

TECHNICAL SPECIFICATIONS

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SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 Project Description

- A. (Varies per development)
- B. The project is located as shown in the approved Drawings.

1.02 General

- A. Contractor shall perform all work to produce the construction as described by the approved Drawings, Town of Timnath Construction Specifications, and the Development Agreement
- B. Contractor, subcontractors, and material suppliers shall inform themselves as to conditions relating to execution of work of each Section.
- C. Division 1 - General Requirements is applicable to all Sections of work included herein; Contractor shall abide by these requirements throughout work.
- D. Sequence of operations or place of work commencement may be determined by the Town as deemed to best serve needs and convenience of the Town, or as necessity if occasion requires.
- E. Contractor shall restore to original condition or better all areas disturbed by construction, unless otherwise indicated.
- F. Contractor shall be thoroughly familiar with the provisions and the content of these Specifications and shall be responsible for meeting the requirements of these Specifications.

1.03 Reference Standards

- A. Where reference is made to an industry standard, any technical society, organization, or association, or to codes of local or state authorities, reference is to standard in effect at time of opening of bids, unless otherwise noted.

1.04 Definitions

- A. The term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. The term "install" is used to describe operations at project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- C. The term "provide," "place," or "construct" means to furnish and install, complete and ready for the intended use.

- D. References to the "Town" are to the Town of Timnath
- E. References to "Engineer" or "Town Engineer" or "Construction Coordinator" or "Inspector" shall mean the person authorized by the Town to represent the Town for this project and who shall be the Contractor's contact person.
- F. References to "Design Engineer" shall mean the individual, partnership, or corporation who is registered as a professional engineer in the State of Colorado and who is hired by the Developer to provide engineering services for this project.
- G. References to "Contractor" shall mean the corporation, association, partnership, or individual who has entered into an Agreement with the Developer to perform the Work.
- H. References to "Developer" shall mean the corporation, partnership, or individual who has entered into an agreement with the Town through an approved Development Agreement and who has hired the Contractor to perform the work.
- I. The term "Drawings" or "Plans" or "Details" shall mean the detailed and working drawings, including plan, profile, and detail sheets of the proposed improvements as approved by the Town and signed and stamped by the Design Engineer.
- J. The term "Work" shall mean the entire completed construction or the various separately identifiable parts required to be furnished for the project. Work is the result of performing the services required by the Drawings and Specifications.
- K. The term "Specifications" shall mean the Construction Specifications current at the effective date of the Development Agreement and which are included in the Town of Timnath Design Criteria Manual and Construction Specifications document.
- L. The term "District" shall mean the water and/or sanitary sewer provider responsible for providing potable water service or sanitary sewer service for the Development.
- M. The term "working days" shall exclude weekends (Saturday and Sunday) and holidays.
- N. ASTM – American Society for Testing and Materials
- O. CDOT – Colorado Department of Transportation
- P. ACI – American Concrete Institute
- Q. OSHA – Occupational Safety and Health Administration
- R. AWWA – American Water Works Association

1.05 Specification Explanation

- A. Should anything be omitted from the approved Drawings which is necessary for a clear understanding of the work, or should it appear that various clarifications are in conflict, the Contractor shall then notify the Engineer and Design Engineer in writing and secure written instructions from the Design Engineer, subject to the Town's approval, before proceeding with the construction affected by such omissions or discrepancies.
- B. In addition to the Specifications contained in the Contract Documents, reference is also made to the State of Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction and the Larimer County Urban Area

Street Standards, which shall be from the latest edition and construed to be a part of these documents by reference.

- C. Written dimensions on drawings and details supercede the measured (scaled) dimensions.

1.06 Coordination

- A. Contractor shall coordinate its activities to facilitate general progress of work. Inspect Drawings for interrelated work and afford each trade reasonable opportunity to install its work. Perform each item of work in proper sequence and arrangement to other activities in accordance with intent of the Approved Plans, Subdivision Improvement Agreement, and construction schedule.
- B. Anticipated project completion date will be based on deadline for Initial Acceptance set forth in the Subdivision Improvement Agreement.
- C. Contractor and subcontractors shall periodically inspect work in progress to ensure proper preparation for their work and so that no delay is caused in progress of work.
- D. Notify Town when work is complete in compliance with Approved Plans and the Subdivision Improvement Agreement.
- E. Prior to the commencement of Work at the site, a preconstruction conference will be held at the Public Works Facility Town Hall. Reference the Design Criteria Manual, Part I, General Standards.
- F. Contractor shall be responsible for coordinating work affecting any utility with that utility's owner. All connections to or work affecting existing Town or District utilities shall be done at a time authorized by the Town or District.

1.07 Work Shut-Down

- A. The Town, ~~or~~ Engineer, or Inspector may order work shut down or suspended for such nonconformance issues as unsafe conditions, nonconformance with schedule, cause of public nuisance, unnecessary private property disturbance, materials and labor unsuited to the task, nonconformance to technical specifications, nonconformance with the Subdivision Improvement Agreement, failure to comply with permits, etc. A written warning will be given by the Town to the Contractor and Developer with a specified deadline during which time the Contractor and Developer shall remedy the cause(s) described on the warning. Failure to do so shall justify the Town to order work shut down or suspended. Such shutdown will not be compensated by cost reimbursement or time schedule adjustment.
- B. Failure to promptly execute the approved schedule in the judgment of the Engineer will result in a written warning submitted to the Contractor and Developer explaining the specific compliance needed. Failure of the Contractor and Developer to remedy the noted items may be considered a breach of the Subdivision Improvement Agreement, lead to work being suspended, and/or bonding payment being pursued to have the work finished by others.

1.08 Regulatory Requirements

- A. Comply with local and municipal ordinances and applicable state and national codes.
- B. Provide all necessary licenses and permits and pay all fees, taxes, and royalties. An annual contractor's business license shall be obtained from the Community Development Coordinator for all contractors and subcontractors performing work within Town limits. The license may be obtained once the applicable form is filled out and the fee is paid.
- C. Regulatory compliance includes, but is not limited to, filing information on hazardous materials (if any) to be used at the project site with the State Emergency Response Board, the Local Emergency Planning Committee (county agency), and the local fire department in accordance with the Superfund Amendment and Reauthorization Act (SARA) Title III. If reportable amounts of hazardous materials will be used at the project site, Contractor shall file material safety data sheets and tier two reports, along with the project's Drawings and the Town's Construction Specifications needed by Contractor.
- D. Contractor shall obtain a construction dewatering permit from the Colorado Department of Public Health and Environment (CDPHE) if groundwater will be discharged or drain to an irrigation ditch, stream, river, pond, or waterway. Contractor should note that it will take time (approximately 45 days) for the CDPHE to review and approve a permit application. Contractor shall prepare and submit permit application to the CDPHE immediately after Notice of Award and prior to the Notice to Proceed. Contractor shall be responsible for following all requirements of the permit.

1.09 Easements and Rights-of-Way

- A. Contractor shall be responsible for acquiring a right-of-way work permit ~~and a grading permit~~ from the Town. A right-of-way work permit may also be required from Larimer County for work within the County right-of-way.
- B. Contractor shall coordinate with CDOT for any construction permit applications, submittals and requirements related to work performed in the Interstate 25 right-of-way. Contractor shall follow any CDOT requirements.
- C. Contractor shall confine their construction operations within the limits indicated on the Drawings within the public right-of-way or designated easements, and shall use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies, so as to minimize damage to property and interference with traffic.

1.10 Field Measurements and Inspection of Surfaces

- A. Verify grades, lines, levels, locations, and dimensions as shown on Drawings, and inspect surfaces that are to receive work before proceeding with excavating, clearing, fabricating, assembling, fitting, or erecting, or any other portion of the Work. Contractor shall be solely responsible for accuracy of measurements and laying out its work. Notify Engineer in writing in case of unsuitable conditions, defective substrates, or discrepancies in the Approved Plans or Specifications. Starting of work shall imply acceptance of conditions.
- B. Correct any errors or defects due to faulty measurements, improper layout, or failure to report discrepancies. Remove and replace work applied to defective substrates at no

additional cost. Developer and Design Engineer shall be responsible to correct any errors, defects, or necessary changes to the Approved Plans. Any changes must be reviewed and approved by the Town.

- C. Submit copy of survey notes and cut sheets to the Engineer when requested. Engineer's review of such material shall not relieve Contractor of being solely responsible for accuracy of survey, measurements and laying out of its work.
- D. Proof Roll. Before the pavement subgrade is deemed acceptable for future street reconstruction and temporary recycled asphalt patching, Contractor shall perform a proof roll test in accordance with the Larimer County Urban Area Street Standards. Failure of the proof roll test in the sole opinion of the Engineer/Inspector shall require subgrade and trench backfill material removal, replacement, and compaction at the Contractor's expense.

1.11 Records

- A. Contractor shall keep neat and legible notes of measurements and calculations made by him or her in connection with the layout of the work. Copies of such data shall be furnished to the Engineer for use in checking Contractor's layout as provided under Paragraph 1.10, Field Measurements and Inspection of Surfaces.
- B. Record Drawings shall be submitted to the Town for approval. The Contractor shall record construction information concurrently with construction progress. Record Drawings shall be marked legibly and with an indelible pen. Record Drawings shall record actual construction and contain, but not be limited to, the following:
- Field dimensions, elevations, and details
 - Field changes which are made by minor deviations to the Drawings
 - Details which are not on the original Drawings
 - Surveyed elevations of manhole inverts in relation to the project datum
 - Surveyed horizontal location of manhole lids
 - Field locations of utilities changed or altered as part of the Work
- C. Work to survey improvements for the Record Drawings shall be performed under the direction of a licensed professional surveyor in the State of Colorado.

1.12 Utility Locates and Potholing

- A. Contractor shall be responsible for field locating existing utilities prior to construction and for protecting those utilities during construction. The Contractor may undertake potholing if they so desire as an aid to their work. This potholing may be done at the Contractor's discretion at those locations as determined by the Contractor to confirm location and elevation of utilities before construction. Potholing results shall be submitted to the Town and Design Engineer and shall include elevation (not depth) to each utility. In the event that during the course of the Work the Contractor discovers a previously unknown utility, Contractor shall coordinate with the Town and Design Engineer to determine the best course of action. If deemed necessary by the Town or Design Engineer, the utility may require relocation.

1.13 Salvage of Materials and Equipment

- A. Existing materials and equipment removed, and not reused, as a part of the Work, including excess fill material, asphalt, and concrete shall become property of the Contractor.
- B. Existing materials and equipment removed by Contractor shall not be reused in the Work except where so specified or indicated.

1.14 Notice to Owners and Authorities

- A. Notify Engineer at least 5 working days prior to beginning the Work and before closing or restricting any public thoroughfares.
- B. Contractor shall notify owners of adjacent property and utilities when prosecution of the Work may affect them. Notification shall be given at least 48 hours (exclusive of holidays and weekends) prior to the expected disturbance.
- C. Contractor shall have all utilities field-located by requesting such from the Utility Notification Center of Colorado.
- D. Contractor shall give the Town a minimum of 48 hours notice (exclusive of holidays and weekends) prior to locates, testing, and inspections.
- E. Notify Engineer or Inspector prior to backfilling any items being abandoned so that abandonment procedure can be verified.
- F. Notify and maintain regular contact with the Larimer County Sheriffs Department and the Poudre Valley Fire Authority regarding upcoming road closures, construction sequencing, and daily traffic control that may affect emergency vehicle access and travel routes.
- G. Contractor shall not conduct work on holidays or weekends without prior approval of the Town.
- H. Operation hours in the Town can begin no earlier than 7am and no later than 7pm unless written approval is acquired from the Contractor by the Town, Engineer or Inspector

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1.15 Connections to Existing Facilities

- A. Unless otherwise specified or indicated, Contractor shall make all necessary connections to existing facilities including structures, drain lines and utilities such as water, sewer, storm sewer, gas, telephone, and electric. In each case, Contractor shall receive permission from the owning utility prior to undertaking connections. Contractor shall protect facilities against deleterious substances and damage.

1.16 Construction Survey

- A. Contractor shall be responsible for construction staking necessary for proper and accurate completion of the work covered by this contract. The Contractor shall provide experienced instrument personnel, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement

work. Survey work shall be performed by or under the direction of a licensed professional surveyor in the State of Colorado.

- B. All work shall be performed to the lines, grades, and elevations shown on the approved plans. When construction falls within the following tolerances, the installation will be acceptable to the Town, with respect to the lines and grades. If the tolerances are not met, the contractor shall be responsible for performing modifications to the facilities or redesign by the design engineer to bring the construction into the tolerances. The design engineer may impose stricter tolerances as necessitated by the project. Other construction specifications may affect the minimum tolerances shown below. The stricter standard shall govern.

Description:	Maximum Permissible Deviation from Alignment and Elevation shown on the Drawings:
Horizontal centerline alignment of pipelines	0.50 feet (6 inches)
Vertical elevation of pipelines (inside invert)	0.05 feet (5/8 inch)
Horizontal location of structures	0.50 feet
Vertical elevation of structures	0.10 feet
Vertical elevation of roadways	0.05 feet
Overlot grading	0.25 feet
Final grading	0.10 feet

Contractor shall remove and reconstruct work that is improperly located. Horizontal and vertical alignments shall be checked as the work progresses. Contractor shall report results to the Town Engineer or Inspector.

If the construction survey uncovers any discrepancies, the Contractor shall notify the Design Engineer prior to construction proceeding. The Contractor and Design Engineer are responsible for resolving apparent discrepancies and performing any subsequent modifications. Modifications to the Approved Plans shall follow the procedures of Part I, Section 9.10, of the Town of Timnath Design Criteria Manual.

1.17 Material Testing During Construction

- A. All material testing required by these Specifications is the responsibility of the Contractor. All field and laboratory test results shall be submitted to the Engineer in writing as soon as possible after completion of the test.
- B. Material testing shall be performed directly by or under the responsible charge of a professional engineer licensed in the State of Colorado.

- C. Reference individual Technical Specifications for specific material testing requirements.
- D. The Town may at times and at various locations, at the Town's discretion, perform field and/or laboratory tests on construction items such as, but not limited to in place density of backfill materials, in place density of subgrade materials, concrete slump and compressive strength, and material gradations. Tests may be conducted by the Town for acceptance of completed work upon notification by the Contractor or the Town may rely upon the separate testing documentation provided by the Contractor for this determination. The cost of Town initiated tests will be the responsibility of the Town except in the case of failed tests which result in rejection of the work and retesting by the Town. The Contractor shall be liable for the cost of all retesting.
- E. Contractor shall follow the recommended guidelines and procedures of the Development's geotechnical investigation report.

1.18 Environmental Controls

- A. Maintain erosion control measures to protect the project site, public right-of-way, and private property and prevent sediment pollution of adjacent water courses and properties.
 1. Install erosion control measures prior to start of construction and maintain them until final completion of work. Erosion control facilities shall be checked by the Contractor and replaced if necessary at a minimum of once every two weeks and after each storm event. Unless otherwise instructed, remove temporary erosion control measures prior to final application for payment.
 2. When temporary erosion control measures are removed, Contractor shall be responsible for the clean up and removal of all sediment and debris from all drainage infrastructure, streets, other public facilities, and private property. All removed sediment and debris shall be disposed of in a manner and location so as not to cause their release into any waters of the United States.
 3. There shall be no earth-disturbing activity outside the minimum required for completion of the Work as shown on the Drawings.
 4. Strive to limit the exposure of bare soil in order to minimize the possibility for erosion to occur.
 5. No soil stockpile shall exceed ten (10) feet in height. All soil stockpiles shall be protected from sediment transport by surface roughening, watering, and perimeter silt fencing.
 6. Construct and maintain filter fabric barriers, wattles, or temporary diversions to receive runoff leaving site. In addition to Contractor determined erosion control measures and those specified in an approved Water Control Plan (see Section 02240), construct and maintain those measures indicated in the Drawings. All required erosion control measures shall be installed at the appropriate time in the construction sequence as indicated in the approved project schedule.
 7. Protect storm drain inlets by using filter fabric barriers, wattles, gravel inlet protection, or equivalent.

8. Soil or sediment deposition is not allowed on public or private streets not part of the construction site. Contractor shall take care to prevent the tracking of mud and the inadvertent dropping of sediment out of the construction site. The Contractor shall remove any such deposition immediately.
9. Contractor shall control the quality of water originating from his operations so as to have no measurable or visible impact on irrigation ditches or the Cache La Poudre River.
10. Contractor shall not wash sediment through or allow sediment to enter a storm sewer pipeline (existing or proposed), the Cache La Poudre River, or any irrigation ditch. Contractor shall clean to a level satisfactory of the Engineer any sediment inadvertently or otherwise deposited in a pipeline or that negatively affects a canal or the river.

- B. Colorado Discharge Permit System (CDPS) requirements make it unlawful to discharge or allow the discharge of any pollutant or contaminated water from construction sites. Pollutants include, but are not limited to discarded building materials, concrete truck washout, chemicals, oil and gas products, litter, and sanitary waste. The Contractor shall at all times take whatever measures are necessary to assure the proper containment and disposal of pollutants on the site in accordance with any and all applicable local, state, and federal regulations.
- C. Minimize dispersion of dust from construction operations by application of water or other dust control materials. Controls shall confine dust and dirt within the immediate area of the project. A water truck shall be available throughout the project for dust abatement as necessary. All land disturbing activities shall be immediately discontinued when fugitive dust impacts adjacent properties, as determined by the Town.
- D. Provide noise control measures to limit the amount of noise and prevent nuisance. Properly equip all equipment with mufflers. Limit construction activities generating significant noise to normal working hours (between 7am and 7pm).
- E. If underground petroleum storage tanks, petroleum contaminated soils, or other hazardous environmental conditions are encountered, and are not identified to be part of the work, Contractor shall immediately stop work in connection with the hazardous condition and shall notify the Town.
- F. The Inspector must be notified at least 48 hours prior to any construction on this site.

1.19 Safety and Protection

- A. Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. Contractor shall take all necessary precautions for the safety of and shall provide the necessary protection to prevent damage, injury or loss to:
 - Employees and others on the work site
 - Other persons who may be affected by the work

- Other property at the site or adjacent to, including but not limited to trees, shrubs, lawns, other landscaping, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of the work.

B. Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Where any of these are in conflict, the more stringent requirement shall be followed.

C. Contractor shall comply with all applicable OSHA regulations.

1.20 Traffic Control

A. Conduct operations to ensure minimum interference with streets, walks, and adjacent facilities not part of construction project.

