SECTION T1

INTRODUCTION

A. DESCRIPTION

These Specifications sets forth minimum acceptable standards for construction procedures and materials for the installation of water and sanitary sewerage facilities under the jurisdiction of Springdale Water Utilities (SWU) and the testing of those facilities. Construction procedures, materials, and tests other than those outlined in these Specifications shall meet with the approval of the Department. Complete specifications covering an unusual or special construction procedure, material, or testing method not listed in these Specifications shall be submitted to the Department for approval prior to the beginning of construction.

1. Materials Production
   All materials shall be manufactured in accordance with applicable ASTM and AWWA standards at ISO approved manufacturing facilities and as set forth herein.

2. References
   Any reference to specifications published by other agencies shall implicitly refer to the latest edition or revision of that specification or publication.

3. Testing
   SWU shall have the authority to require any test outlined in these Specifications as well as any other test that may be deemed necessary by the Department for the acceptance of facilities, if in the opinion of the Department such tests are needed to demonstrate that the quality of materials and construction procedures meet the requirements of these Specifications. All tests shall be made in the presence of the Engineer and a representative of SWU before new utilities shall be accepted by the Department. No test shall be accepted unless a representative of the Department is present during the test procedure.

END OF SECTION

SECTION T2

SITE PREPARATION, EXCAVATION, AND FILL

A. DESCRIPTION

This Section sets forth requirements for the proper execution of sitework necessary for the construction of water and sewer facilities, including selective clearing, vegetation preservation, excavation, dewatering, embankment and fill, compaction, and disposal of excavated material.

B. EXECUTION

Site clearing operations shall not commence until all applicable permits have been acquired.

1. Soils Report
   The Engineer shall submit a soils report authored by a qualified, independent geotechnical laboratory acceptable to the Department, to be reviewed and accepted by SWU, unless otherwise directed.

2. Clearing and Grubbing
   The construction areas shall be cleared of all necessary obstructions, including but not limited to trees, stumps, roots, logs, rubbish, and other vegetation. Commencement of site clearing shall not be allowed until all temporary erosion control measures are in place, as specified in the Erosion Control paragraph in the General Project Requirements Section and the Environmental Permits Section found in the General Requirements Chapter of these Specifications.

   Benchmarks, control points, and existing construction shall be protected from disturbance and damage during the course of construction.

   At a minimum, all trimming, repair, and reestablishment of vegetation located in Class I areas shall be performed by a qualified horticulturist, unless otherwise directed by the Department. Class I Areas, as set forth in the Cleanup, Seeding, and Sod Section of these Specifications, are defined as areas of construction within lawn, gardens, or other well-kept areas, including street right-of-ways kept as lawns by adjacent landowners. Trees shall be trimmed in accordance with ANSI A300 (Tree, Shrub, and Other Woody Plant Maintenance – Pruning (Part I)).

   The Contractor shall remove only that vegetation, including trees, necessary for the progress of construction. Vegetation to remain or be relocated shall be clearly marked or otherwise identified. If construction shall be in close proximity to such vegetation, particularly shade trees or other trees of significant value, the Contractor shall be expected to work without removing or damaging such vegetation. The Contractor shall adequately grub stumps and remove roots, obstructions, and other debris. Surface irregularities, such as holes produced from the removal of cleared

items, shall be filled with approved backfill materials and compacted as directed by the Department Engineer, except in areas to be excavated.

All brush, timber, and other debris required to be removed shall be hauled from the site and disposed of by the Contractor in accordance with all federal, state, and local regulations. Burning of brush shall be permissible, provided that burning procedures shall be in full compliance with the provisions of all state and local agencies controlling and supervising these activities. Burning shall be conducted only when it does not jeopardize surrounding vegetation, right-of-way, and adjacent property.

3. Utilities

The Contractor shall be responsible for the location of all existing utility lines within the construction area and shall verify that these existing utilities have been disconnected and capped before commencing site clearing. Procedures for uncovering existing utilities, utility crossings, proximity, and notification of intent to excavate near existing utilities shall be as specified in the Existing Utilities Section in the General Requirements Chapter of these Specifications.

