concrete may be reason for disqualifying that facility as a source of supply until such deficiencies are corrected. Examples would include cement and aggregate scales that will not accurately weigh materials or mixer units that will not thoroughly mix concrete materials.

D. The following chart indicates the submittal frequency for each item required for approval as a source of supply.

TABLE 4.1 SUBMITTAL FREQUENCY

SUBMITTAL	FREQUENCY		
	Monthly	Annually	Other
1- Complete mix design			Every 3 years*
2. Aggregate gradations	X		With mix design
3. L.A. Abrasion			With mix design
4. Soundness			With mix design
5. Deleterious substances			With mix design
6. Water quality (if well)		X	
7. Cube strengths and time of set			With mix design
8. Cement mill certificates	X		
9. Organic Impurities			With mix design
10. Inspection of facilities			As indicated

Note: The monthly reports indicated above will not be required during non-production months. Frequency of submittals may change as dictated by variations of test data.

*Or per directed by section 4.2.B.3a

END OF SECTION