B. Schedule work so as to minimize inconvenience to businesses and residences located adjacent to the project. Coordinate with individual property and business owners.

C. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes, including signage, around closed or obstructed traffic ways.

D. Prepare a Final Traffic Control Plan for review and approval by the Town, Larimer County, Weld County, the Town of Windsor and CDOT as appropriate and implement its specified measures.

E. Traffic control at all locations within the project area shall be in general conformance with the most recent CDOT adopted MUTCD (2000 version).

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F. All construction zone traffic control devices, including but not limited to barricades, signs, arrow panels, variable message boards, flashing beacon (portable), and channelizing devices, shall be installed by the Contractor, maintained (including washing), replaced if damaged or stolen, removed when temporarily not in use, reset as necessary during the progress of construction, and removed entirely when the project is complete. Contractor shall provide traffic control inspection and supervisor services. At a minimum, daily inspection of all traffic control devices is required.

G. All affected local streets shall have a minimum of one lane open during non-construction hours for local access and appropriate signing shall be used. Driveway access shall be restored at the end of each construction day if at all possible. Collector and arterial status streets shall be reopened at the end of each day unless prior approval is received from the Town.

H. Vehicular access shall be provided to businesses at all times throughout construction. Signage that is visible to vehicular travel shall be placed to indicate that businesses are open during construction.

I. Pedestrian access shall be provided to businesses and residences at all times throughout construction.

J. When streets are to be closed or restricted, notify all Emergency Services, including but not limited to fire, police, and ambulance, at least 48 hours in advance.

- K. Notify businesses and residents to inform them of traffic control and access procedures and allow adequate time (48 hours minimum) to remove vehicles prior to obstructing driveways, alleys, and street access.
- L. Contractor shall be responsible for restoring street surfaces to an acceptable traffic condition before opening them to traffic per the requirements of the Town of Timnath Design Criteria Manual and Construction Specifications.

1.21 Watermain

- A. All connections between new and existing watermain shall be performed using the appropriate procedures as required by the District. All new watermain segments shall be constructed, disinfected, and tested per District specifications prior to shut down and connection to the existing watermain.
- B. Where storm or sanitary sewer lines cross watermains, there shall be a minimum of 18 inches clear distance vertically between the two. Clearance shall be evaluated at all storm sewer and watermain crossings as indicated on the Drawings. Butyl rubber joint sealant protection shall be provided for all storm and sanitary sewer crossings. Protection shall consist of wrapping the storm and sanitary sewer joints with at least 12-inch wide joint sealant material on each joint within a distance of 10 feet on each side of the watermain (reference individual pipe material Specifications). In all cases, suitable backfill (flowable fill) or other approved structural protection shall be provided to prevent settling and/or failure of the pipes. Coordinate with the District for any additional measures.
- C. Existing water and sanitary sewer services to buildings may be interrupted temporarily to make required reconnections to new mains, but any interrupted services shall be reconnected and made fully operational at end of each working day. Businesses shall not be interrupted for more than 4 consecutive hours without prior approval. Some businesses may not be able to experience loss of service during business hours. Therefore, Contractor shall perform shut downs at night as necessary to accommodate business needs.
- D. Contractor shall notify property owners a minimum of 48 hours and business owners a minimum of 72 hours prior to any service interruption, which shall be for the minimum amount of time possible. Contractor shall coordinate with the Engineer and the District for all water service shut downs and scheduling. Contractor shall not operate valves except under emergency circumstances.

1.22 Restoration

- A. Contractor shall return all areas disturbed by the Work to their original or better conditions in both function and appearance. Contractor shall be responsible for all finish grading, cleaning, repairing, topsoil import, revegetation, and restoration of areas disturbed by the Work.
- B. Contractor shall provide vegetation restoration, including watering, in accordance with Part I, General Standards, of the Town of Timnath Design Criteria Manual.

1.23 Technical Specification Clarifications

- A. The following items refer to the standard Technical Specification that is updated, clarified, or revised within this Paragraph 1.35 of Section 01010:
02240/3.01 - Water Control, Execution, General - The Contractor shall not be permitted to interrupt the flow of any irrigation water and shall maintain measures to allow existing conditions delivery of irrigation water. The Contractor shall prevent irrigation water from entering the work area.

02321 - Trenching, Backfilling, and Compacting; 01500 - Construction Facilities and Temporary Controls - Construction materials, falsework, equipment, forming and bracing, fencing, and similar components of construction activity shall be adequately designed and secured to withstand minimum wind velocities of 125 miles per hour which are reasonably possible along the Colorado Front Range. Contractor shall be responsible for wind-blown debris, including dust and damage to structures, property, and persons which occurs due to the displacement by wind of materials and equipment for which he or she is responsible.

02321 - Trenching, Backfilling, and Compacting - Creation and maintenance of open excavations in a safe manner is the full responsibility of the Contractor.

02321/3.10 – Trenching, Backfilling, and Compacting; Granular Bedding – Granular bedding for all PVC and HDPE pipe shall be placed from the trench bottom as dimensioned in the Drawings (standard details) to a minimum of 1-foot above the top of the pipe.

02506/2.02B - Concrete Pipe and Fittings, Reinforced Concrete Pipe (RCP) and 2.03 Rubber Ring Gaskets – Joints for concrete pipe shall be push on bell and spigot type in accordance with ASTM C443. All gaskets shall be o-ring or profile type manufactured in accordance with ASTM C443. Storm sewers crossing irrigation ditches shall have butyl rubber exterior joint sealant, 12-inch material width minimum, at all pipe joints within 20 feet to either side of the ditch crossing.

1.24 Unfavorable Construction Conditions

- A. During unfavorable weather, wet ground, frozen ground, or other unsuitable construction conditions, the Contractor shall confine his operations to work that will not be affected adversely by such conditions. No portion of the work shall be constructed under conditions that would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the work in a proper and satisfactory manner. The Contractor shall also protect all exposed utilities from damage due to unfavorable weather.

1.25 Special Requirements

- A. All work must be accepted by the Town and District(s) prior to being placed in service.
- B. Field changes from the approved plans shall not be permitted without prior permission from the Town.
- C. Contractor shall warrant all work for a period of two (2) years after Initial Acceptance and acceptance of all portions of the Work.

- D. The Owner shall make periodic checks of the work to verify its quality and progress. The Engineer, Inspector, and any other authorized representative of the Town shall be provided safe access to the work whenever it is in preparation or progress.

1.26 Closeout Procedures

A. Substantial Completion

1. Contractor shall notify Engineer when it considers the Work (or a portion of the Work which the Town agrees to accept separately) to be substantially complete. Contractor's notice shall include a comprehensive list of items to be completed or corrected.
2. Upon receipt of Contractor's notice, Engineer will schedule a project walk-through with the Contractor, Developer, Town, District(s), and Design Engineer to inspect and verify that the Work is substantially complete.
3. If the Town considers the Work to be substantially complete, the Town will issue a notice of Initial Acceptance along with a "punch list" of items to be completed.
4. Contractor shall complete items on the punch list to the Town's satisfaction within 30 days unless a written extension is granted by the Town. Contractor shall notify the Engineer of work schedule and when work is complete.
5. If Engineer does not consider the work to be substantially complete, the Engineer will inform the Contractor of items that need to be completed or corrected before Initial Acceptance may be considered. Contractor shall promptly complete these items and request a reinspection by the Engineer.

A. Closeout Submittals. Submit the following items to the Town:

1. Project record documents marked to show all changes made during construction and as-built information as specified.
2. Evidence of continuing insurance coverage complying with insurance requirements.
3. Contractor's affidavit, along with final releases and waivers of liens as required, indicating that all debts and claims against project have been paid in full or otherwise satisfied.
4. Consent of surety company to final payment.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

1.01 Summary

- A.A. Submit items to Town for review as listed below and as required by the other Specifications. Refer to individual specification sections for submittal requirements.

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1.02 Related Sections

- A. Section 01010 – Summary of Work

1.03 Submittals

- A. Submit items for review as listed below and as indicated in individual technical specification sections. Unless otherwise indicated, submit the following quantities for each type of submittal:
- List of contractors and subcontractors with qualifications and references: 2 copies
 - Comprehensive C.P.M. construction schedule: 5 copies
 - Water control plan: 5 copies
 - Traffic control plan: ~~35~~ copies
 - Concrete and grout mix designs: 5 copies
 - Shop Drawings: 5 copies
 - Product Data: 5 copies
 - Permits and Approvals: 2 copies
 - Material testing results: 1 copy
 - Others as required by individual Technical Specifications
 - Record drawings: 2 copies of Preliminary and Final Plat and 14 copy Construction Drawings(mylars and electronic CAD files)
- B. Engineer will examine submittals promptly and will respond with a recommendation within ~~30 business days~~fourteen days. Submittals of construction materials and products shall be provided to the Engineer at least ~~thirtyfourteen~~ days before such materials are needed for the construction and are subject to their approval. As-constructed field drawings (Record Drawings) shall be provided before initial acceptance is given. Contractor will not be afforded additional time or compensation in the event of delays in construction resulting from rejection of materials by the Town or Engineer.
- C. Submittals shall not be used in the work unless they have been reviewed and bear the reviewed stamp and signature of Engineer. Submittals will only be reviewed for general conformance with the design concept of the project and general compliance with the information given in the approved plans. Contractor shall be responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating his or her work with that of all other trades, and performing all work in a safe and satisfactory manner. Corrections or comments made on submittals shall not relieve Contractor from compliance with requirements of Drawings and Specifications and shall not be considered an order for extra work.
- D. The project schedule must be updated and resubmitted monthly.

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- E. Required shop drawings and product data submittals are designated under the various technical specifications.
- F. Other than mobilization, work will not be allowed at the site until Town approval has been given for the construction schedule and water control plan and receipt of all necessary permits has been confirmed (i.e., grading permit, right-of-way work permit, etc.).

1.04 Construction Schedule

- A. Prior to or at preconstruction conference, submit five (5) copies of a proposed schedule of operations that demonstrates how work will be completed within given time frame reflecting anticipated adverse weather delays, milestones, and specific details.
- B. After acceptance of construction schedule, distribute copies to subcontractors and other parties required to comply with scheduled dates.
- C. When revisions to schedule are made, notify all parties of changes and submit revised schedule to the Town .

1.05 Schedule of Submittals

- A. Within 10 days of acceptance of construction schedule or at preconstruction conference, submit two copies of a schedule of submittals. Schedule shall list anticipated date for each required submittal and shall allow Engineer at least ~~thirtyfourteen~~ days for reviews.
- B. After acceptance of schedule of submittals, distribute copies to subcontractors and other parties required to comply with submittal dates.

1.04 Shop Drawings

- A. Required shop drawings are designated under the various specification sections. Submit shop drawings for review prior to fabrication, delivery, or installation. Submit a minimum of five copies; two copies will be retained and the remainder returned to Contractor who shall keep one copy at project site. The Design Engineer shall also review and approve shop drawings.
- B. Fabrication and erection drawings may consist of a reproducible transparency and two sets of prints; the reproducible copy will be returned to Contractor.
- C. Each brochure of shop drawings shall contain an index of contents and shall consist of layout details, schedules, setting instructions, manufacturer's literature, and other data specifically prepared for the work. Shop drawings shall be identified with project name, numbered consecutively, and bear the stamp of approval of Contractor as evidence of accuracy, compatibility, and conformance with contract requirements. Drawings not so stamped will be returned without being examined. Reproductions of contract drawings may not be used without prior approval.
- D. Specific written notice shall be given of each variation that shop drawings may have from requirements of the Contract Documents.
- E. Partial submittals will not be considered; each portion of work shall be complete in one submittal.

- F. Shop drawings shall not be used in the work unless they have been reviewed and bear the stamp and signature of the Engineer and Design Engineer. Shop drawings will only be reviewed for general conformance with the design concept of the project and general compliance with the information given in the approved plans. Contractor shall be responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating his or her work with that of all other trades, and performing all work in a safe and satisfactory manner. Corrections or comments made on shop drawings shall not relieve Contractor from compliance with requirements of Drawings and Specifications.
- G. If information on previously reviewed shop drawings is altered, submit changes for review.

1.06 Product Data

- A. Required product data submittals are designated under the various specification sections. Submit product data for review in accordance with procedures for shop drawings.
- B. Product data shall consist of manufacturer's literature, illustrations, and brochures of catalog cuts; instructions for handling, storage, and installation; and specifications and design data.
- C. Products subject to product data review shall not be used in the work until they have been reviewed and bear the stamp and signature of Engineer and Design Engineer.

1.07 Samples

- A. Prior to fabrication, delivery, or installation, submit samples as designated in the various specification sections; allow reasonable time for review and testing.
- B. Submit samples in sufficient quantity and of adequate size to show quality, type, and extremes of color range, finish, and texture. Submit a minimum of two sets of appearance and color samples. Label each sample stating material, description, project name, and Contractor's name. Expedite submittal of appearance and color samples following the pre-construction conference.
- C. Submit samples with transmittal letter requesting review; prepay transportation charges. Samples shall become the Town's property, unless otherwise designated.
- D. Samples will be reviewed for acceptability or selection of color, pattern, and texture only. Compliance with specifications is the responsibility of Contractor.
- E. Order no materials subject to sample review until receipt of written notice of completion of review. Installed materials shall match reviewed samples. No review of samples shall be taken in itself to change contract requirements.

1.08 Certificates of Compliance

- A. Submit two copies of certificates of compliance as designated in the various specification sections.
- B. Certificates shall be furnished by manufacturer, producer, or supplier of material or product and shall indicate that material or product conforms to or exceeds specified requirements. Include supporting reference data as appropriate. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer.

1.09 Permits and Approvals

- A. Submit two copies of permits, code inspections, and agency approval documents, as designated in the various specification sections.

1.10 Test Reports

- A. Submit two copies of test reports as designated in the various technical specifications.

1.11 Project Record Documents

- A. Keep a current set of documents at job site at all times that are marked to show all changes made during construction. Dimension underground and concealed work and utilities from permanent reference points; record vertical distances. Submit project record documents upon completion of Work.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1.01 Temporary Electricity

- A. Contractor shall provide temporary electric service and distribution facilities for its own construction purposes. Provide portable power supply or make arrangements with local utility company for temporary service including service poles, driven ground, main service switch, transformer, and metering facilities, and pay for electrical energy consumed.

1.02 Temporary Lighting

- A. Contractor shall provide temporary lighting sufficient to enable its workers to complete work and to enable inspectors to check work, as required.

1.03 Temporary Heating and Ventilating

- A. Contractor shall provide temporary heat and adequate ventilation to protect its own work and materials from damage. Unless otherwise approved, temporary heating units shall be portable hot air type with electric blowers and automatic controls. Use of units which may damage materials will not be allowed. Provide proper ventilation. Keep equipment in a clean and safe condition; carefully guard against fire.

1.04 Temporary Telephone

- A. Contractor desiring private telephone installation shall pay all costs of such service.

1.05 Temporary Water

- A. Contractor shall be responsible for obtaining water for its needs. Pay cost of water used and meter rental, if applicable.

1.06 Temporary Sanitary Facilities

- A. Contractor shall provide temporary outside toilets sufficient for its own workers. Toilets shall be self-contained chemical type. Maintain sanitary facilities in a clean and sanitary condition; supply toilet paper until completion of project.

1.07 Temporary Fire Protection

- A. Contractor shall provide fire extinguishers and other fire protection equipment for all possible classes and types of fire.

1.08 Protection of Work & Property

- A. Observe safety provisions of applicable laws and building codes.

- B. Erect and maintain all required planking, barricades, guard rails, fences, safety lanterns and temporary walkways of sufficient size, strength and type necessary for protection of material storage, open excavations, trench shoring, adjacent property and new construction, as well as to prevent accidents to public and workers at job site. Execute work in a manner to avoid interference with use of adjacent facilities. Safety of the public and workers is the sole responsibility of the Contractor.
- C. Notify Town if existing property interferes with work so that arrangements for proper protection can be made.
- D. Provide and maintain temporary shoring and bracing for existing utilities and other improvements encountered during work; protect them from collapse or other damage until such time as they are to be removed, incorporated into new work, or can be properly backfilled. Keep heavy loads off in-place utilities; provide planking over utilities where heavy traffic must cross. Repair damage to active utilities and other existing improvements. See drawings for approximate locations of underground utilities and improvements.
- E. Protect all work, materials, apparatus, and fixtures incorporated in work or stored on site against damage from rain, snow, wind, ice, storms or heat. Remove snow and ice as necessary for safe and proper execution of work. At end of day, cover all new work likely to be damaged.
- F. Maintain erosion control measures to prevent sediment pollution of adjacent water courses.
- G. Provide controls to confine dust and dirt within project area. Thoroughly soak masonry and debris during demolition and loading operations. Water exposed soils or aggregates as required to prevent windblown dust.
- H. Protect all finished construction until acceptance by the Town. Repair damage to finished work to satisfaction of the Town.

1.09 Construction Cleaning

- A. Site cleanup shall be ongoing to help provide a project site that is in a safe condition at all times.
- B. Construction materials shall be neatly stored.
- C. Remove rubbish and debris from work area promptly upon its accumulation. Perform a broom cleaning of all appropriate surfaces weekly.
- D. Immediately clean-up spillages of oil, grease, or other liquids which could cause a slippery or otherwise hazardous situation or stain a finished surface.
- E. Form or scrap lumber shall have all nails withdrawn or bent over; shall be stacked, placed in trash bins, or removed from site.

- F. At completion of project, thoroughly clean, sweep, and wash work to remove foreign matter, spots and soil from work and equipment under this contract. Remove temporary guards and protective coatings.

1.10 Disposal

- A. Provide industrial type waste containers in number and size required or provide other acceptable methods of disposing of debris. Place containers at adequate locations to handle debris and have them emptied as required. Containers shall not be stored in any existing public right-of-way without written permission from the local entity.
- B. No burning of rubbish or debris will be allowed at site.
- C. Store combustible waste in fire-resistive containers. Store hazardous wastes, such as caustics, acids, and harmful dusts, in appropriate covered containers. Dispose of wastes regularly.
- D. If a contractor does not remove rubbish or clean work as specified above, the Town reserves right to have work done by others at Contractor's expense.

1.11 Field Offices

- A. Contractor shall provide and maintain temporary offices where directed for himself and his subcontractors. Field offices shall not be located in any easement or right of way.