4. Topsoil Removal

Prior to the commencement of construction, the site shall be cleared and grubbed as set forth in the Clearing and Grubbing paragraph in this Section. After the site is cleared, all topsoil shall be stripped from the site and an adequate amount stored for reuse in final seeding and landscaping. Adequate surface removal is dependent on the area through which construction proceeds and is specified in the Surface Removal Section of these Specifications. Subsoil and other materials such as trash, debris, weeds, roots, and other waste shall be removed from the topsoil.

Topsoil shall be replaced as set forth in the Cleanup, Seeding, and Sod Section of these Specifications. In the event there is insufficient topsoil stored along the ditch line to accomplish the topsoiling requirement, the Contractor shall haul in additional topsoil at own expense to meet this requirement.

Any unstable materials located shall be stabilized in-place or removed and replaced with select fill as set forth in the Excavation in Poor Soil, Stabilization, and Refilling to Grade paragraph in this Section.

5. Excavation

Excavation work shall include the necessary removal and disposal of all debris; excavation and trenching; handling, storage, transportation, and disposal of all excavated material; placement of all necessary sheeting, shoring, and protection; preparation of subgrades; pumping and dewatering; protection of adjacent property; backfilling; construction of fills and embankments; and other pertinent work.

Excavation in soils should be performed in accordance with all applicable local, state, and federal regulations and as set forth herein.

a. Obstructions

The Contractor shall proceed with caution in trench preparation and excavation so the exact location of underground structures and conflicts, known and unknown, may be accurately determined. The Contractor shall be held responsible for the repair of such facilities when broken or otherwise damaged from carelessness. If obstructions not shown on the Plans are encountered during the progress of the Work and interfere to such an extent that an alteration in the Plans is required, the Engineer shall have the authority to change the Plans and order a deviation from the line and grade only after approval of the change by SWU, or the Engineer may arrange with the owner of the facilities in conflict for the removal, relocation, or reconstruction of the obstruction.

Historic items, relics, and other similar items, including but not limited to cornerstones, commemorative plaques or tablets, antiques, and other items of interest or value that

may be encountered during excavation shall be carefully removed and salvaged in order to prevent damage.

b. Excavation Support and Protection

Excavation and trenching work shall include the removal and handling of all excavated materials, regardless of type, character, composition, or condition. Excavation shall be performed in accordance and compliance with all applicable local, state, and federal safety regulations, including 29 CFR 17, Part 1926, Subpart P – OSHA - Excavations.

Excavation work shall be performed in a safe and proper manner with appropriate precautions taken against all practicable hazards. The Contractor shall furnish, install, monitor, and maintain an adequate excavation support and protection system capable of supporting excavation sidewalls and resisting pressure exerted from soil, groundwater, superimposed loads, and construction loads. Except where banks are cut back into a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored as necessary to prevent caving and sliding, provide protection for workers and the Work, and protect existing structures and facilities. If the trench walls are sloped away from the trench to prevent slides or cave-ins, it shall be permissible to cut the trench banks on a slope above an elevation two (2) feet above the crown of the pipe. Sheeting, bracing, and shoring shall be designed in accordance with OSHA requirements; built to withstand any loads caused by earth movement or pressure; and designed to be rigid, maintaining shape and position under all circumstances. The excavation support and protection shall be installed without damage to existing facilities and nearby site improvements.

The excavation support system shall be withdrawn as the Work progresses in such a manner as to not endanger life or property and to allow for backfilling of the trench in accordance with these Specifications. If the excavation is close enough to buildings or other foundations to endanger the stability of the structure by the removal of such bracings, then the support system shall be secured, the excavation backfilled and thoroughly tamped, and the bracing left in place.

It shall be the responsibility of the Contractor to maintain the excavation free from slides or cave-ins, ensure the safety of the workers, and comply with all federal labor requirements for trench safety. No observation by the Engineer or representative of SWU shall reduce the Contractor's responsibility.

c. Dewatering

All excavation shall be dewatered before the commencement of any construction. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches, or other parts of the Work. All excavations for concrete structures or trenches extending to or below the groundwater table shall be dewatered by lowering and maintaining the groundwater level at least 12 inches below the bottom of such excavations. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without endangering public health or causing damage to adjacent property, existing facilities, and site improvements.