END OF SECTION

SECTION 02110

CLEARING, GRUBBING, AND STRIPPING

PART 1 GENERAL

1.01 Section Includes

- A. Clearing, grubbing, stripping, and otherwise preparing the project site for construction operations.

1.02 Related Work

- A. Section 02213 - Topsoil

1.03 Quality Assurance

- A. The Contractor shall employ only trained, experienced landscapers for completion of the work within the construction limits.
- B. Do not disturb ground surface or vegetation outside the construction limits.

PART 2 PRODUCTS

None Required

PART 3 EXECUTION

3.01 Clearing

- A. Remove and dispose of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth indicated for removal. Remove all evidence of their presence from the surface, including sticks and branches greater than 1 inch in diameter or thickness. Remove and dispose of trash piles and rubbish. Protect trees, shrubs, and vegetative growth which are not designated for removal.

3.02 Grubbing

- A. Remove and dispose of subsurface wood or root matter remaining after clearing, including stumps, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a minimum depth of 12 inches below the ground surface.

3.03 Stripping

- A. Remove and dispose of all organic sod, grass, and grass roots, and other objectionable material remaining after clearing and grubbing from the area, to a depth of 6 inches.
- B. Salvage topsoil for reuse as indicated on the drawings or as specified elsewhere.

END OF SECTION

SECTION 02213

TOPSOIL

PART 1 GENERAL

1.01 Description

- A. This section covers materials, handling, and installation for topsoil. Sections referenced in Subsection 1.02 are complimentary to this section.
- B. The work done under this contract shall include furnishing of all materials, labor tools, and equipment to install topsoil complete in place.

1.02 Related Work

- A. Section 02110 - Clearing, Grubbing, and Stripping

PART 2 PRODUCTS

2.01 Topsoil

- A. Topsoil shall consist of loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, roots, rocks, brush weeds, or other material which would be detrimental to the proper development of vegetative growth. A sample of the topsoil shall be supplied by the Contractor to the Town for approval.

PART 3 EXECUTION

3.01 Soil Preparation

- A. Excavated topsoil from the construction area or from borrow shall be placed directly upon constructed cut and fill slopes and vegetated without the use of stockpiles whenever conditions and the progress of construction will permit. Topsoil shall not be placed until the areas to be covered have been properly prepared and grading operations in the area have been completed. The underlying material shall be harrowed or rolled as necessary to properly key into the topsoil. Topsoil shall be placed and spread to a minimum thickness of 6 inches at locations shown on the Drawings to be covered by lawns and grasses. The topsoil shall be wetted to field capacity utilizing a fine water spray so as not to cause erosion of the topsoil and immediately thereafter seeded or sodded.

END OF SECTION

SECTION 02240

WATER CONTROL

PART 1 GENERAL

1.01 Section Includes

- A. Dewatering and controlling groundwater and surface water during construction.

1.02 Related Sections

- A. Section 02321 - Trenching, Backfilling, and Compacting

1.03 Submittals

- A. Submit water control plan and receive acceptance from the Engineer prior to initiating construction work. The water control plan shall include the location, height, and type of construction for all water control measures, including temporary dams or flow rerouting schemes. The plan must also include a schedule showing the location and duration of anticipated pumping, etc. The water control plan shall not create conditions where property outside of the construction limits is damaged, otherwise, the Contractor will be liable for any and all damages resulting from the deficient plan. A groundwater discharge permit is required from the State of Colorado and must be obtained prior to the start of construction. It will take approximately 45 days to obtain this permit from the State.

PART 2 PRODUCTS

2.01 General

- A. Implement the water control plan by using on-site natural materials or manufactured products and equipment as approved by the Engineer.

PART 3 EXECUTION

3.01 General

- A. Provide and maintain control of water from all sources during construction and provide sufficient labor and equipment to remove and properly dispose of water entering excavations or other parts of the work. Dewatering shall insure dry excavations and preserve the final lines and grades of excavations or trenches. Methods may include well points, sump pumps, replacement rock or gravel installed below the required bedding to facilitate drainage and pumping operations, temporary pipe lines, or other appropriate means.
- B. The Contractor shall expect to encounter groundwater while performing the work and to be responsible for controlling it so that the work may be accomplished.

- C. Temporary berms and dams may be allowed as an aid in controlling water in work area. The design, placement, permitting, and safety of these features is entirely the Contractor's responsibility. All excavations made as part of water control operations shall be backfilled and compacted in compliance with Section 02221.
- D. The Contractor shall be aware that flooding is possible in the work area. The Contractor acknowledges that they have investigated the risk of flooding associated with a 100-year flood and more frequent events and assumes all risks associated with these events. The Contractor shall conduct his construction operations in a manner such that the extent of flooding damage from these events is not aggravated by his activities, including but not limited to raising water levels and spatially diverting flow. Any damage done by such storm flows to the work shall be repaired by the Contractor at his expense.

3.02 Water Quality

- A. The Contractor is responsible for collecting and disposing of groundwater and surface water from the construction site in an appropriate and legal manner. The Contractor shall comply with all federal, state, and local regulations pertaining to disposal of such water. The water control plan shall include appropriate methods for limiting the sediment load discharged or flowing to an off-site location to a level acceptable to the property owner or regulator of the receiving waters. A groundwater discharge permit is required from the State of Colorado.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.01 Summary

- A. Provide earthwork as shown and as specified. Comply with applicable provisions of Div. 0 and Div. 1.

1.02 Related Sections

- A. Section 02110 – Clearing, Grubbing, and Striping
- B. Section 02321 – Utility Trenching and Backfill

1.03 Classification

- A. Excavation of materials encountered under this work will be unclassified without regard to type, difficulty to remove, or suitability for use in construction.

1.04 Submittals

- A. Test Reports: Submit reports for laboratory and field tests required under "Testing" article. Test reports for footing, slab, and pavement subgrades shall be submitted prior to placing concrete or paving materials. Make submittals in accordance with Section 01330.

1.05 Testing

- A. Contractor will arrange and pay for soil sampling and testing. Contractor shall extend full cooperation to Engineer and testing agency in obtaining samples and performing tests. Where soil materials do not conform to type or density specified, soil shall be replaced or reworked to conform. Cost of extra tests for replaced or reworked areas shall be paid for by Contractor.

1.06 Protection

- A. Protect existing improvements, utilities, trees and shrubs, and reference marks in accordance with Section 02321.

1.07 Blasting

- A. Use of explosives is not permitted.

PART 2 PRODUCTS

2.01 Soil Materials, General

- A. Soil materials shall be free of organic matter, debris, frozen soils, ice, and other objectionable materials. Rock particles larger than maximum size specified shall be removed prior to placement of soil.
- B. Select existing material from required excavations may be used for fill or backfill if it meets the specified product requirements. If necessary, furnish additional approved material from suitable off-site sources.

2.02 Granular Fill, Bedding, and Backfill

- A. Select soils complying with ASTM D2487 soil classification groups GW (well-graded gravel), GP (poorly-graded gravel), SW (well-graded sand), or SP (poorly-graded sand). Aggregate shall pass a 3/4-in. sieve and not more than 35% shall be retained on a No. 10 sieve. Maximum 5% by weight shall pass a No. 200 sieve.

2.03 Fill and Backfill

- A. Previously excavated soils, free of aggregate larger than 3 in., and suitable for intended purpose.

PART 3 EXECUTION

3.01 Preparation

- A. Prepare site for work in accordance with Section 02110. Layout and stake work to be performed.

3.02 Excavation

- A. Excavate to achieve necessary dimensions, lines, grades, and cross-sections. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 ft.
- B. For footings and foundations, take care not to disturb bottom of excavation. Excavate to final grade just before concrete is placed. Trim bottoms to required lines and grades to leave solid, undisturbed base to receive granular fill, base course, or concrete as shown.

3.03 Trenching

- A. Excavate trenches so that pipe can be laid safely and accurately to required line and grade. Hand excavate for bells, fittings and projections to allow for proper jointing and to insure that pipe rests evenly along barrel and is not resting on bell.
- B. In sand and gravel soils, bottom of trench may be shaped to fit bottom 1/3 of pipe. In silt or clay soils, bottom of trench shall be 4 inches below pipe barrel and 3 inches below bell. Under foundations and footings, bottom of trench shall be 8 inches below pipe. Provide Granular Bedding as specified below.

3.04 Unauthorized Excavation

- A. Unauthorized excavation consists of removal of materials beyond indicated elevations or side dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work, shall be at Contractor's expense. Notify Engineer if unauthorized excavations are made.
- B. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed.

3.05 Additional Excavation (Over Excavation)

- A. When excavation has reached required subgrade elevation, notify Engineer who will make an inspection of conditions. Inform Engineer of unsuitable, unconsolidated subgrade soils.
- B. If unsuitable bearing materials, such as poorly compacted fill, existing foundations, rubble, debris, or organic deposits, are encountered at required subgrade elevations, carry excavations deeper and replace excavated material with properly compacted Fill as directed by Engineer.
- C. Removal of unsuitable material and its replacement as directed will be paid for as extra work. Do not proceed with extra work until authorized.

3.06 Stability of Excavations

- A. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Slope sides of excavations to angle of repose of material excavated; otherwise, shore and brace where sloping is not possible either because of space restrictions or stability of material excavated. Comply with applicable codes and ordinances.

3.07 Dewatering

- A. Perform earthwork in a manner to prevent surface water and ground water from flowing into excavations. Promptly remove water from excavations using pumps, sumps, and dewatering system components necessary to convey water away from excavations. If underground springs are encountered, notify Engineer before proceeding.

3.08 Stockpiling

- A. Stockpile excavated materials meeting the requirements for fill and backfill where directed until required for the work. Place, grade, and shape stockpiles for proper drainage. Locate stockpiles a sufficient distance from edge of excavations to prevent such material from falling or sliding into excavations and to prevent cave-ins.

3.09 Cold Weather Protection

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F by covering with dry insulating materials of sufficient depth to prevent frost penetration.

3.10 Examination of Subgrade

- A. Examine subgrade prior to placement of fill or backfill. Do not place materials on frozen subgrade. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that material will bond with subgrade. When subgrade has a density less than that specified for the particular area, breakup ground surface, pulverize, moisture-condition to optimum content, and compact top 12 in. to density specified in Part 4 Schedules.

3.11 Filling and Backfilling, General

- A. Do not place fill or backfill until required excavation and subgrade preparation have been inspected and approved by Engineer.
- B. Place fill or backfill in approximately horizontal layers; do not exceed the maximum lift thickness specified in Part 4 Schedules before compaction. Spread piles and windrows uniformly.
- C. Adjacent to structures, place fill or backfill to prevent damage and allow structures to assume loads gradually and uniformly, at approximately the same rate on all sides of structure.

3.12 Granular Fill

- A. Provide 6 in. of Granular Fill immediately below concrete slabs and elsewhere as indicated on Drawings.

3.13 Trench Bedding and Backfill

See Section 02321 – Utility Trenching and Backfill

3.14 Backfill

- A. Provide Backfill material to bring excavations to natural or designated grade.

3.15 Grading

- A. Grade area within project limits by cutting and/or filling as necessary to achieve lines and grades shown. Grade areas adjacent to structure lines to drain away from structure to prevent ponding. Finish surface to be reasonably smooth and free from irregular surface changes. Tolerance for areas to receive topsoil shall be 0.3 ft above or below established grade, less allowance for topsoil. Tolerance for areas to be paved shall be 0.1 ft above or below established pavement subgrade.

3.16 Compaction

- A. Compact each layer of soil material to not less than the percentage of maximum density specified in Part 4 Schedules.
- B. Provide compaction equipment required to obtain specified compaction. Compaction by travel of grading equipment is not considered adequate for uniform compaction. Small vibratory compactors are required wherever fill is placed adjacent to foundation walls,

footings, and piers. Pipe bedding and initial backfill shall be hand or mechanically tamped.

- C. During placement and compaction, maintain moisture content of materials within optimum range.

3.17 Disposal of Excess and Waste Materials

- A. Remove excess excavated material, trash, debris, and other waste materials and legally dispose of them off-site.

3.18 Field Quality Control

- A. Moisture and density tests are the responsibility of the Contractor and shall be performed by a private Geotechnical Consultant.
- B. Field tests will be conducted to determine compliance of moisture/density testing methods with specified density in accordance with ASTM D2922.
- C. Test results shall be submitted to the Engineer by the Contractor or the Geotechnical Consultant for approval by the Town prior to acceptance of the pipeline and shall be made available on the day of the test.
- D. All failed test areas shall be recompacted and retested at Contractor's expense.
- E. All compacted material shall be within 2% (+/-) of the optimum moisture content of the soil as determined by ASTM D698. Water shall be added to the material, or the material shall be harrowed, disced, bladed, or otherwise worked to ensure a uniform moisture content as specified.

PART 4 SCHEDULES

4.01 Compaction Schedule (unless otherwise stated on the Drawings or other Specifications)

<u>Location</u>	<u>Lift Thickness⁽¹⁾</u>	<u>Compaction⁽²⁾</u>
Below foundations, slabs, pavements, walks, and other designated areas.	8"-9"	95%
Unpaved areas 15 ft. or less outside structure line.	8"-9"	95%
Unpaved areas more than 15 ft. outside structure line.	12"	90%

⁽¹⁾Place manually compacted materials in maximum 4-inch layers.

⁽²⁾Percent of maximum density determined in accordance with ASTM D1557 (Modified Proctor test).

END OF SECTION

SECTION 02321

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.01 Section Includes

- A. General cleaning and grubbing, excavation, bedding construction, filling, grading and surface restoration associated with installing subsurface pipes of various types.

1.02 Related Work

- A. Section 02110 – Clearing, Grubbing, and Stripping
- B. Section 02240 – Water Control
- C. Section 02501 – Manholes
- D. Section 02506 – Concrete Pipe and Fittings
- E. Section 02507 – PVC Plastic Pipe and Fittings
- F. Section 02701 – Pavement Replacement

1.03 Notification of Utility Companies

- A. The Contractor shall notify all affected utility companies of his construction operations to coordinate his work regarding poles, wires, valve boxes, and other surface obstructions and to determine the location of gas, watermain, power, light, cable television, telephone or telegraph conduit or service connection thereto or any other subsurface structure that crosses or passes through the space occupied by any of the proposed improvements. The Contractor shall make arrangements with the utility companies for any relocation of interfering utilities. Contractor shall be responsible for all utility coordination. Contractor shall also coordinate work with the Engineer when scheduling activities related to utility relocations.

PART 2 PRODUCTS

2.01 Concrete

- A. Cast-in-place concrete shall be in accordance with Section 03300.

2.02 Mortar

- A. Mixture of mason sand, water, Portland cement and masonry cement as follows:

Portland cement - ASTM C150, Type I, IS or II

Masonry cement - ASTM C91, Type II

Water - Free of oil, acid, excess alkalinity, organic matter, and salts

Sand - 100% passing No. 8, 15 to 35% passing No. 50, and 2 to 10% passing No. 100

2.03 Granular Bedding

- A. Pipe shall be bedded in a uniformly graded material conforming to CDOT #67 granular bedding unless otherwise noted on the Drawings or as approved by the Engineer.

2.04 Replacement Material (Stabilization Material)

- A. Material needed to replace unsuitable soils shall consist of 1-1/2-inch rock conforming to CDOT #357 or other material as approved by the Engineer.

2.05 Flowable Fill

- A. The approved mixture for flowable fill is shown below:

Ingredients:	Pounds/Cubic Yard
Cement	42 (.047 sack)
Water	235 (39 gallons as needed)
Coarse Aggregate (No. 57)	1700
Sand (ASTM C-33)	1845

The desired 28-day strength is 60 psi. The combination of material listed above or an approved equivalent may be used to obtain the desired flowable fill.

PART 3 EXECUTION

3.01 Surface Obstructions

- A. Structures, sidewalk, driveways, curb and gutter, trees, shrubs, lawns, signs, fences, utilities, survey monuments, pavements, lawns, culverts, and other appurtenances which are adjacent to the right of way or work easements, shall be carefully protected against damage. In the event of damage or inadvertent injury or removal of these surface features by failure of the Contractor to exercise reasonable precautions or proper construction techniques, he shall bear the full cost and responsibility for resulting damages and shall replace or repair such damage as early as possible.
- B. Clearing, grubbing, and removal of all pavements, sidewalks, curbs, signs, poles, fences, etc., shall be done only as necessary for the completion of the work. Brush, trees, shrubs, concrete, rubble, and other removals which are not intended to be replaced shall be disposed of by the Contractor off the site of work. Burning of trees and brush is not permitted.
- C. Obstructions which are intended to be replaced shall be stored and protected by the Contractor. Fences, signs, mailboxes, trees, shrubs, and similar features requiring removal, shall be restored to their original position except where permanent removal is indicated.
- D. Monuments for land surveys encountered in the path of work shall be carefully protected from movement. Should removal be necessary, the Contractor shall notify the Engineer in advance. The Contractor will set reference stakes and give notice that the monument

will be removed. The Contractor will reset the monument after backfilling and settling. The Contractor will also be held responsible for reestablishing monuments lost due to his negligence.

3.02 Subsurface Obstructions

- A. Contractor shall be responsible for all field utility locates.
- B. The Contractor shall use caution in excavating and trenching so that the exact location of underground structures, both known and unknown, may be determined; he shall be held responsible for the repair of such structures when broken or otherwise damaged during construction.
- C. The Contractor shall make arrangements with the utility companies for any relocation of interfering utilities.
- D. Any underground utilities or other structures that are located outside of the construction limits of this development which the Contractor wishes to have moved to facilitate construction shall be arranged with the owner of such structures; the Contractor shall pay all costs of the accommodation and shall provide written authorization prior to any such activity.
- E. During the construction of the pipelines, it may be necessary to cross under certain sewers, drains, culverts, water lines, gas lines, electric conduits, and other underground structures. Where necessary, the flow in drains or culverts shall be diverted so that the excavation may be kept dry during the progress of the construction work. Every effort shall be made to prevent damage to such underground structures. Wherever such structures are disturbed or broken, they shall be restored to existing or better condition.
- F. The Contractor shall use sand or gravel backfill beneath said structures. This backfill shall be deposited and thoroughly compacted by mechanical means in layers not to exceed six inches in depth.

3.03 Ordinary Excavation

- A. Excavation shall be made in such a manner that the pipe can be laid safely and accurately to the line and grade shown.
- B. Topsoil shall be salvaged and reused as required.
- C. The depth of excavation shall extend from the ground surface to the bottom of the pipe bedding. Unnecessary excavation below this required level shall be backfilled at the Contractor's expense with compacted sand, gravel, crushed stone or concrete, as approved by the Engineer.
- D. The bottom of the trench must be dug to a depth of 4 inches minimum below the pipe barrel and bell, or as indicated on the Drawings. Bell holes must be hand excavated to allow for proper jointing, and to insure that the pipe rests evenly along the barrel and is not resting on the bell.

- E. Trench widths shall be limited at the top of the pipe to not less than a 6-inch clearance on either side of the barrel to allow for the free flow of bedding material between the pipe and the trench wall. Maximum trench width at the top of the pipe shall be the outside pipe diameter plus 30 inches, except that the trench width need not be less than 30 inches. The trench above the top of the pipe may be sloped, stepped or vertical, to comply with state and federal regulations.
- F. Contractor shall follow the most current regulations concerning excavations set forth by OSHA, 29 CFR Part 1926.

3.04 Rock Excavation

- A. Rock excavation shall be defined to include all hard, solid rock in ledges, bedded deposits, boulders, buried concrete structures not shown on the plans, and all natural conglomerated deposits so firmly cemented as to possess all the characteristics of solid rock. Removals of isolated masses less than 1/2 cubic yard which are not attached to larger masses will not be considered rock excavation.
- B. Firmly cemented sedimentary materials in the form of silt-stone, sandstone, shale, or conglomerate, shall be classified as rock if, after several blows with the pointed end of a standard pick applied to the flat surface, the material cannot be loosened, broken down, or penetrated.
- C. When the Contractor believes he has encountered what may be classified as rock excavation, he shall notify the Engineer who will test the degree of resistance, and make a final determination.
- D. The depth of rock excavation in a trench shall be a minimum of 6 inches below the pipe barrel to provide space for a sand or gravel bedding material. Bedding material shall be evenly spread, compacted, and shaped to conform to the pipe.
- E. Trench width in rock excavation shall not be less than that for ordinary excavation. Maximum trench width shall be the outside pipe diameter plus 18 inches for an unsheathed trench, and not to exceed the outside pipe diameter plus 30 inches for a sheathed trench.
- F. Blasting will not be permitted unless securing Engineer's approval, showing evidence of insurance specifically for such work, and demonstrating that the blasting will be conducted to protect adjacent existing or completed work, persons, and surrounding property. The hours of blasting may be fixed by the Engineer. Any damage caused by blasting shall be repaired or replaced at the Contractor's expense. The Contractor shall ascertain that the method of blasting will be in accordance with state and local ordinances. Any blasting shall be done only under the direct supervision of a certified blaster.

3.05 Sheathing and Bracing

- A. Where it is necessary to protect nearby structures and pavements, or when the trench must be confined to allow for traffic flow, tight sheathing will be required. The Contractor ~~shall to~~ call ~~to~~ the Engineer's attention to any unforeseen condition that requires the use of sheathing. Sheathing must be driven unless soil conditions allow the sets to be placed after excavating. If placed after excavating, the voids between the trench wall and sheathing must be immediately filled with sand.

- B. Removal of sheathing must not take place until the trench is backfilled. Flooding or jetting the trench shall be done after the sheathing is removed.
- C. The Engineer may approve, in writing, some or all of the sheathed sets to remain in place. Sheathing ordered left in place shall have the upper portion within 2 feet of a street surface cut off and removed.
- D. Spot braces, individual shorings spaced at various intervals along trench, portable trench boxes or sliding shields will be considered incidental to the cost of the pipe laying.

3.06 Limits of Amount of Work Opened

- A. In no case shall the Contractor be allowed to open any trench more than 100 feet in advance of the pipe laying unless otherwise permitted by the Engineer; the backfilling shall be kept within 150 feet of the completed pipe laying. Trenches shall be completely backfilled to grade at the end of each day to within 50 ft of complete pipe installation.
- B. Provide construction fence barricades around open trenches and pits when unattended.
- C. Maintain access to residences, commercial enterprises and municipal facilities at all times. Intersecting streets, private drives, and alleys shall be open to local traffic at end of each day, unless otherwise permitted by the Engineer.

3.07 Wet Trench Conditions

- A. The Contractor shall attempt to dispose of all groundwater or surface drainage seeping in the trench by employing ordinary dewatering techniques such as the use of sump pumps, dikes, etc. Allowing water to flow into the pipe being laid will not be permitted except in the case of a storm sewer where the joints have set. Water entering the installed pipe must flow through the pipe or be pumped out. The installed pipe shall not be used as a reservoir. A temporary stopper or plug must be installed on the upper end of each pipe being laid if there is danger of sand or debris being washed into the pipe. Do not place water so that it ponds on roadway subgrade, ~~or~~ adjacent private property, or any place that could be potentially dangerous to the public.
- B. Contractor shall follow provisions of Section 02140 Water Control, the approved Water Control Plan, and the Groundwater Discharge Permit.
- C. If the existing soil in the trench bottom is judged to be unsuitable by the Engineer after dewatering measures have been taken, a minimum of the top 6-inches of the subgrade shall be removed and replaced with stabilization material.

3.08 Dewatering

- A. Contractor shall be responsible for maintaining a dry trench by ordinary dewatering techniques, well points, or other measures as approved in the Water Control Plan or by the Engineer during the course of work.
- B. If wells are utilized for dewatering, the wells shall be drilled, maintained, and abandoned in accordance with the requirements of the State of Colorado, Office of the State Engineer.

3.09 Granular Base to Replace Poor Subsoil

- A. At any time material such as muck, sawdust, bark, or other material is encountered which would not form a suitable and permanent base, the Engineer shall be notified to decide if it should be removed and replaced with suitable granular bedding or stabilization material. The sand or gravel base replacement is to be compacted in 6-inch layers up to the bottom of the normal trench section.

3.10 Granular Bedding

- A. Bedding material shall be placed from the trench bottom to the pipe spring line in accordance with the Drawings or as required by pipe material specifications.

3.11 Backfilling with Existing Material

- A. Backfilling shall be accomplished immediately after installation of the pipe unless otherwise approved by the Engineer.
- B. Unless otherwise noted on the Drawings, initial backfill material over the pipe to a minimum depth of 1 foot above the pipe shall be granular bedding material or previously excavated granular soil reasonably free of large rock, organic matter, clay or other unsuitable material if approved by the Engineer. Trench backfill over the initial backfill zone may be previously excavated soil except as determined by the Engineer Coordinator to be unsuitable.
- C. The initial backfill material over the pipe up to a minimum depth of one foot above the pipe shall be filled in by hand and well compacted over and around the pipe with hand tampers or mechanical means to the proper density. Special care shall be taken in placing and tamping the initial backfill material so the alignment and grade of the pipe will not be disturbed nor the pipe damaged.
- D. When backfilling in frozen material, the Contractor shall cover the pipe and tamp the backfill around the pipe using only loose thawed material. No frozen material shall be placed in the trench. All frozen material shall be kept from around manholes and other structures.

3.12 Granular Backfill

- A. Granular backfill shall be provided by the Contractor and placed in the trench when the excavated material is unsuitable for backfill or when ordered by the Engineer. Bank run gravel may be used provided the initial backfill zone (one foot above pipe) has been filled with acceptable granular bedding material.

3.13 Trench Compaction

- A. Trench Compaction shall consist of mechanically compacted backfill placed in 6-inch layers (maximum), from a distance of 1 foot above the pipe to the surface. The degree of compaction shall be a minimum of 95 percent (95%) of the maximum Standard Proctor Density as determined by ASTM D698/AASHTO T99 unless otherwise noted on the Drawings.

3.14 Restoration

- A. Unless otherwise specified, restore surface drainage, pavements, lawns, and other areas disturbed by construction to their original or better conditions.

3.15 Disposal of Surplus or Undesirable Material

- A. Surplus material shall include all excavation that is more than the amount needed for backfilling or is undesirable for backfilling.
- B. The Contractor shall find his own disposal sites, remove and load excess material, haul, and dispose of material. Such material shall become property of the Contractor.

3.16 Field Quality Control

- A. Moisture and density tests are the responsibility of the Contractor and shall be performed by a private Geotechnical Consultant.
- B. Field tests will be conducted to determine compliance of moisture/density testing methods with specified density in accordance with ASTM D2922.
- C. Test results shall be submitted to the Engineer by the Contractor or the Geotechnical Consultant for approval by the Owner prior to acceptance of the pipeline and shall be made available on the day of the test.
- D. Moisture/density tests shall be performed at a minimum of once every 200 linear feet, as measured along the pipe, or as determined by the Engineer. Tests shall be performed at a depth of two (2) feet above the top of the pipe bedding and in two (2) foot vertical increments up to finish grade. A minimum of one test shall be performed in the backfill and one at final grade. A minimum of one test shall be performed for each service line or lateral installation.
- E. Moisture/density tests in the vicinity of manholes shall be performed at a maximum of one (1) foot away from the manhole section. A test shall be performed in all four directions from the manhole (four tests total per set). A minimum of one set of tests shall be performed for every two (2) feet of backfill material.
- F. All failed test areas shall be recompacted and retested at Contractor's expense.
- G. All compaction shall be to a minimum of 95 percent (%) of the maximum Standard Proctor Density unless otherwise noted on the Drawings.
- H. All compacted material shall be within 2% (+/-) of the optimum moisture content of the soil as determined by ASTM D698. Water shall be added to the material, or the material shall be harrowed, disced, bladed, or otherwise worked to ensure a uniform moisture content as specified.

END OF SECTION

SECTION 02501

MANHOLES

PART 1 GENERAL

1.01 Summary

- A. Provide manholes as shown and as specified. Comply with applicable provisions of Div. 0 and 1.

1.02 Related Sections

- A. Section 02321 - Trenching, Backfilling, and Compacting
- B. Section 02506 - Concrete Pipe and Fittings
- C. Section 02507 – PVC Plastic Pipe
- D. Section 03300 – Cast-In-Place Concrete

1.03 Submittals

- A. Submit five copies of manhole shop drawings for review.

PART 2 PRODUCTS

2.01 General

- A. All precast manhole risers, bases, and cone section shall be manufactured in accordance with ASTM C478, and shall be made with Type I/II cement. All reinforcing materials shall conform to ASTM A615, A617, or A185 (Reference Section 03200).

2.02 Precast Risers

- A. Precast reinforced concrete risers, ASTM C478, or concrete pipe sections, ASTM C76, of 48" inside diameter, unless otherwise designated. Joint shape shall be compatible with designated joint materials. Steps and pipe seal components shall be cast into riser sections. See standard Details.

2.03 Bases

- A. Precast bases shall be minimum 6" thick and either separate or integral with first riser. Cast-in-place concrete bases shall be minimum 12" thick and cast with first riser embedded at least 4". See standard Details.

2.04 Top

- A. Manhole top shall be precast eccentric cone with a chimney of precast reinforced adjusting rings. Where space does not permit a cone top or where specified on the Drawings, a minimum 6" thick slab top with eccentric opening may be substituted. Tops shall be designed for H-20 loading or greater. See standard Details.

2.05 Preformed Plastic Joint Gaskets

- A. All preformed plastic gaskets shall conform to AASHTO M198.
- B. The diameter of a performed plastic gasket shall be 1.5 inches for a 48-inch diameter manhole.
- C. Gaskets shall be pliable at the time of installation.
- D. Acceptable gaskets and their manufacturers are: Henry Co. Rub-R-Nek, Con Seal CS-202, or an approved equal. Ram-Nek is NOT acceptable.

Comment [E1]: Gary, do we use these?

2.06 Pipe Seals

- A. Flexible, watertight, gasketed seals for pipe entrance holes; Press-Seal/Press-Wedge II or PSX, Scales/Res-Seal, or approved equal.
- B. Non-shrink grout (see Section 03300) shall be used around entrance holes.

2.07 Castings

- A. Manhole frames and lids shall be cast iron, ASTM A48, Class 35, of uniform quality, free from blow holes, porosity, hard spots, shrinkage defects, cracks or other serious defects. Manhole castings shall be true to pattern with machined bearing faces between frame and cover.
- B. Type of castings shall be as designated on Details or approved equal. Provide traffic-rated castings, unless otherwise noted. All rings shall be 8 inches in height. Lids for sanitary manholes shall have self-sealing neoprene o-ring gaskets and concealed pick holes.
- C. Acceptable rings and covers are: Neenah R-1706, D&L A1161, or approved equal.

2.08 Manhole Steps

- A. ASTM C478; steel reinforced copolymer polypropylene by M.A. Industries (PS-2.B.), or approved equal.
- B. Steps shall be placed with spacing and distances as shown in the Details.

2.09 Cast-In-Place Concrete

- A. Job-mixed or ready-mixed concrete in accordance with Section 03300, Class B or better.

PART 3 EXECUTION

3.01 Manholes

- A. Manholes shall be installed in accordance with the Details.

- B. Construct manholes of precast or cast-in-place bases, precast risers, adjusting rings, and precast top section in accordance with the Drawing Details. Alternate construction with cast-in-place concrete forms or other procedures shall be submitted for approval.
- C. Reference Section 02321, Trenching, Backfilling, and Compaction. Excavate as necessary to construct manholes. Set precast bases on firm, level, granular bedding. Pour cast-in-place bases on undisturbed earth; if over excavation occurs, backfill with concrete or compacted granular material. On wet subgrades, provide 3" minimum thickness washed or crushed stone under bases.
- D. For cast-in-place bases, support first riser section on brick and embed in base a minimum of 4".
- E. Join risers, top sections, adjusting rings and castings using compatible rubber rings or plastic gasket material. When plastic gasket material is used, joining surfaces shall receive manufacturer's approved primer, as required. Under weight of superimposed sections, gasket material shall form a tightly packed, watertight seal in annular joint space.
- F. Flattop manholes are required whenever the distance between the finished road surface and a manhole barrel section does not allow room for a cone section. Access holes for flattop manholes shall be offset from center unless the distance between the invert of the main pipe and the manhole cover is less than 3 feet.
- G. Manholes shall be set plumb.
- H. Precast concrete adjustment rings shall be used to bring the ring and cover to grade. The total height ~~from~~ from the top of the cone section to the finish street grade shall not exceed 16 inches. The adjustment rings shall be flush with the inside of the manhole and grouted. Adjustment rings, ring, and covers shall be joined using mortar.
- I. Manhole riser sections shall be joined to each other and to the base using a double row of preformed plastic gaskets.
- J. The joint between the manhole section and the base shall be grouted on the inside to provide a smooth surface. Manhole top sections shall also be grouted to ring and covers on the inside.
- K. All lifting holes, joints, and other imperfections shall be filled with an approved non-shrink grout to provide a smooth finished appearance.
- L. Manholes may require additional pressure and watertight treatments if specified by the Drawings. Such measures may include, but not be limited to, bolt down watertight manhole rings and covers, bolt-connection between base and riser sections, bolt-connected tops, bolt-connected or cast-in-place ring and cover, and additional concrete work. Additional products required by Drawings are job specific and are not specifically described within this specification.
- M. Backfill and compact soils around manholes as required for adjacent piping.

3.02 Piping Installation

- A. Wherever practicable, lay pipe continuous through manhole and remove upper half of pipe after grouting. Manholes with more than one entrance pipe and manholes at changes in alignment or grade shall have formed flow channels with smooth radius transitions.
- B. Complete pipe seals in accordance with manufacturer's instructions and these Specifications.
- C. For manholes with flexible seals, support pipe outside manholes by bedding as specified for type of pipe installed.
- D. For manholes with rigid seals, support pipe outside manholes until reaching undisturbed soil or to first joint by cast-in-place concrete or a wall of brick or concrete block contoured at top to fit lower 1/3 of pipe.
- E. Fill all voids and roughness around entrance holes with non-shrink grout to provide a watertight, smooth connection to manhole. Trowel extruding grout from interior to form smooth transition between pipe and manhole sections.

3.03 Provision for Future Connection

- A. Connections for future sewers, when indicated, shall consist of a short piece of sewer terminating with a bell end and stopper or bulkhead not more than 1 foot or one stub diameter outside manhole wall, unless otherwise shown. If no elevation is given, set invert at spring line of main sewer.

3.04 Drop Connections

- A. Manhole drop connections shall be outside drops constructed according to Drawing Details and the following provisions.
- B. Drop assembly shall consist of a tee or wye connecting to inflowing sewer, a drop pipe of same diameter as inflowing sewer, and a 90 deg. bend at bottom, all encased in concrete and resting on manhole base. Concrete encasement is not required for drop pipes of cast iron soil pipe or ductile iron water pipe (ANSI/AWWA C151) where drop pipe is free of joints between 90 deg. bend and tee or wye.

3.05 Adjusting Manhole Castings

- A. Adjust existing manhole castings to required elevation by removing or adding concrete adjusting rings or masonry and reinstalling fixtures, supporting them in a collar of concrete masonry constructed to hold them firmly in place.

END OF SECTION

SECTION 02506

CONCRETE PIPE AND FITTINGS

PART 1 GENERAL

1.01 Summary

- A. Provide pipe and fittings as shown and as specified. Comply with applicable provisions of Div. 0 and 1.

1.02 Related Work

- A. Section 02321 - Trenching, Backfilling, and Compacting
- B. Section 02501 - Manholes

1.03 Submittals

- A. Submit three certified copies of test and inspection reports in accordance with ASTM C76, C497, C443, and C655 standards as applicable, covering hydrostatic tests, physical and chemical properties.
- B. Product Data: Submit product data for pipe, fittings, and gaskets.
- C. Make submittals in accordance with Section 01330.
- D. Accurately record locations of fittings and field changes. Prior to initial acceptance, deliver record drawings to Engineer.

1.04 Material Handling

- A. Carefully unload and store pipe to prevent chipping, cracking, or damage to surface coating. Do not skid pipe. Remove structurally damaged pipe from site. Repair damaged coatings.
- B. Pipe and fittings shall be stored in accordance with manufacturer specifications.

PART 2 PRODUCTS

2.01 Pipe, General

- A. Piping, fittings, and accessories shall be of size and class shown on the Drawings and shall conform to quality and type specified in this Section.

2.02 Reinforced Concrete Pipe (RCP)

- A. ASTM C76 (circular pipe) Class III minimum or ASTM C507 (elliptical pipe) Class HE-III minimum unless otherwise designated on the Drawings.