Excavations shall be kept dry during subgrade preparation and continually thereafter until the structure to be built or the pipe to be installed therein is completed to such an extent that no harm from hydrostatic pressure, flotation, or other water damage shall result. Concrete shall be placed only upon dry firm foundation material, and pipe shall be laid only in dry trenches. Positive surface drainage shall be established and maintained during construction to prevent surface water ponding and saturation of subgrade soils. Prolonged saturation of the foundation soils by ponding water may result in significant changes in soil strength and compressibility characteristics. Therefore, footing excavation, steel placement, and concreting shall be accomplished expeditiously to

reduce the possibility of changes in foundation conditions. Foundation or subgrade soils which become saturated by ponding water or runoff shall be excavated to firm soil or otherwise stabilized, as specified below in the Excavation in Poor Soil, Stabilization, and Refilling to Grade paragraph in this Section. Standby equipment, available for immediate operation, shall be provided by the Contractor to maintain the dewatering system if any part of the system should fail.

Discharge from dewatering pumps shall be conducted to natural drainage channels, drains, or storm sewers. The Contractor shall be held responsible for the condition of any pipe or conduit which may be used for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment and debris.

d. Disposal of Excavated Material
Excavated material shall be piled adjacent to the Work for reuse in backfilling, if suitable. All unsuitable excavated material and any excess material shall be disposed of in a manner approved by the Department. Excess material shall not impede construction; endanger workers; or obstruct sidewalks, roads, and other structures.

6. Excavation in Poor Soil, Stabilization, and Refilling to Grade
Where the soil at the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic materials; unstable Class IV or V soil, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications; and/or large fragments of inorganic material, which in the judgment of SWU should be removed; the Contractor shall excavate and remove the unsuitable material to the width and depth required by the Department. Before the pipe is laid, the subgrade shall be backfilled with Class I clean, crushed rock or gravel, including Class 7 Aggregate Base Course, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, in 6-8 inch uncompacted layers. The layers shall be hand or machine tamped, as directed by the Department, to the density of the adjacent undisturbed soil.

a. Undercutting and Physical Stabilization
When water or unstable soil is encountered in the bottom of the trench, the Contractor shall be required to excavate below grade and bring the trench back to grade with Class I clean, crushed rock or gravel, as defined in ASTM D2487 (Standard Classification of Soils for Engineering Purposes) and including Class 7 Aggregate Base Course. Undercutting shall be required to remove moisture-sensitive, soft, and wet soils to obtain a stable subgrade prior to construction of structures or embankments, especially during and following wet periods. The amount of material to be excavated below grade may vary with the season of the year, with less undercutting anticipated during the dry seasons, but in no case shall be less than six (6) inches.

Uncontrolled fills shall be removed and replaced at the Contractor's expense with Class I material, as specified in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications. The layers shall be backfilled in 6-8 inch, uncompacted lifts. The layers shall be thoroughly hand or machine tamped as directed by the Department Engineer and formed to provide a uniform and continuous bearing and support for the pipe at all points along the pipe length. The finished elevation of stabilized subgrades shall not be above subgrade elevation shown on the Plans.

Corrective action shall be taken if minimum required soil densities are not achieved. Such corrective actions shall include additional compactive effort; scarifying, adjusting the moisture content, and recompacting; and/or the removal of the unsuitable material and replacement with adequate material.

Subgrade areas shall not be prepared nor shall fill be placed during unfavorable weather conditions. If construction is interrupted by heavy rains or freezing weather, site

preparation operations shall not be resumed until tests indicate the moisture content and density of the subgrade materials are as specified.

7. Embankment and Engineered Fill Material
   Fill material shall be free of cinders, ash, refuse, organic and deleterious substances, frozen soil, and any other materials in the opinion of the Engineer and SWU is unacceptable. Fill shall not contain rocks larger than six (6) inches in the largest dimension; and in the top 12 inches of the embankment, rocks shall not exceed four (4) inches in size. Fill materials shall have a minimum plasticity index of 8 and a maximum of 18 to avoid objectionable silty or high plasticity soil characteristics and shall have a liquid limit no greater than 40 to avoid potentially compressive materials, unless otherwise directed by the Department. All costs associated with laboratory and field testing shall be borne by the Contractor.