- B. Joints for storm sewer and drainage piping shall be bell and spigot type, watertight, and suitable for rubber ring gaskets meeting ASTM C443. Joints should be capable of withstanding 30 feet of water pressure head. The Contractor shall provide joint pressure testing results from the pipe supplier.
- C. RCP may be rejected if it is not in conformance with ASTM C76. Individual sections of pipe will be rejected for the following reasons:
- Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
 - Defects that indicate imperfect proportioning, mixing, and molding.
 - Surface defects indicating honeycombed or open texture.
 - Damaged or cracked ends where such damage would prevent making a satisfactory joint that would meet testing requirements of Paragraph 3.04.
 - Any continuous crack having a surface width of 0.01 inch (0.25 mm) or more and extending for a length of 12 inches (310 mm) or more, regardless of position in the wall of the pipe.
 - Exposed steel reinforcement

2.03 Joint Gaskets

- A. All storm sewer pipe gaskets shall be of o-ring or profile type manufactured in accordance with ASTM C443 unless otherwise specified. No bituminous sealer or gaskets will be allowed (i.e., Con Seal, Ram-Nek, etc.)
- B. External wrap-around rubber gaskets shall consist of a ribbed rubber band and a rubber base bonding mastic coated with water soluble film, which together form a waterproof joint seal. Materials making up joint shall meet approval of Engineer. External gaskets are in addition to standard rubber ring gaskets and are for watermain and irrigation ditch crossings only. Use EZ-Wrap Butyl Sealant with EZ-STIK No. 4 primer by Press-Seal Gasket Corporation (12" width min.), Cadilloc External Sealing Bands by Cadilloc External Pipe Joint, Inc. (11" width min.), or approved equal.
- C. Lubricant shall be that which is specified by the pipe manufacturer.

PART 3 EXECUTION

3.01 Line and Grade

- A. Contractor shall provide line and grade at a convenient offset. Contractor shall be responsible for preservation of line and grade markings and if disturbed, shall pay actual cost of replacement.
- B. Contractor shall transfer line and grade from offset to sewer by means of laser beam equipment or other approved methods. Inform Engineer of proposed methods and equipment prior to construction. Discontinue methods that do not produce accurate control for setting line and grade.

3.02 Pipe Installation

- A. Trenching, bedding, backfill, and compaction shall comply with Section 02321 and with the Details. Pipe shall be joined in accordance with manufacturer's recommendations and as specified below.
- B. Lay pipe true to line and grade on bedding material shaped to contour of pipe. Pipes shall be fitted and matched to form a smooth and uniform invert. Bell ends of gravity pipe shall be laid up-grade. Any work that does not conform to line and grade at time of Initial Acceptance shall be removed and relayed.
- C. Ends of pipeline shall be protected from entry of dirt or other debris by means of a tapered wood plug or other acceptable temporary blockage inserted in end when pipe is not being laid. Keep inside of pipe clean.
- D. Pipes shall be laid with straight alignment between adjacent manholes. Do not lay pipe in water or when trench conditions are unsuitable.
- E. For pipe sizes 24 inches and larger, use positive mechanical means to bring pipe sections together such as a chain or cable and a mechanical pipe puller.
- F. At all watermain crossings install watertight external gasket joint sealant a minimum of 10-feet to each side of the watermain crossing or at three (3) pipe joints, whichever is greater. Follow manufacturer installation specifications.

3.03 Joining Concrete Pipe

- A. For rubber-type gasket joints, thoroughly clean receiving bell and spigot ends of sand and dirt. Liberally spread a manufacturer specified vegetable lubricant on rubber material. If rubber gasket is O-ring type, groove in spigot shall be lubricated before setting gasket. Position spigot end to bell end of pipe and force pipe section home.
- B. For pipe sizes 24 inches and larger, use positive mechanical means to bring pipe sections together such as a chain or cable and a mechanical pipe puller. Inform Engineer of proposed methods and equipment for review and approval prior to construction.

3.04 Field Testing

- A. Watertight joints are specified in the Specifications and all such pipe equal to or greater than 48-inches in diameter shall be subjected to a low pressure air test on the project.
- B. For pipe not required to have the joints air pressure tested, if the Engineer is unsatisfied that the joint meets the Specifications for a watertight joint, then defer to 3.04C for air tests. Contractor shall perform air tests.
- C. For air testing, furnish test plugs, air compressor, test gauge, stop watch and experienced personnel for conducting tests. Test pressure shall be based on an average of 3.5 psig net. Air testing shall adhere to the following measures:
 - The low pressure air test shall occur after completion of the backfilling and compaction.

- The ends of the sewer pipe being tested shall be plugged and braced.
- The length of pipe being tested shall be initially pressurized to 4.0 psi. Allow the air to stabilize then drop the pressure to 3.5 psi.
- It is recommended that the inside of the pipe be wetted prior to testing.
- If groundwater is higher than the top of the pipe, the test pressure shall be adjusted to account for the high groundwater.
- The pressure must not drop more than 1 psi for the amount of time indicated by the following formula:
-
- $$T = LD^2 \frac{0.00037D^2}{Q} \times L$$
- where T = time of test in seconds
L = length of pipe being tested in feet
D = diameter of pipe in inches
Q = allowable air loss (see chart on the this page)
- Pipe sections that fail the air test shall have the defects repaired by the Contractor and the test shall be repeated. Repair and retesting shall continue until the testing requirements are met.

Pipe Diameter (inches)	Test Duration (Minutes per 100 L.F.)	Q (cf)
18	2.4	5.0
21	3.0	5.5
24	3.6	6.0
27	4.0	6.8
30	4.4	7.5
33	4.9	8.3
36	5.3	9.0
42	6.2	10.5
48	7.1	12.0
54	8.0	12.5
60	8.9	13.5
66	9.8	16.5
72	10.7	18.0
78	11.5	19.5

END OF SECTION

SECTION 02507

PVC PLASTIC PIPE AND FITTINGS

PART 1 GENERAL

1.1 Summary

- A. Provide pipe and fittings as shown and as specified. Comply with applicable provisions of Div. 0 and 1.

1.2 Related Sections

- A. Section 02321 – Trenching, Backfilling, and Compacting
- B. Section 02501 - Manholes

1.3 Submittals

- A. Test Reports: Upon request, submit three certified copies of test and inspection reports in accordance with applicable ASTM Standards.
- B. Product Data: Submit product data for pipe, fittings, and gaskets.
- C. Make submittals in accordance with Section 01330.
- D. Accurately record locations of fittings and field changes. Prior to initial acceptance, deliver record drawings to Engineer.

1.4 Material Handling

- A. Carefully unload and store pipe to prevent chipping, cracking, or damage to surface coatings. Pipe shall not be skidded upon ground. Repair damaged coatings.
- B. Pipe or fittings shall not be dropped. Damaged pipe or fittings shall not be installed.
- C. Lubricant shall be stored or handled in a manner to prevent contamination of the lubricant.
- D. Rubber gaskets shall be stored in a location which protects them from deterioration.
- E. Pipe shall be stored in accordance with manufacturer's specifications.

PART 2 PRODUCTS

2.1 PVC Plastic Pipe, General

- A. PVC pipe, fittings, and accessories shall be of material and type indicated in the Drawings and shall conform to the quality and type specified in this Section. If not designated, use the material listed below. Each pipe shall be stamped or indelibly marked with its type and class and the manufacturer's name or mark.

2.2 PVC Gravity Pipe

- A. All gravity pipe and fittings shall conform to ASTM D3034, Type PSM, SDR-35 poly (vinyl chloride); or ASTM F789, Type PS-46, poly (vinyl chloride). The standard dimension ratio (SDR) of plastic gravity pipe shall not exceed 35.
- B. All PVC pipe fittings shall be made from PVC components that conform to ASTM D1784.
- C. All joints shall be bell and spigot type and shall be manufactured in accordance with ASTM D3212. All gaskets shall be of o-ring type and manufactured in accordance with ASTM F477. All bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket, which is positively retained.

2.3 PVC Pressure Pipe

- A. Polyvinyl Chloride (PVC) plastic pressure pipe, AWWA C900, Class 150, SDR-18, ductile iron O.D., with elastomeric gasket bell and spigot joints. PVC pressure pipe only allowed where specified in the Drawings. Mechanical joint restraints are not required.

2.4 Bedding

- A. PVC pipe shall be bedded in accordance with the Drawings (see standard details) using CDOT #67 granular material place to a minimum of one (1) foot above the top of pipe. Refer to Section 02321 for Trenching, Backfilling, and Compacting specifications.

2.5 Tees and Wyes

- A. Tees and wyes shall be of the diameter indicated consisting of a standard or short length of main pipe with a factory fabricated spur attached. Joining of spur to main line pipe shall provide strength, water-tightness, and a flush inside surface of the main line pipe. All work shall be done in accordance with the Drawings (see standard details).

2.6 Gravity Pipe Couplings

- A. ASTM C1173, rubber or elastomeric sleeve and stainless band assembly fabricated to mate with OD of pipes to be joined, for nonpressure joints.

2.7 Concrete

- A. Cast-in-place concrete shall be in accordance with Section 03300.

PART 3 EXECUTION

3.1 Line and Grade

- A. Contractor shall provide line and grade at a convenient offset. Contractor shall be responsible for preservation of line and grade markings and if disturbed, shall replace the pipe.

- B. Contractor shall transfer line and grade from offset to sewer by means of laser beam equipment or other approved methods. Inform Engineer of proposed methods and equipment prior to construction. Discontinue methods that do not produce accurate control for setting line and grade.

3.2 Pipe Installation

- A. PVC pipe installation, including trenching, bedding, backfill, and compaction, shall be done in accordance with the Drawings and with Section 02321, Trenching, Backfilling, and Compacting. Pipe shall be joined in accordance with manufacturer's recommendations and as specified below.
- B. Where practicable, begin at lowest point of proposed sewer line; lay with bell end or receiving groove edge upstream in direction of laying.
- C. Pipe shall be laid immediately following the trench preparation and bedding provisions of Section 02321 and of the approved plans.
- D. Exercise care when handling pipe. Ropes, nylon slings, or other devices must be used for lowering pipe into trench. Only pipe which is suitable for use is to remain on site. Damaged or broken pipe shall be immediately separated from acceptable pipe.
- E. Lay pipe uniformly to line and grade on a prepared bed providing even support along entire barrel. Excavate bell holes in bedding material so pipe will rest on barrel and not on bell. As work progresses, interior of sewer shall be cleared of dirt and debris. Do not lay pipe where water is above bedding material except where Engineer determines that foundation is stable, pipe will not be displaced upward, and joint construction will not be affected by water.
- F. Joint materials and methods shall conform to manufacturer's recommendations.
- G. Rubber-type gasket joint shall be made using lubricant of vegetable origin. Groove in spigot shall be lubricated before setting gasket. Prior to connecting pipe joints, all surface of the joint shall be clean, dry, and completely free of dirt. When final grade is achieved, the joint shall be carefully pushed home using approved methods of leverage. Seating of the gasket shall be checked around the entire circumference of the pipe by visual and feeler gauge inspection.
- H. At all watermain crossings provide and install watertight external gasket joint sealant a minimum of 10-feet to each side of the watermain crossing or at two (2) pipe joints, whichever is greater. Follow manufacturer installation specifications.
- I. Each pipe shall be bedded by hand or by equally careful means to 12-in. cover before laying subsequent pipes. Fill space between pipe and trench wall in 6-in. layers and manually compact. Pipe sizes larger than 15-in. diameter may require mechanical compaction of bedding material.
- J. Pipes shall be laid with straight alignment between adjacent manholes and/or inlets.

- K. When work is not in progress, securely close ends of pipe fittings so that no trench water, earth, or other substances will enter pipe.

3.3 Alignment and Grade

- A. The Town reserves the right to require further tests of alignment and grade if video tape and inspections indicate additional tests are necessary in the Engineer's opinion. If so directed, Contractor shall check alignment and grade by the lamping method. If pipe shows poor alignment, offset or open joints, sags or kinks; defects shall be corrected by Contractor before initial acceptance. If defects are found due to failure of proper installation or sound materials, Contractor shall pay for and promptly correct defects.

END OF SECTION

SECTION 02701

PAVEMENT REPLACEMENT

PART 1 GENERAL

1.01 Summary

- A. Promptly restore pavements, sidewalks, curb and gutter, driveways and appurtenant improvements disturbed by construction to prior conditions or better as shown and as specified. Comply with applicable provisions of Div. 0 and 1.

1.02 Related Sections

- A. Section 02321 – Trenching, Backfilling, and Compacting
- B. Section 03300 – Cast-In-Place Concrete
- C. Larimer County Urban Area Street Standards

1.03 Condition of Repair

- A. All infrastructure elements that undergo reconstruction and repair shall be restored to a condition equal to, or better than, the condition prior to repairs. Patching of pavement may be an exception.

1.04 Unsatisfactory Work

- A. Removal and replacement of unsatisfactory work shall be completed within 15 days of written notification from the Engineer of the deficiency unless the condition is deemed an emergency requiring immediate correction. In the event the replacement work is not completed within the specified time period, the Engineer will take action to complete the work and charge the Contractor for all related costs.

1.05 Guarantee

- A. Upon initial acceptance (after submission of Record Drawings), the warranty period shall commence. The warranty period shall be two years. If deficiencies are noted during the Town's warranty inspection, the Contractor shall repair the deficiency. If approved by the Town, the deficiency may remain in place and the warranty period for the defective improvement may be extended up to three additional years.
- B. A Warranty Surety shall be required for the entire warranty Period and shall be in the form of a letter of credit, bond, escrowed funds, or cash deposit in accordance with the Town's approved format. The Surety shall be in place for 150 percent of the cost of all improvements.

1.06 Testing

- A. Contractor shall arrange and pay for subgrade and base course compaction testing by a qualified testing agency, acceptable to the Town and independent of Contractor.

Determine laboratory density of base course material. Perform at least one field density test for every 2000 sq ft of paved area, but in no case less than three tests. Comply with testing requirements of Section 02321 Trenching, Backfilling, and Compacting.

- B. Asphaltic pavement job mix formula shall be derived from tests performed by a qualified testing agency paid for by Contractor. Results of previous tests performed on aggregates from same source and using asphaltic material of same brand as used in a previous mix design may be used. Submit job mix formula to Engineer prior to asphalt placement.
- C. Before the pavement subgrade is deemed acceptable for street paving, Contractor shall perform a proof roll test in accordance with the Larimer County Urban Area Street Standards. Failure of the proof roll test in the sole opinion of the Engineer shall require subgrade and trench backfill material removal, replacement, and compaction at the Contractor's expense.
- D. Concrete testing shall be in accordance with Section 03300.

PART 2 PRODUCTS

2.01 Aggregate for Bases

- A. Aggregate for bases shall comply with the Standard Specifications for Road and Bridge Construction (CDOT, 1999), Section 703.03. Aggregate base Class shall be as shown on the Drawings or Class 5 or 6 if not indicated. Aggregate for bases shall meet the following grading requirements:

Sieve Size	Percentage Passing by Weight						
	LL not greater than 35			LL not greater than 30			
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
4 inch	--	100	--	--	--	--	--
3 inch	--	95-100	--	--	--	--	--
2-1/2 inch	100	--	--	--	--	--	--
2 inch	95-100	--	--	100	--	--	--
1-1/2 inch	--	--	--	90-100	100	--	--
1 inch	--	--	--	--	95-100	--	100
3/4 inch	--	--	--	50-90	--	100	--
No. 4	30-65	--	--	30-50	30-70	30-65	--
No. 8	--	--	--	--	--	25-55	20-85
No. 200	3-15	3-15	20 max.	3-12	3-15	3-12	5-15

2.02 Asphaltic Mixtures

- A. Asphaltic concrete and road mix shall conform to the Standard Specifications for Road and Bridge Construction (CDOT, 1999), Section 702. Surface course aggregate shall conform to Section 703.04.

2.06 Prime Coat, Tack Coat, Rejuvenating Agent, Seal Coat, Joint and Crack Sealant, Lime Treated Subgrade, Heating and Scarifying Treatment, and Cold Bituminous Pavement

- A. All of the above described materials and others not specifically described within this specification shall conform to the Standard Specifications for Road and Bridge Construction (CDOT 1999).

2.07 Wheel Stops

- A. Precast concrete wheel stops. Provide 3/4-inch diameter by 30-inch long galvanized steel pins.

2.08 Traffic Marking Paint

- A. Factory mixed, quick-drying, non-bleeding traffic marking paint complying with AASHTO M248, Type S. Color shall be white, except where yellow is designated.

2.09 Flowable Backfill

- A. The approved mixture for flowable fill is shown below:

Ingredients:	Pounds/Cubic Yard
Cement	42 (.047 sack)
Water	235 (39 gallons as needed)
Coarse Aggregate (No. 57)	1700
Sand (ASTM C-33)	1845

The desired 28-day strength is 60 psi. The combination of material listed above or an approved equivalent may be used to obtain the desired flowable fill.

2.10 Concrete

- A. Cast-in-place concrete for pavements, sidewalk, curb and gutter, and incidentals shall be in accordance with Section 03300.

PART 3 EXECUTION

3.01 Preparation

- A. Prepare for pavement replacement after trenches have been backfilled and compacted in accordance with Section 02321. Proof roll testing of subgrade required prior to installing road base and pavement. Level and grade as necessary. Neatly sawcut adjacent permanent pavement a minimum of 2 feet back from disturbed area. Restore and adjust to grade manhole castings, valve boxes, curb stops, and other utility appurtenances.

3.02 Pavement Replacement, General

- A. Designated types of pavement replacements are considered as minimums; wherever existing pavement is heavier than the replacement indicated, replacement pavement shall match existing pavement. Comply with local municipal and state standards, including the Larimer County Urban Area Street Standards.

3.03 Removal of Bituminous Pavement

- A. The pavement cut shall follow a line parallel to the roadway centerline and at least 2 feet beyond the trench side wall. All pavement cuts parallel to the direction of travel shall be placed on the lane line or at the center of the aligned travel lane. For bicycle lanes, the cut shall be at the line or the edge of the gutter. Longitudinal joints are not allowed in the wheel path.

- B. If pavement adjoining the original pavement cut is damaged during construction, additional pavement shall be removed and repaired. The additional pavement shall be removed with cuts, with the original cuts. The additional pavement damaged by the Contractor shall be repaired at the Contractor's expense.
- C. All excavated pavement material shall be stockpiled separately and disposed of by the Contractor off site at Contractor's expense and shall not be used as backfill material.
- D. When the proposed excavation falls within 3 feet of a section of failed pavement, the failed area shall be removed up to sound pavement and patched. Scarring, gouging, or other damaged pavement adjacent to a patch shall be removed and the pavement repaired.

3.04 Removal of Concrete Curb, Gutter, Sidewalk, and Driveways

- A. Concrete shall be removed to edges that are neatly sawed to a minimum of one-half the concrete thickness. Sidewalks and driveways shall be saw cut in straight lines either parallel to the curb or perpendicular to the alignment of the sidewalk or curb.
- B. No concrete section to be replaced shall be less than 5 feet in either width or length for a driveway or crossspan, and 5 feet in length for sidewalk, curb, and gutter.
- C. If a proposed saw cut falls within 5 feet of a construction joint, expansion joint, or edge, the concrete shall be removed to the joint or edge.

3.05 Removal of Concrete Pavement, Crosspans, and Alley Intersections

- A. Concrete that is to remain shall be cut in a straight, true line with a vertical face. Concrete shall be cut in accordance with CDOT Specifications Section 202.02.
- B. Concrete pavement shall be removed to its full depth.
- C. If the removed portion falls within 3 feet of a construction joint, cold joint, expansion joint, or edge, the concrete shall be removed to the joint or edge.
- D. When removing concrete pavement, the pavement shall be removed and replaced in sections from joint to joint. Replaced sections shall require doweling connections.
- E. Contractor shall be responsible for the cost of removal and replacement of all over-break.
- F. In the case of damaged concrete, the limits of removal shall be identified in the field by the Engineer.

3.06 Reconstruction or Repair of Concrete Apron, Radius, or Ramp Area

- A. Whenever construction, alteration, or repair to an existing street affects any part of the apron, radius, ramp area, or pedestrian crossing area, the entire apron, radius, ramp area, or pedestrian area shall be removed and replaced with a pedestrian ramp. Work shall be done in accordance with the Larimer County Urban Area Street Standards and as required by the Americans With Disabilities Act Guidelines, Section 14, Public Rights of Way, as amended.

3.07 Concrete Pavement Replacement

- A. For preparation, base course placement, and other installation procedures, refer to the Larimer County Urban Area Street Standards and the Standard Specifications for Road and Bridge Construction (CDOT, 1999).
- B. Provide Class P concrete of thickness shown on Drawings on a prepared subgrade; cure and finish in accordance with Section 03300.

3.08 Bituminous Pavement Replacement

- A. For preparation, base course placement, overlays, placing mix, rolling, sealing, and other installation procedures, refer to the Larimer County Urban Area Street Standards and the Standard Specifications for Road and Bridge Construction (CDOT 1999).
- B. Provide hot mix asphaltic concrete surface course, placed on base course of thickness and type shown on Drawings.

3.09 Permanent Asphalt Patching

- A. Patch Geometry. Existing pavements shall be removed to clean, straight lines parallel or perpendicular to the flow of traffic. Patches shall not be constructed with angled or irregular shaped edges.
- B. Separation. Strips of pavement greater than 6 feet in width from the edge of the new patch to the edge of an existing patch or the lip of the gutter may remain. Strips of pavement less than 6 feet in width from the edge of the new patch to the edge of an existing patch or the lip of the gutter shall be removed and replaced as a single new patch.
- C. Series of Patches. Where three or more pavement cuts are proposed within a 75-foot-long roadway section, the pavement between the patches shall be milled and inlaid with new pavement over the entire work area. In cases where the existing pavement is in poor condition and may require overlay within the next few years, this requirement may be modified or waived by the Town. A series of patches may also be repaired with an overlay.
- D. Patch Widths. Trenches shall be patched for the entire lane width for a distance of 1-foot minimum on all sides of the trench. Transverse patch lengths shall extend across the full width of the travel lane. Minimum width for transverse patches shall be:
- E. Arterial – 10 feet
Collector – 8 feet
Residential – 3 feet
- F. Transitions. Patches should have a smooth longitudinal grade consistent with the existing roadway. Patches should also have a cross slope or cross section consistent with the design of the existing roadway.
- G. Older Pavement. In the case of older pavement where the likelihood of cracking and potholes next to the patch is greater, extend the "shoulders" of the pavement beyond the 2-foot minimum, and reinforce this area with a geotextile fabric. "T" cutting is required for all repairs in accordance with Section 25.7.4.C of the Larimer County Urban Area Street Standards.

- H. Width Consistency. The width of patches shall be consistent to simplify future maintenance.
- I. Patch Thickness. The thickness of asphalt street patches shall typically be the thickness of the existing asphalt plus one inch.

Minimum Patch Widths

Minimum Asphalt Thickness (for full depth pavement only)	Transverse Patches
Residential – 6 inches	Residential – 5 feet
Collector – 8 inches	Collector – 8 feet
Arterial – 10 inches	Arterial – 10 feet

- J. Edges. Pavement designated for removal shall be cut vertically with square edges such that each edge of the finished patch will be parallel or at right angles to the direction of traffic. The edge for removal will be in a straight line set by a string line, chalk line, or other means to ensure a straight removal line.
- K. Scoring Edge of Removal Area. Marking or scoring the asphalt pavement shall be done in such a way that damage to the adjoining mat is minimized. Use of a power cut-off saw is an approved method of scoring or precutting the perimeter of the asphalt removal area.
- L. Damage Outside Removal Limits. Any over-break, separation, gouging, or other damage to the existing asphalt mat outside of the designated removal limits shall be repaired at the Contractor's expense.
- M. Tack Coat. For patches in asphalt, a tack coat shall be applied to all edges of the existing asphalt and to the subgrade before placing the new pavement. Refer to Section 25.5.4B of the Larimer County Urban Area Street Standards for additional information.
- N. Protection from Solvents and Oils. The Contractor shall protect the asphalt (both existing and new) from solvents and oils. Any piece of equipment leaking fluid shall be removed from the work site immediately and shall not return to the work site until all leaks are repaired. If any piece of equipment leaks any fluid a second time, it shall be removed from the work site immediately and shall not be allowed on the work site again for the remainder of the project. The Contractor shall not use diesel or other solvents to remove or prevent the sticking of asphalt to the wheels of rubber-tired rollers or other equipment used on the asphalt. Remove and replace any asphalt damaged by solvents or oils.
- O. Base Material. Aggregate base course required for any areas that have been opened up during inclement weather (rain/snow) shall be replaced at the expense of the Contractor. The Contractor shall protect all excavated areas from water infiltration of any type and will be responsible for any dewatering and subgrade stabilization.
- P. Base Course. Base course material shall be placed and compacted in layers not to exceed 6 inches thick. The resulting total compacted base thickness shall be the thickness of the removed base plus 2 inches or as specified in the Drawings. Bituminous pavement may be used in lieu of aggregate base course in trench patches. If this option is used, the total pavement patch thickness shall match the minimum thickness for full depth pavement.

- Q. Placement of New Asphalt. All patching shall be performed with Grading S or SG. The materials must conform to requirements of Chapter 22, Materials and Construction Specifications of the Larimer County Urban Area Street Standards. A mix design shall be required. In all cases, the pavement wearing course must match the grading of the surrounding pavement. The HBP must be placed with a self-propelled paver if patching widths are greater than 8 feet. For patch widths greater than 4 feet and up to 8 feet, the mixture must be placed with either a self-propelled paver or a box spreader. These machines may be used to patch areas wider than 8 feet with the use of a screed extension that will extend beyond the width of the proposed patch. Patches paved with a self-propelled paver shall conform to the requirements specified in Standard Specifications for Road and Bridge Construction (CDOT, 1999) Section 401.1. Rollers shall move at a uniform speed with the drive roll or wheels nearest the paver. Steel-wheeled rollers shall operate at a maximum speed of 3 mph. The use of plate type compactors will not be permitted except in areas that are not accessible to the roller. Areas wider than the machine screed may be patched with a box spreader only if the length of the patch is less than 50 feet. Areas as wide as the street or longer than 50 feet shall be patched with an asphalt lay down machine.
- R. Where irregularities, unavoidable obstacles, or patch widths of less than 4 feet make the use of mechanical spreading and finishing equipment impractical, the mixture shall be spread, raked, and luted by hand tools. For such areas, the mixture shall be dumped, spread, and screeded to give the required compacted thickness. New HBP shall be added in compacted layers, until the patch thickness meets the requirements of Paragraph 3.05H of this Specification.
- S. Cold In-Place Recycling. Patching may be achieved by cold in-place recycling if approved by the Engineer. This is also used for reconstruction of larger areas of pavement as well.

3.10 Temporary Patches

- A. Temporary Patches. When the final surface is not immediately installed, it shall be necessary to place a temporary asphalt surface on any street cut opening immediately after backfilling. The temporary surface installation and daily maintenance shall be the responsibility of the Contractor until the permanent surface is completed and accepted. The temporary surface shall be either a hot mix or cold mix paving material. Temporary surfaces shall be compacted, rolled smooth, and sealed to prevent degradation of the repair and existing structures during the temporary period.
- B. Backfilling or Covering with Steel Plates. When required by the Engineer, trenches within Arterials or Collectors, shall be backfilled or covered with steel plates (4 feet x 8 feet, 1-inch thick minimum) at the conclusion of the work done in order to open the roadway to traffic.
- C. Permanent Patching. Permanent patching shall occur within 2 weeks unless approved in advance by the Engineer. The temporary patch shall be removed prior to placement of the permanent patch. Refer to Paragraph 3.09 for patching.

3.11 Concrete Pavement Patching

- A. The concrete pavement patch shall be replaced with CDOT Class P concrete to match the finish and thickness of the existing pavement, but not less than 8 inches thick.

- B. Concrete shall be coated and sealed with a uniform application of membrane curing compound applied in accordance with manufacturer's recommendations.
- C. The use of quick cure concrete (3000 psi strength within 48 hours) shall be used on all arterial and collector status streets when repair areas are less than 500 square feet or when temperatures are below 40 degrees Fahrenheit. Quick curing concrete repairs may be opened to traffic within 2 days or when the concrete has achieved a minimum strength equaling 80 percent of the 28-day design strength. All mix design shall be in accordance with CDOT specifications.
- D. Where existing cracks or damage are adjacent to the area being repaired, the repair area shall include the cracked or damaged concrete. Pavement repairs shall include all areas of damage, including leak test holes, potholes, equipment, and/or scarring of the existing surface.
- E. When repairing concrete, the removal perimeter shall be saw cut and dowels inserted into the existing concrete as directed by the Engineer.
- F. Where new construction abuts existing pavement, the work shall be accomplished so that no abrupt change in grade between the old and new work results.
- G. Expansion joint material shall be installed between new structure slabs and existing structure slabs. Joints shall be thoroughly cleaned of all foreign material, then filled with a hot-poured elastic type joint filler conforming to M-173, ASTM D1190-80 or ASTM D1751-83, D1752-84, D3405-78, D3406-78, or D3407-78. Joint material shall be filled to within ½ inch of the surface. Excess material shall be scraped off to provide a smooth riding surface.

3.12 Aggregate Pavement Replacement

- A. Provide 6" thick minimum CDOT Class 5 or 6 surface. Compact to 95% Standard Proctor Density.

3.13 Sidewalk Replacement

- A. Replace sidewalks at all locations where the existing sidewalk is removed or damaged as part of the Work. Replacement shall include area where existing sidewalk is removed or damaged extended to the next adjacent construction joint.
- B. Match thickness and width of original walk, or greater. Concrete sidewalks shall be non-reinforced Class B concrete, 4" minimum thickness except 6" thickness across driveways. Provide 3" thick compacted sand or granular base.

3.14 Curb and Gutter Replacement

- A. Replace curb and gutter at all locations where the existing curb and gutter is removed or damaged as part of the Work. Replacement shall include area where existing curb and gutter is removed or damaged extended to the next adjacent construction joint.
- B. Match material and shape of original curb and gutter. Concrete curb and gutter shall be Class B concrete constructed on 3" thick compacted sand or granular base. Use fiber reinforcement at minimum rate of 1.0 lbs. per batch yard of concrete.

3.15 Driveway Replacement

- A. Match material removed and as follows:

Concrete	- 6-inch thick (min.)
Asphalt	- See Section 02501/3.04
Aggregate	- See Section 02501/3.07

3.16 Flowable Backfill

- A. Flowable backfill shall be required as dry utility trench backfill where cover for trench is less than 2 feet or where the trench is perpendicular to the centerline of the road, unless otherwise directed by the Engineer. This requirement applies to all locations under pavement. Vibration of flowable fill may be required.
- B. Flowable backfill shall be required in all voids and openings created by removal of the soil where compaction equipment is unsuitable.
- C. Trenches shall be initially backfilled to the level of the original surface. After flowable fill has cured, the top surface of the flowable fill shall be removed to the depth necessary to allow repair of permanent surface.
- D. Flowable fill shall not be used as a temporary or permanent street surface.

3.12 Lane and Parking Marking

- A. Paint line work on paving, concrete curbs, sidewalks, and ramps to existing line alignments, colors, and symbols or as otherwise shown on Drawings.
- B. Clean surface in areas to receive markings. Paint markings and symbols with traffic marking paint. Apply paint with mechanical equipment to produce uniform straight edges. Apply two coats at manufacturer's recommended rates.

3.13 Pavement Inspection and Testing

- A. Contractor shall meet all construction tolerances, material testing, reporting, and inspection criteria per Section 23 of the Larimer County Urban Area Street Standards.
- B. Contractor shall proof roll subgrade prior to paving or patching with Engineer present to observe and approve the proof rolling results.

END OF SECTION

SECTION 02745

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 Summary

- A. Provide asphaltic concrete paving as shown and as specified. Comply with applicable provisions of Div. 0 and 1.

1.02 Related Sections

- A. Section 02300 – Earthwork
- B. Section 02701 – Pavement Replacement
- C. Section 02770 – Curb and Sidewalks
- D. Section 03300 – Cast-in-Place Concrete

1.03 Submittals

- A. Mix Design: Submit job mix formula for aggregate and bitumen content for review. Job-mix formula shall have been derived from tests performed by a qualified testing laboratory. Results of previous tests performed on aggregates from same source and using asphaltic material of same brand as used in a previous mix design may be used with approval of Engineer.
- B. Test Reports: Submit reports for laboratory and field tests required under "Testing" article.
- C. Make submittals in accordance with Section 01330.

1.04 Quality Control

- A. Contractor shall maintain a quality control program in accordance with CDOT standard specifications or the Larimer County Urban Area Street Standards to ensure that the asphalt produced meets the job mix design, but documentation submittals are not required. Owner will not provide mix verification testing.

1.05 Testing

- A. Base Course. Contractor shall arrange and pay for base course compaction testing by a qualified testing agency, acceptable to Owner and independent of Contractor. Determine laboratory density of base course material. Perform at least one field density test for every 2000 sq/ft of paved area, but in no case less than three tests.
- B. Proof-Rolling. After the subgrade has been compacted, tested, and found to meet specifications, the entire subgrade shall be mechanically proof-rolled with a heavily loaded vehicle to ensure uniformity of the subgrade. The vehicle must have a loaded GVW of 50,000 pounds with a loaded single axle weight of at least 18,000 pounds

and a tire pressure of 90 psi. Subgrade which is pumping or deforming under loading must be reworked, replaced or otherwise modified, to form a smooth, stable, non-yielding base for subsequent paving courses. The Engineer shall be notified at least 24 hours before final proof-rolling. All proof rolls shall be observed by the Engineer.

- C. Asphaltic pavement job mix formula shall be derived from tests performed by a qualified testing agency paid for by Contractor. Results of previous tests performed on aggregates from same source and using asphaltic material of same brand as used in a previous mix design may be used. Submit job mix formula to Engineer prior to asphalt placement.
- D. Contractor shall arrange and pay for non-destructive nuclear density testing by a qualified testing laboratory, acceptable to Owner and independent of Contractor. Perform field density tests as follows:
 - 1. Lower Layer(s): Perform a minimum of one density test per layer for each lot of 3,000 sq yd of pavement or fraction thereof.
 - 2. Upper Layer: Perform a minimum of three density tests for each lot of 3,000 sq yd of pavement or fraction thereof.
- E. If density is below specified amount, submit proposed corrective action to Engineer.

PART 2 PRODUCTS

2.01 Asphaltic Concrete

- A. Hot-mixed asphaltic mixture conforming to CDOT Section 401, Grade S, SX, and SG as specified by the Geotechnical Engineering Report or the Drawings.

2.02 Asphalt Cement

- A. Asphalt cement meeting the requirements of CDOT Section 401.

2.03 Aggregate

- A. Lower Layer(s) (Binder Course): Aggregate shall conform to CDOT Section 703, Grade S, for the 19 mm (3/4 inch) nominal size.
- B. Upper Layer (Surface Course): Aggregate shall conform to CDOT Section 703, Grade SX, for the 12.5 mm (1/2 inch) nominal size.

2.04 Mineral Filler

- A. Limestone dust, portland cement, or other inert filler meeting requirements of ASTM D242 or AASHTO M17.

2.05 Equipment

- A. Equipment shall be in accordance with CDOT Section 401 and the following criteria; alternate equipment shall be approved by Engineer:

1. Asphalt mixing plant designed to produce a uniform mixture within job-mix tolerances.
2. Self-powered pavers capable of spreading mixture to thickness and width specified, true to line, grade and crown.
3. Smooth metal-bedded haul trucks, with covers when required, to insure continuous paving operations; truck boxes shall be cleaned.
4. Self-propelled steel wheeled rollers with minimum 10 ton rating.
5. Self-propelled pneumatic-tired rollers capable of applying a minimum of 30 psi and a maximum of 90 psi ground contact pressure.
6. A power broom or a power blower or both, as required.
7. All hand tools necessary to complete the job.

206 Aggregate Base Course

- A. Base material shall consist of hard, durable particles or fragments of stone or gravel crushed to the required sizes. Material shall contain an appropriate quantity of sand or other finely-divided mineral matter which conforms to the requirements of AASHTO M 147, and to CDOT Section 703.03, Class 5 or 6 Aggregate Base Course. In addition, the material must have an R-value of 72 or greater, and must be moisture stable. When produced from gravel, not less than 60 percent by weight of the aggregate retained on a No. 4 sieve shall consist of particles having at least one fractured face. Base material shall be free from organic matter and lumps or balls of clay and when placed and compacted will result in a firm, dense, unyielding foundation.