   Fill shall be placed in uniform lifts not to exceed eight (8) inches and then be compacted. Each lift shall be evenly spread and thoroughly mixed during spreading to ensure uniformity of the material and moisture distribution throughout the lift. Compaction shall be to a minimum of 95% of the maximum dry density, as determined by the Standard Proctor test and as set forth in the Density Testing Section of these Specifications. Moisture content shall be controlled within a range of -2% to +3% of the optimum moisture content as set forth in the Density Testing Section of these Specifications.

   Backfilling and construction of fills and embankments shall be placed in accordance with the soils report. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

8. Rock Subgrade
   Prior to placing concrete on rock subgrade, the entire area shall be cleaned of mud and loose material.

C. OTHER CONSIDERATIONS

1. Erosion Control
   Areas denuded of vegetation and subject to erosion shall be protected from erosion either by temporary seeding and mulching or by temporary straw ditch checks. Further specifications concerning erosion control may be found in the Erosion Control paragraph in the General Project Considerations Section and the Environmental Permits Section found in the General Requirements Chapter of these Specifications. Procedures for temporary seeding are addressed in the Cleanup, Seeding, and Sod Section of these Specifications.

D. TESTING

All required testing, including but not limited to density testing; Modified and Standard Proctors; and determination of soil classifications, Atterberg limits, and optimum moisture content shall be performed by a qualified, independent geotechnical laboratory acceptable to the Department Engineer. All costs associated with testing shall be borne by the Contractor. In-place density and moisture tests shall be performed in accordance with the Density Testing Section of these Specifications.

END OF SECTION

SECTION T3

CLEARING AND PROTECTION OF RIGHT-OF-WAY

A. DESCRIPTION

This Section sets forth the materials and procedural requirements for clearing right-of-way. The Contractor shall confine construction activities to the right-of-way(s) obtained. All waste material and debris shall be disposed of in accordance with applicable federal, state, and local regulations.

B. EXECUTION

1. Clearing and Grubbing
   The Contractor shall clear the right-of-way of brush and other debris and conduct such right-of-way construction as necessary to provide an adequate working area within the easement limits.

   In clearing the right-of-way, the Contractor shall remove only that vegetation, including trees, necessary for the progress of construction. If construction shall be in close proximity to such vegetation, particularly shade trees or other trees of significant value, the Contractor shall be expected to work without removing or damaging such vegetation. All shrubbery, small trees (less than four (4) inches in diameter measured 12 inches above the ground), and other landscaping items shall either be protected or replaced.

   All brush, timber, and other debris required to be removed shall be hauled from the site and disposed of by the Contractor in accordance with all federal, state, and local regulations. Burning of brush shall be permissible, provided that burning procedures shall be in full compliance with the provisions of all federal, state, and local agencies controlling and supervising these activities. Burning shall be conducted only when it does not jeopardize surrounding vegetation, right-of-way, and adjacent property.

   If any portion of the Work crosses off-site or private property where livestock are present, it shall the responsibility of the Contractor to protect the livestock by means of temporary fencing and/or other provisions and measures as necessary.

   At the completion of grading work, all right-of-way shall be left in a neat and presentable condition that can be mowed where terrain permits.

2. Utilities
   The Contractor shall be responsible for the location of all existing utilities within the construction area and shall verify that these existing utilities have been disconnected and capped before commencing with right-of-way clearing. Procedures for uncovering existing utilities, utility crossings, proximity, and notification of intent to excavate near existing utilities as specified in the Existing Utilities Section of the General Requirements Chapter of these Specifications.

3. Miscellaneous Items
   Signs, mailboxes, posts, fences, and other obstructions may require removal and replacement within the right-of-way. Such items shall be removed and protected. Temporary replacements shall be provided as necessary until permanent installations are provided. After construction in the immediate vicinity is completed, any items damaged by the Contractor shall be restored to an

equal or better condition than before the damage or otherwise replaced to the original condition as acceptable to the owner of the damaged item.