PART 3 EXECUTION

3.01 Preparation

- A. Prepare surface in accordance with CDOT Section 401.
- B. Place asphaltic mixture on a prepared, firm, and compacted base or foundation course, substantially surface-dry and free and clear of loose and foreign material. Loose aggregate on roadbed shall be incorporated in shoulder construction, if any, or disposed of as directed by A/E.
- C. Prepare holes and depressions in existing asphaltic surfaces by removing loose and defective material and patching with asphalt-aggregate material, compacted to produce a tight surface conforming to adjacent area.
- D. Proof-roll prepared surface to check for unstable areas requiring additional compaction. Notify Engineer of unsatisfactory conditions; do not begin paving work until such conditions have been corrected.
- E. Do not place asphaltic mixture over frozen subgrade or base or where roadbed underlying foundation or base is temporarily unstable from effects of frost heaving.
- F. Do not place asphaltic mixture when raining; remove and replace mixture adversely affected by rain or snow before final rolling.

- G. Do not place asphaltic mixture when air temperature at site of work, in shade and away from artificial heat, is less than 40 deg F.

3.02 Preparing Mixture

- A. Prepare mixture in accordance with CDOT Section 401.
- B. Paving mixtures shall be composed of a homogeneous mixture of coarse and fine aggregate, mineral filler (when required), and asphalt cement heated to proper viscosity for uniform distribution throughout mixture.
- C. Store coarse and fine aggregates separately to prevent intermingling. Stockpile in a manner that will prevent segregation of aggregate sizes. If aggregate tends to segregate during handling, supply and stockpile aggregates in two or more sizes.
- D. When it is necessary to blend aggregates from more than one source, stockpile each aggregate individually and feed through separate bins to cold elevator feeders. Do not blend in stockpile.
- E. When aggregates proposed for work do not provide required stability or void content in compacted mixture or are deficient in fraction passing No. 200 sieve, correct deficiencies by incorporation of mineral filler into mixture or substitute other satisfactory aggregates.
- F. Dry aggregates to a moisture content of less than 1 percent. Screen dry aggregates and store in sizes that may be easily recombined into a gradation meeting requirements of job-mix formula.
- G. Feed cold aggregates uniformly to plant so that surpluses and shortages will not occur and cause breaks in continuous operation. Heat aggregate to provide a paving mixture temperature immediately after mixing of 300 deg F +/- 15 deg F. Mix for not less than 45 seconds; mixing times shall be based on Ross Count Procedure to achieve 95% of coated particles for surface mixture.
- H. Asphaltic mixture which is not sufficiently mixed or is defective in any manner will be rejected.

3.03 Placing Mixture

- A. Place mixture in accordance with CDOT Section 401.
- B. Construct asphaltic concrete pavement in accordance with CDOT specifications, except as otherwise designated.
- C. Place asphaltic mixture in one or more courses to the grades and typical section shown. Comply with minimum and maximum layer thickness requirements of CDOT. Final course of multi-course pavements shall be a surface course. Pavement thickness shall consist of a minimum of 6-inches of aggregate base course and 3½-inches HBP Grading S and SX per the recommendations of the Geotechnical Engineering Report.

- D. Place asphaltic mixture by means of self-propelled paving machines at recommended operating speed. Place inaccessible and small areas by hand. Minimum temperature of mixture at time of placement shall be 235 deg F.

3.04 Compaction

- A. Compact pavement in accordance with CDOT Section 401.
- B. While still hot, compact course thoroughly and uniformly by rolling. Begin rolling when mixture will bear roller weight without excessive displacement. Roller speed shall be slow enough to avoid undue displacement of mixture. Compact with hot hand tampers or vibratory compactors in areas inaccessible to rollers. Do not use pneumatic tire rollers on parking lots, driveways, or other areas where traffic will not smooth out roller marks.
- C. Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material. Following breakdown rolling and while mixture is hot, continue second rolling until mixture has been thoroughly compacted.

3.05 Joints

- A. Place courses as nearly continuous as possible. Do not roll unprotected end of freshly laid mixture unless placement is to be discontinued long enough to permit mixture to cool.
- B. Longitudinal joints shall be made by overlapping screed onto previously laid material for a minimum of at least 1 inch depositing a sufficient amount of materials. A minimum distance of 12 inches shall be permitted between location of joints between different courses.
- C. Transverse joints shall be constructed with proper use of separation paper, and shall be at near right angles to street.
- D. Contact surfaces, manholes, valves, and similar structures shall be sufficiently coated with liquid asphalt and cleaned to prevent accumulation of asphaltic material. Joints between old and new pavement and between fresh and previously cooled work shall be cut back on a straight line to provide a butt-joint for full depth of new mat. Prior to paving, clean contact surfaces and apply emulsified asphalt tack coat.

3.06 Surface Requirements

- A. Finished surface shall be smooth and true. Meet curbs, manholes, and other construction at required grades. Test surface by means of a 10 feet straightedge laid parallel to centerline of road; irregularities in excess of 1/8-inch in surface courses and 1/4-inch in binder courses from lower edge of straightedge between any two contact points shall be corrected.

3.07 Lane and Parking Marking

- A. Paint line work on asphaltic paving, concrete curbs, sidewalks, and ramps as shown.

- B. Clean surface in areas to receive markings. Paint markings and symbols with traffic marking paint. Apply paint with mechanical equipment to produce uniform straight edges. Apply two coats at manufacturer's recommended rates.

3.08 Protection of Work

- A. Use barricades, flares, flagging, and other traffic guidance to prevent damage to fresh asphalt until pavement has hardened. Maintain work during various stages of construction and until final acceptance. Any rich or bleeding areas, any breaks, raveled spots, or other unsatisfactory areas in the wearing surface shall be corrected during such maintenance period.

END OF SECTION

SECTION 02770

CURBS AND SIDEWALKS

PART 1 GENERAL

1.01 Summary

- A. Provide curbs and sidewalks as shown and as specified. Comply with applicable provisions of Div. 0 and 1.
- B. Comply with applicable Governmental Codes for curbs and sidewalks on public property.

PART 2 PRODUCTS

2.01 Forms

- A. Forms may be either stationary or slip-form type. If slip forms are used, finished curb and gutter shall be of quality equal to that produced by stationary forms.
- B. Stationary forms shall be steel or wood, free of distortion and defects, and of appropriate size and strength. Use flexible spring steel forms or laminated boards to form radius bends. Apply nonstaining, clear, paraffin-based form oil.

2.02 Reinforcement

- A. Fiber reinforcement shall comply with Section 03300.
- B. Welded wire fabric shall comply with ASTM A185; furnish flat sheets.
- C. Reinforcement bars shall comply with ASTM A615, Grade 60.

2.03 Concrete

- A. Comply with requirements of Section 03300, Class AA.

2.04 Expansion Joint Filler

- A. Premolded joint filler (PJF), bituminous/fiber type or asphalt-impregnated felt type, ASTM D994; 1/2-inch thickness by depth of concrete, unless otherwise shown.

2.05 Curing Compound

- A. Wax resin, white pigmented; ASTM C309, Type 2.

PART 3 EXECUTION

3.01 Preparation

- A. Remove loose material from compacted subgrade. Proof-roll subgrade; give notice of unstable areas. Moisten subgrade to provide a uniformly damp condition.

- B. Set clean forms to required grades and lines, rigidly braced and secured. Sidewalks shall be minimum 4-inch thick, except provide minimum 6-inch thickness across driveways.
- C. Place and support steel reinforcement as specified in Section 03200/03300.
- D. Check tolerances as follows (slip form methods shall produce equivalent results):
 - 1. Top of form: 1/8 inch in 10 feet
 - 2. Alignment of vertical face: 1/4 inch in 10 feet
- E. Adjust manholes and utility structures to grade.

3.02 Joints

- A. Construct expansion, isolation, and weakened-plane (contraction) joints true-to-line with face perpendicular to surface. Construct transverse joints at right angles to centerline, unless otherwise shown.
- B. At abutting existing walks, align transverse joints with previously placed joints, unless otherwise shown.
- C. Provide weakened-plane (contraction) joints for a depth equal to at least 1/4 the walkway or curb thickness. Locate joints in walks at intervals equal to width of walk. Locate joints in curbs at 20 ft on center, unless otherwise shown.
- D. Place construction joints at end of all pours and when operations are stopped for more than 1/2 hr. Use standard metal keyway section forms for joints not shown on drawings.
- E. Provide premolded joint filler for expansion joints and isolation joints abutting fixed objects. Provide expansion joint filler between abutting curbs and sidewalk.
- F. Locate expansion joints at 30 ft on center, unless otherwise shown. Extend joint fillers full width and depth of the joint, set 1/2 to 1 inch below finished surface. Conform to profile of concrete surface. Furnish joint fillers in one-piece lengths wherever possible; otherwise lace or clip joint filler sections together. Protect top edge of joint filler during concrete placement.

3.03 Concrete Placement

- A. Mix, place, cure, and protect concrete in accordance with Section 03300.
- B. After striking off and consolidating concrete, smooth surface by screeding and floating. Test surface for trueness with a 10 ft straightedge. Remove surface irregularities and refloat repaired areas to provide a continuous, smooth finish of uniform texture.
- C. Work edges of slabs and joints with edging tool to form a 1/2-inch radius.
- D. After floating and when excess moisture has disappeared, provide broom finish by drawing a fine-hair broom perpendicular to line of traffic.
- E. After 24 hours, remove forms, clean ends of joints, and point-up honeycombed areas.

3.04 Repair and Protection

- A. Repair or replace broken or defective concrete. Remove surface stains. Protect concrete from damage until Initial Acceptance.
- B. Prior to final inspection, sweep concrete and wash free of stains, dirt, and other foreign material.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 GENERAL

1.01 Description

- A. Formwork for cast-in-place concrete shall include shoring for cast-in-place concrete and installation into formwork of items furnished under other Sections, such as anchor bolts, setting plates, bearing plates, anchorages, frames, and accessory items embedded in concrete.

1.02 Related Work

- A. Section 03300 – Cast-In-Place Concrete

1.03 Codes and Standards

- A. Unless otherwise indicated, comply with the American Concrete Institute (ACI) Standard 308, "Recommended Practice for Concrete Formwork."

1.04 Design

- A. Design of formwork, shoring and accessories shall be the responsibility of the Contractor. Design, erect, support and maintain formwork so as to safely support all vertical and lateral loads until such loads can be supported by the concrete structure. Determinations shall be made in accordance with ACI 308.
- B. Forms for concrete surfaces requiring subsequent treatment shall receive a type of coating that will not impair bond or adhesion.
- C. Form oil for steel forms shall be non-staining, rust-preventative type.

PART 2 PRODUCTS

2.01 Forms for Exposed Finish Concrete

- A. Unless otherwise designated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced, or other panel type materials acceptable to the Construction Coordinator, to provide continuous, straight, smooth surfaces. Furnish panels in largest practicable sizes to minimize number of joints. Provide form material of sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

2.02 Plywood

- A. Form plywood shall be Douglas Fir, 5 ply "Plyform," mill treated, edge sealed, water resistant plywood made for the purpose, free of loose knots, splits, checks, or excessive raised grain.

2.03 Ties

- A. Ties shall have a minimum working strength of 3,000 lbs when fully assembled. Ties shall be adjustable to permit tightening of forms. Ties shall leave no metal closer to the surface than 1-1/2 inch nor create a hole larger than 7/8 inch in diameter. Wire or bank iron ties are not permitted.

2.04 Chamfer Strips

- A. Three-fourths by three-fourths-inch by 45° wood, plastic, or rubber stripping.

2.05 Form Coating Compound

- A. Form Coating Compound shall be a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces and not impede the wetting of surfaces to be cured with water or curing compounds.
- B. Forms for concrete surfaces requiring subsequent treatment shall receive a type of coating that will not impair bond or adhesion.
- C. Form oil for steel forms shall be non-staining, rust-preventative type.

PART 3 EXECUTION

3.01 Construction

- A. Construct forms to the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb in finished construction. Provide for openings, offsets, sinkages, recessed, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Forms shall be sufficiently tight to prevent leakage of concrete. Assemble forms so their removal will not damage concrete.
- B. Chamfer all corners of concrete exposed to view.

3.02 Form Coatings

- A. Coat form contact surfaces with form coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- B. Coat steel forms with form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.03 Provision for Other Trades

- A. Provide openings in concrete formwork to accommodate work of other trades, including those under separate prime contracts (if any). Size and location of openings, recesses and chases are the responsibility of the trade requiring them. Accurately place and securely support items built into forms.

3.04 Cleanouts, Cleaning, and Tightening

- A. Provide temporary openings in wall and column forms as required to facilitate cleaning and inspections. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove ships, wood, sawdust, dirt, and other debris immediately before concrete is to be placed.
- B. Tighten form immediately after concrete placement as required to eliminate mortar leaks.

3.05 Removal of Forms

- A. Remove forms from cast-in-place concrete only after concrete has achieved sufficient strength to support itself and superimposed loads, but in no case in less time than stated below.
- B. Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed 24 hours after placing concrete provided concrete is sufficiently hard to not be damaged by form removal operations, and provided that curing and protection operations are maintained.
- C. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements shall not be removed until concrete has attained minimum 28-day compressive strength, but not less than 14 days.
- D. Form-facing materials may be removed 4 days after placement, if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.06 Re-Use of Forms

- A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for the new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use "patched" forms for concrete surfaces exposed to view.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 Summary

- A. Provide concrete reinforcement including bars, welded wire fabric, ties, and supports as shown and as specified. Comply with applicable provisions of Div. 0 and 1.

1.02 Related Sections

- A. Section 03100 - Concrete Formwork
- B. Section 03300 - Cast-in-Place Concrete

1.03 Codes and Standards

- A. Comply with provisions of following codes and standards, except as otherwise designated:
 - 1. ACI 315 Details and Detailing of Concrete Reinforcement
 - 2. ACI 318 Building Code Requirements for Reinforced Concrete
 - 3. AWS D1.4 Structural Welding Code-Reinforcing Steel
 - 4. CRSI Manual of Standard Practice

1.04 Submittals

- A. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315. Show bar schedules, stirrup spacing, diagrams of bent bars, and arrangements and assemblies of concrete reinforcement. Include special reinforcement required at openings through concrete structures.
- B. Make submittals in accordance with Section 01330.

1.05 Quality Assurance

- A. Notify Construction Coordinator 24 hours prior to concrete placement to permit review of reinforcement.

1.06 Delivery and Storage

- A. Deliver reinforcement bundled and marked using metal tags corresponding to placement diagrams. Store concrete reinforcement to prevent damage and accumulation of dirt or excessive rust.

PART 2 PRODUCTS

2.01 Reinforcing Bars

- A. ASTM A615, Grade 60, deformed, new billet steel.

2.02 Welded Wire Fabric (WWF)

- A. ASTM A185, welded steel wire fabric.

2.03 Supports for Reinforcement

- A. Furnish bolsters, chairs, spacers, hangers, and other devices for spacing, supporting and fastening reinforcement in place. Use wire bar type supports complying with CRSI specifications, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.
- B. For slabs-on-grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs.
- C. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
- D. For sandblasted, bush-hammered, and tooled concrete, provide stainless steel accessories.
- E. Over waterproof membranes, use precast concrete chairs to prevent penetration of membrane.

2.04 Fabrication

- A. Shop-fabricate reinforcing bars to conform to required shapes and dimensions; comply with fabrication tolerances of ACI 315. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken material. Reinforcement with the following defects will not be permitted:
 - 1. Bar exceeding specified fabrication tolerances
 - 2. Bend or kinks not indicated on Drawings or final shop drawings
 - 3. Bars with reduced cross-section due to excessive rusting or other cause

PART 3 EXECUTION

3.01 Placing Reinforcement

- A. Comply with specified codes and standards, and CRSI recommendations.
- B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which interfere with bond to concrete.

- C. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing with metal chairs, runners, bolsters, spacers, and hangers, as required to carry reinforcement.
- D. Provide a minimum center-to-center spacing of 2-1/2 bar diameters and a minimum clear spacing between bars 1-1/2 times maximum aggregate size. Place reinforcement to obtain minimum concrete coverages specified below.
- E. Securely tie bars and bar supports together with 16 gage annealed iron wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that ends are directed away from exposed concrete surfaces. Do not place reinforcing bars more than 2 inches beyond last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

3.02 Placing Fabric

- A. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh, but not less than 6 inches on side joints and 12 inches on end joints; lace splices with 16 gage annealed iron wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.03 Splices and Terminations

- A. Comply with requirements of ACI 318, CRSI, and as shown.
- B. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
- C. Splices and laps indicated in reinforcement for beams, columns, elevated slabs, and walls shall be 30 bar diameters minimum, unless otherwise noted. Stagger adjacent laps and splices, unless otherwise shown.
- D. Horizontal reinforcement in footings, foundations and walls at corners and intersections shall be made continuous using corner bars or "L" dowels of same diameter; lap 30 bar diameters, unless otherwise shown.
- E. Splices for horizontal wall reinforcement of circular tanks shall be staggered so that no more than each fifth bar is spliced within any two feet of wall perimeter.
- F. Splices not shown on Drawings or shop drawings shall be determined on basis of safe bond stress and stress in reinforcement; splices shall not be less than 24 bar diameters and minimum 12-inch length.
- G. Terminate horizontal reinforcement in beams, elevated slabs and walls with a standard hook, unless otherwise shown.

- H. Rebar splicing devices and anchorage systems, such as inserts in lieu of continuous bars to facilitate gang forming, will be allowed provided strength capacities are equal to rebar they replace. Submit details for approval before installation.

3.04 Concrete Cover

- A. Provide the following minimum concrete cover over steel reinforcement, unless otherwise shown:

Footings:	3"
Foundation walls:	2"
Tank walls:	2"
Walls exposed to earth:	2"
Walls to dry interior spaces:	1"
Beams, interior:	1-1/2"
Columns, interior:	1-1/2"
Slabs-on-grade, bottom:	3"
Slabs, surfaces exposed to dry interior spaces:	3/4"
Slabs exposed to water and wastewater:	2"

3.05 Grouting Reinforcement Bars

- A. Where shown, drill and grout reinforcement bars into existing concrete. Use pre-mixed non-shrink grout or expansive portland cement grout consisting of two parts sand, one part portland cement, and unpolished aluminum powder at rate of 4 grams per sack of cement, thoroughly dry mixed with cement. Grout shall be mixed as dry as practicable. Fill hole with grout and ram reinforcement bar into place. Remove excess grout from surface area. Proprietary non-shrink grout products shall be submitted for approval.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 Section Includes

- A. Portland cement concrete shall be composed of a mixture of an air entraining agent, Portland cement, fine and coarse aggregates, and water, proportioned to produce a workable, strong, dense, and impermeable concrete. Admixtures may be added to achieve a desired result provided such admixture does not adversely affect strength and durability of the concrete.

1.02 Related Work

- A. Section 02321 - Trenching, Backfilling, and Compacting
- B. Section 02501 - Manholes
- C. Section 02701 - Pavement Replacement
- D. Section 03100 - Concrete Formwork
- E. Section 03200 - Concrete Reinforcement
- F. Section 03253 - Waterstop

1.03 Submittals

- A. Prepare mix design and prove with laboratory 7- and 28-day compressive tests, or submit test reports of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects. Submit mix design in writing for review by the Owner at least 15 days before placing any concrete.
- B. The compressive strength of the laboratory trial mix shall be at least 25 percent greater than the desired 28-day field compressive strength.
- C. Provide certificate that cement complies with ASTM C150 Standard Specifications for Portland Cement and these specifications.
- D. Provide certificate that aggregates comply with ASTM C33 Standard Specifications for Concrete Aggregates. State weathering region limits of coarse aggregates: severe, moderate, or negligible. State abrasion resistance in percent loss as measured per ASTM C131. State basis of determining that potential reactivity is negligible.
- E. For Ready Mix Concrete: Provide delivery tickets or weighmasters' certificate per ASTM C94, including weights of cement and each size aggregate, amount of water in the aggregate, and amount of water added at the plant. Write in the amount of water added on the job.
- F. For concrete admixtures, provide manufacturer's certificate of compliance with these specifications.

- G. Epoxy Bonding Compound: Provide manufacturer's specific instructions for use.
- H. Non-shrink Grout: Provide manufacturer's certificate of compliance with these specifications and specific instructions for use.

1.04 Inspection

- A. Prior to placing concrete, the Contractor shall notify the Construction Coordinator for inspection of surface preparation and the placement of reinforcement steel.

1.05 Weather Limitations

- A. Cold weather concreting procedures shall be provided as recommended in the ACI Manual of Concrete Practice, except as noted below. Except when authorized by the Construction Coordinator, concreting operations shall not be continued when a descending air temperature in the shade, away from artificial heat, falls below 40°F nor resumed until an ascending air temperature in the shade, away from artificial heat, reaches 35°F. Curing of slabs on grade and footings may be omitted during the season of the year when freezing temperatures can be expected or when the atmospheric temperature may be expected to drop below 40° Fahrenheit during the required protection period following the placement of concrete, provided that the newly laid concrete shall be protected by covering with a layer of impermeable paper or plastic and covered with not less than 12 inches of loose, dry hay or straw. Plastic sheathed, insulated blankets are approved equals for the insulating layers of plastic and hay. The covering shall be retained in place for a period of 10 days.
- B. Neither calcium chloride or chemical admixtures shall be added to the concrete to prevent freezing.
- C. The Contractor shall employ effective means, such as precooling of aggregates and mixing water and placing at night, as necessary, to maintain the temperature of the concrete, as it is placed, below 90°F. This shall be accomplished in accordance with recommendations for hot weather concreting given in detail in "Hot Weather Concreting" reported by ACI Committee 305.

PART 2 PRODUCTS

2.01 Cement

- A. Use Portland cement, ASTM C150, Type I or II, unless otherwise specified, and when high early strength concrete is specified, use Type III. Type II Portland cement shall be used during warm weather conditions as directed by the Construction Coordinator in accordance with the ACI recommended installation practices.

2.02 Synthetic Fibers

- A. When Drawings designate fibermesh concrete, mix synthetic fiberglass fibers into concrete such as Harbourite, manufactured by Fibermesh Incorporated, Chattanooga, Tennessee, or approved equal according to manufacturer's specifications. The amount of synthetic fibers added to the concrete shall be 1.5 pounds per cubic yard of concrete.

2.03 Aggregates

- A. Fine and coarse aggregates shall comply with ASTM C33 Standard Specification for Coarse Aggregates. Aggregate shall consist of clean, hard, durable sand, crushed rock, and crushed gravel, or gravel. Coarse aggregate shall meet the grading requirements for size number 67, or 57 Colorado Standard Specifications for Road and Bridge Construction. The maximum aggregate size for riprap grout shall be 3/8 inch.
- B. Ratio of coarse aggregate to fine aggregate shall not be less than 1:1 nor more than 2:1.

2.04 Water

- A. Mixing water shall be free of oil, acid, excessive alkalinity, organic matter, salts, or other impurities.

2.05 Admixtures

- A. Use admixtures when specified or with express permission of the Construction Coordinator, in strict accordance with the manufacturer's instructions. Exercise care to assure that the admixture does not increase or decrease the air content beyond the allowable limits.
- B. Air entraining agent shall be Master Builders, MB-AE10; W.R. Grace and Co., Dara Vair, or approved equal. The added air entraining agent shall produce, in accordance with ASTM C260, an entrained air content as specified in Table 601-1 of Colorado Standard Specifications for Road and Bridge Construction.

2.06 Concrete Mixture

- A. Use the following classes of concrete, if not otherwise indicated, as described in the Standard Specifications for Road and Bridge Construction (CDOT 1999), and as modified herein.

<u>Concrete Class</u>	<u>Use</u>	<u>Modifications</u>
Design Strength		
A	Use Class B Concrete	
B - 3,000 psi	All concrete 12-inch or less thick. (May substitute class D).	none
D - 4,500 psi	As specifically called out by structure or concrete greater than 12-inches thick.	none
P - 4,200 psi	Concrete pavement.	none

Additional modifications and mixture specifications are given in Section 01010. Class D concrete requires the use of an approved water reducing mixture.

2.07 Riprap Grout Mixture

- A. 2,000 psi
Min 6 sacks total cementitious material/per cubic yard
Up to 25 percent flyash substitution, Class C or F*
Type II cement
70 percent Type I granular bedding, 3/8-inch gravel
7-inch \pm 2-inch slump
1.5 lb fibermesh or equivalent per cubic yard concrete as required by Construction Coordinator
(Max 3/4-inch fiber length)
7-1/2 percent \pm 1-1/2 percent air entrainment
*Class F when high sulfate content in soil

PART 3 EXECUTION

3.01 Preparation

- A. Surfaces which will be in contact with the new concrete shall be prepared as follows:
 - 1. Forms shall be wetted with light oil.
 - 2. Subgrade shall be sprinkled with water.
 - 3. Old concrete and adjacent structures shall be separated from new concrete with 3/4-inch asphalt-impregnated felt (performed expansion joint filler) as specified below.
 - 4. All reinforcement steel shall be positioned to provide a minimum of one and one-half (1-1/2) inch concrete cover except as noted otherwise on the Drawings.

3.02 Joints

- A. Preformed joint filler shall be furnished. Damaged or repaired joint filler shall not be used unless approved by the Construction Coordinator. The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing concrete. Finished joints shall not deviate more than 1/4-inch in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. Plugs of concrete shall not be permitted anywhere within the expansion space. Expansion joints shall be formed at all existing or proposed structures and features projecting through, into or against the concrete work. When expansion joint details are not shown on the Drawings, the Contractor shall form the joint in conformance with good construction practice, and furnish all expansion joint materials.

B. Construction Joints

1. Concrete in each unit of construction shall be placed continuously. Before new concrete is placed on or against concrete which has set, forms shall be retightened and the surface of the set concrete shall be cleaned of foreign matter. Watertight joints shall be provided with waterstop as specified in Section 03253.
2. Construction joints shall be formed as specified below. A rough surface of exposed concrete aggregates shall be produced using a surface retardant at construction joints, including joints between slab and grout. The limit of the treated surfaces shall be 1 inch away from the joint edges. Within 24 hours after placing, retarded surface mortar shall be removed either by high pressure water jetting or stiff brushing or combination of both so as to expose coarse aggregates. A rough surface of exposed aggregate may also be produced by sandblasting followed by high pressure water jetting. Sandblasting, if used, shall remove 1/8 inch of laitance film and shall expose coarse aggregate to insure adequate bond and watertightness at the construction joints.

After cleaning and before new concrete is placed, vertical joints shall be thoroughly wetted. After cleaning, and immediately prior to placement of concrete in walls, the construction joint at the base of the wall shall be slushed with one two inches of neat cement grout. The neat cement grout shall be formulated with water and cement only, shall have a water/cement ration less than or equal to that of the concrete and a consistency similar to thick paint. The fresh concrete shall be placed before the grout has attained its initial set.

3.03 Inserts and Embedments

- A. Where pipes, castings, or conduits pass through structures, the Contractor shall place such pipes or castings in the forms before placing the concrete, or he may provide openings in the concrete for subsequent insertion of such pipes, castings, or conduits with approval of the Construction Coordinator. Such openings shall be provided with waterstops and a V-shaped construction joint and shall have a slight flare to facilitate grouting and permit the escape of entrained air during grouting. Additional reinforcement shall be provided around large openings as shown in the Drawings. The grout shall be as specified herein.
- B. Gate frames, gate thimbles, special castings, channels, or other miscellaneous metal parts that are to be embedded in the concrete shall be set and secured in the forms prior to concrete placement. Unless otherwise specified, anchor bolts and inserts shall be embedded in concrete and bedrock as shown. The Contractor shall provide inserts, anchors, or other bolts necessary for the attachment of piping, valves, metal parts, and equipment. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removal material to prevent the entry of concrete into the voids. Operators or sleeves for gate or valve stems shall be positioned to clear reinforcing steel, conduit and other embedments, and to align accurately with equipment.

3.04 Mixing Concrete

- A. If "Ready-mix" concrete is used, it shall be produced, delivered, and handled in accordance with the requirements of the State of Colorado Standard Specifications for Road and Bridge Construction.

- B. Concrete shall be deposited at the job site within one hour after introduction of water in the mix. Care shall be taken in transferring concrete from the truck or mixer to avoid segregation of aggregates in the mixture.

3.05 Field Quality Control

- A. Contractor shall conduct tests on the proposed concrete mixture to determine the slump, entrained air content, compressive strength, or other appropriate tests to determine conformance with these specifications.
- B. The Construction Coordinator may elect to have slump tests taken prior to concrete placement. Testing will be done by the Contractor or his representative. Failure to meet the limits established for slump may result in rejection of the load.
- C. The concrete shall be subjected to compressive strength tests. The Contractor shall supply standard test cylinders and the Contractor or his representative may fill the cylinders. Two cylinders for compressive strength tests at 7 and 28 days shall be cast for each test. One test may be required for each daily pour of 25 cubic yards of concrete or more or for a single structure that requires less than 25 cubic yards.
- D. Test procedures shall conform to ASTM C31, C39, C143, and C172 specification standards as applicable.
- E. The Contractor will arrange to have the cylinders tested by an approved laboratory.
- F. Should the Construction Coordinator consider it necessary, Standard Proctor and field density tests will be required to determine adequacy of compaction of subgrade or base materials, as specified in Section 02321 or 02701.
- G. All tests shall be taken under the supervision of the Construction Coordinator or Inspector. The cost of the test, including materials, transportation, and reports shall be paid for by the Contractor.

3.06 Placing Concrete

- A. The concrete shall be deposited on the subgrade in a manner requiring as little rehandling as possible. Necessary hand spreading shall be done with shovels; rakes are not permitted. Workers shall not work in the green concrete with boots coated with earth.
- B. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. In case of a temporary shutdown, the concrete at the unfinished end of slabs shall be covered with wet burlap. When delays are necessary and of such length so that the concrete deposited will attain its initial set, and in any event where interruption in the concrete placing operations of more than 30 minutes occurs, a joint shall be provided and installed.
- C. Batches shall be dumped so that the concrete will not displace or disarrange the joint installations. The concrete shall be shoveled into place against the expansion joints and against or around other preassembled joint installations, which might otherwise be displaced or disarranged by concrete flowing against them. The concrete shall be placed against both sides of intermediate joint installations simultaneously.

- D. Sufficient spading, rodding, or mechanical vibrating shall be provided to insure concrete flow into the smallest corners, under pipes, and all places where concrete will not readily flow. Watertightness and an absence of honeycomb is essential for acceptance.
- E. Concrete shall not be placed around castings, frames, joints, and other embedded fixtures until they have been accurately adjusted and set to the required alignment and grades. Paint castings, frames, and embedded metal fixtures on their contact surface with a heavy coat of asphaltic mastic or separate with expansion joint material prior to the placement of concrete.

3.07 Placing Grout

- A. Placement shall conform to ASTM 304 as modified by these specifications.
- B. Pump grout near its final position to avoid segregation caused by rehandling or flowing. The use of a low pressure grout pump for filling voids, such as with grouted riprap is required. Do not deposit concrete in large quantities in one place to be worked along the riprap with vibrator.
- C. Use mechanical vibration when placing grout to eliminate pockets and voids, to consolidate each layer with that previously placed, and to bring just enough fine material to exposed surfaces to produce a smooth, dense, and even texture. Vibrators shall be of the high frequency internal type, and the number in use shall be ample to consolidate the incoming grout to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least two vibrators shall be available at the site.
- D. Do not place grout during rain or snow. Protect grout placed immediately before rain or snow to prevent water from coming in contact with the wet grout. Keep sufficient protective covering on hand at all times for this purpose.

3.08 Formed Surface Finishes

- A. Surface defects, including tie holes, minor honeycombing, or otherwise defective concrete shall be repaired in accordance with ACI 301, Chapter 9. Areas exhibiting unconsolidated concrete shall be brought to the attention of the Construction Coordinator prior to the start of patching. Areas to be patched shall be cleaned. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of at least 1 inch. The edges of the cut shall be perpendicular to the surface of the concrete. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set. Patches shall be cured as specified for the concrete. Finished surfaces shall be protected from stains and abrasions. Finishes shall be equal in workmanship, texture, and general appearance to that of the adjacent concrete. Concrete with honeycombing which exposes the reinforcing steel or with defects which affect structural strength or impermeability shall be corrected or replaced as directed by the Construction Coordinator.
- B. Formed surfaces shall be finished as soon as practicable after form removal and repair of surface defects. Finishes shall be as follows:
 - 1. FINISH A: Finish A shall be a grout clean finish in accordance with ACI 301, Section 10.3.2. Surfaces shall be lightly sandblasted prior to sacking. Finish A shall be provided for painted and unpainted surfaces, structures immersed in water from 1 foot below minimum water surfaces and up, and permanently exposed vertical and sloped surfaces, such as bridge piers and abutments.

Surfaces subjected to high water velocities of 40 fps or more must have accurate alignment and an even surface to prevent destructive water effects on adjacent surfaces. Such surfaces include outlets, draft tubes, surfaces of outlet works downstream from gates and spillway tunnels of dams. The forms must be strong and held rigidly and accurately to the required alignment and shape with less than 1/4-inch maximum irregularity allowance for projections and zero allowance for depressions. Abrupt irregularities on Finish A in high velocity flow areas of 1/4-inch or less shall be ground smooth in the direction of flow. No abrupt irregularities on these surfaces is greater than the maximum allowable 1/4-inch, the irregularity shall be ground to conform to the allowable limitation, with a maximum grinding height removal allowance of 1/4-inch. All grinding shall bevel irregularities to a 1:20 ratio of height to length and shall not be steeper than the allowed bevel. No abrupt irregularities shall exceed 1/8-inch in any direction not parallel to the direction of flow. If any irregularity exceeds the 1/8-inch limitation, the entire irregularity shall be eliminated by grinding on a bevel of 1:20 ratio of height to length.

2. FINISH B: Finish B shall be referred to as a finish which has surface imperfections less than 3/8-inch in any dimension. Surface imperfections greater than 3/8-inch shall be repaired or removed and the affected areas neatly patched. Finish B or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.
3. FINISH C: Finish C shall be the finish for surfaces which may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2-inch in any dimension shall be repaired.

3.09 Slab Finishing

- A. The surface of the concrete shall be thoroughly floated after the concrete has been struck off.
- B. Walks, ramps, pavements, operator platforms, curb and gutter, and driveways shall have a lightly broomed surface with the grain perpendicular to the direction of travel.
- C. Edges shall be neatly trimmed with a 1/4-inch radius edging tool. Any honeycombed areas shall be pointed with mortar.

3.10 Curing

- A. All exposed concrete slabs and formed structures above grade shall have provisions to prevent loss of moisture for at least 24 hours after placement. Methods may include plastic sheets, constant wetting of the surface with water, curing paper, or by use of an approved commercial curing compound and application methods in accordance with procedures designated in ACI 318 and ASTM C309. The rate of application shall be not more than 200 square feet per gallon of compound and in accordance with manufacturer's recommendations.
- B. All grout shall be sprayed with clear curing compound.

3.11 Watertightness, Testing, and Repair

- A. Selected structures as specifically identified elsewhere are subject to hydrostatic pressure and shall be tested for watertightness. The tests shall be made after all piping connections are completed and any gates are operational and closed, and prior to backfilling. Testing shall consist of filling with water to the maximum operating water surface for at least 24 hours. Wet spots, leakage, or seepage revealed by the test, including those caused by shrinkage of concrete, honeycombed areas, construction joints, or other sources shall be repaired by either or both of the following methods:
 - 1. Grouting of the joint by drilling grout holes to the affected crack or honeycombed area, installing injection ports and forcing epoxy grout into the joint under pressure.
 - 2. Cutting of a bevel groove on the water side of the joint. The groove shall be 1/2- to 3/4-inch in width and depth and shall be caulked with epoxy joint sealer in accordance with manufacturer's instructions.
- B. Long sections of completed pipe to be backfilled may be pressure tested if acceptable to the Construction Coordinator, so that backfilling may proceed concurrently with concrete construction.
- C. The Contractor shall retest items which have been repaired to check the suitability of repairs. Water required for the testing and retesting shall be provided by the Contractor and disposed of so as not to create a nuisance.
- D. It shall be the responsibility of the Contractor to repair or replace damaged concrete to perform the same design functions as originally intended (i.e., structural, directional, aesthetic appearance).
- E. No repair shall be made without prior approval from the Construction Coordinator. Due to the possible variations in repairs needed and function of the structure no further direction is given for repair; careful quality control of design mix, placement, formwork, and finishing is considered the most satisfactory alternative to concrete repair work. Replacement of the repaired concrete may be required if performance is unsatisfactory.

3.12 Cleanup

- A. Upon completion of the work and prior to final inspection, the Contractor shall clean all concrete surfaces. The cleaning procedures shall be as follows: After sweeping with an ordinary broom to remove the loose dirt, the surface shall be flushed with clean water. Final scrubbing by hand or machine shall follow.

END OF SECTION