Historic items, relics, and other similar items, including but not limited to cornerstones, commemorative plaques or tablets, antiques, and other items of interest or value that may be encountered during right-of-way clearing shall be carefully removed and salvaged in order to prevent damage.

4. Restoration of Property Markers
   Specifications outlining procedures for the restoration of public property markers are included in the Construction Layout and Staking paragraph of the Responsibilities, Inspection, and Layout Section in the General Requirements Chapter of these Specifications.

5. Fences
   If the Plans indicate it shall be necessary to cross a fence during the course of construction, the cutting and rebuilding or repairing of the fence shall be as set forth in the Cutting and Rebuilding/Repairing Fences Section of these Specifications.

END OF SECTION

SECTION T4

SURFACE REMOVAL

A. DESCRIPTION

This Section sets forth requirements for surface removal within lawns; gardens; mowed, cultivated, or other well-kept areas; fields, meadows, and other graded areas; wooded and rocky areas; or within the limits of paved or unpaved driving surfaces.

This Specification shall not apply to state or interstate highways or driving surfaces within railroad right-of-ways unless otherwise directed by the Department Engineer. Specifications regarding state highways and railroads shall be as set forth in the Street and County Road Crossings Section and the Arkansas State Highway Crossings and Railroad Crossings Section in these Specifications.

B. ALLOWABLE SURFACE REMOVAL

In all areas that water lines, sewer lines, force mains, manholes, and other appurtenances shall be constructed, any paved or unpaved surfaces shall be removed prior to excavation. The allowable limits of surface removal shall be dependent upon the type of area through which construction proceeds as set forth below.

1. Lawns; Gardens; and Other Well-Kept Areas
   In these areas, the Contractor shall excavate the top six (6) inches of topsoil from the ditch line, or as otherwise necessary to provide adequate topsoil for the establishment of vegetation as set forth in the Cleanup, Seeding, and Sod Section of these Specification, and store such material along the ditch line to prevent mixing with the remaining excavation,

   The width of allowable surface removal shall be the standard trench width, as defined in the appropriate Section of these Specifications for water or sewer lines.

   The length of ground cover removed for the installation of pipe, fittings, manholes, or other appurtenances shall be the linear dimension of such installation plus 12 inches on each side of the trench.

2. Fields, Meadows, and Other Graded Areas
   Surface removal in these areas shall be as set forth in the Lawns; Gardens; and Other Well-Kept Areas paragraph in this Section.

3. Wooded and Rocky Areas
   In wooded or rocky areas, the ground cover shall be removed as set forth in the Lawns; Gardens; and Other Well-Kept Areas paragraph above, with the exception that the Contractor shall generally not be required to separate and store the top six (6) inches of topsoil along the ditch line. However, the Contractor shall be required to store and replace topsoil as required to establish adequate vegetation in disturbed areas as set forth in the Cleanup, Seeding, and Sod Section of these Specifications.

4. Driving Surfaces
   Excavation within the limits of any driving surface, including paved and gravel streets, roads, driveways, and parking areas, shall be in accordance with the following Specifications.

   The Contractor shall remove any required pavement or road surface as a part of the trench excavation. The amount to be removed shall depend upon the width of trench specified and the type of pavement area to be removed for the installation of pipe, fittings, manholes, and other

appurtenances. Driving surfaces shall be removed to the dimensions set forth on the Plans, and in accordance with the City of Springdale Street Specifications.

The Contractor shall use such methods as drilling, chipping, and sawing, to assure the pavement shall break along straight lines. The face of the remaining pavement shall be approximately vertical.

END OF SECTION

SECTION T5

PIPE BACKFILL MATERIAL AND AGGREGATE BASE COURSE

A. GENERAL

This Section sets forth the adequate materials and testing procedures for acceptable pipe backfill material and aggregate base course. Crushed stone suppliers shall submit certificates stating that the materials provided are in conformance with these Specifications.

B. MATERIALS

All backfill material shall be free from cinders, ashes, refuse, vegetable or other organic material, boulders and other large rocks, frozen soil, or other inorganics and materials that in the opinion of the Engineer or SWU is unsuitable.

1. Initial Backfill
   Initial backfill is defined as that material placed on top of the pipe embedment material and extending to the top of the pipe. Suitable materials shall be termed “select materials” and include soil Classes I, II, and III as defined herein. Select materials shall generally be earth, sand, or gravel that is free from rocks and hard, lumpy materials larger than 1-1/2 inches in diameter. Select materials require hand placement and consolidation. Class I or Class II materials shall include but not be limited to, AHTD aggregate base course designation Class 7, as specified in the *Standard Specifications for Highway Construction* published by the Arkansas State Highway Commission.

   a. Class I
      These materials provide maximum stability and pipe support due to the angularity of the particles. This class can be installed at relatively high densities over a wide range of moisture contents and aid in drainage control. Class I materials shall consist of clean, manufactured, angular, granular material, with a maximum particle size of 1-1/2 inches (40 mm), a minimum size of 1/4 inches, and no more than 5% passing the No. 200 sieve.

   b. Class II
      These materials provide a relatively high level of pipe support but less than that provided by Class I materials due to the presence of rounded particles. Class II materials shall consist of clean, coarse sands and gravels with a maximum particle size of 1-1/2 inches (40 mm), including variously graded sands and gravels, and no more than 5% passing the No. 200 sieve. Material shall be generally granular, non-cohesive, USCS soil types GW, GP, SW, and SP, as defined in ASTM D2487 (Standard Classification of Soils for Engineering Purposes) and below.

      GW – Clean, well-graded gravels and gravel-sand mixtures with 50% or more retained on the No. 4 sieve. Material shall contain little or no fines, with no more than 5% passing the No. 200 sieve.

      GP – Clean, poorly-graded gravels and gravel-sand mixtures with 50% or more retained on a No. 4 sieve. Material shall contain little or no fines, with no more than 5% passing the No. 200 sieve.

SW – Clean, well-graded sands and gravelly sands with more than 50% passing a No. 4 sieve. Material shall contain little or no fines, with no more than 5% passing the No. 200 sieve.

SP – Clean, poorly-graded sands and gravely sands with more than 50% passing the No. 4 sieve. Material shall contain little or no fines, with no more than 5% passing the No. 200 sieve.

c. Class III

These materials provide less support for a given density than Class I and II and may require high levels of compaction to achieve the required density. Class III materials shall consist of coarse-grained soils with fines and a maximum particle size of 1-1/2 inches (40 mm), including variously graded sands and gravels containing 12-50% passing the No. 200 sieve. These materials may exhibit plasticity and includes USCS soil types GM, GC, SM, and SC, as defined in ASTM D2487 and below.

GM – Silty gravels and gravel-sand-silt mixtures with 50% or more retained on the No. 4 sieve. Material shall contain 12-50% fines passing the No. 200 sieve.

GC – Clayey gravels and gravel-sand-clay mixtures with 50% or more retained on the No. 4 sieve. Material shall contain 12-50% fines passing the No. 200 sieve.

SM – Silty sands and sand-silt mixtures with more than 50% passing a No. 4 sieve. Material shall contain 12-50% fines passing the No. 200 sieve.

SC – Clayey sands and sand-clay mixtures with more than 50% passing the No. 4 sieve. Material shall contain 12-50% fines passing the No. 200 sieve.

2. Pipe Protection Cover

Pipe protection cover is defined as the backfill from the top of the pipe to a point 12 inches above the top of the pipe and shall consist of select material (Class I, II, and III) as defined above.

3. Final Backfill

Final backfill is defined as that material placed above the pipe protection cover. Acceptable final backfill for DIP shall be excavated material free from rock larger than eight (8) inches. Final backfill for PVC and PE pipe shall be excavated material free from rock larger than six (6) inches within three (3) feet of the top of the pipe, and any additional backfill beyond three (3) feet of the top of the pipe shall be free from rock larger than eight (8) inches.

C. EXECUTION

After embedment materials and initial backfill materials have been placed to the required depth and compacted as set forth in the applicable Sections for water or sewer lines in these Specifications, pipe protection cover shall be placed above the top of the pipe. All pipe, regardless of material or size, shall have at least 12 inches of pipe protection. Final backfill shall be placed above the pipe protection cover to the required grade.

D. TESTING

All Modified Proctor (AASHTO T180) and Standard Proctor (AASHTO T99) densities, gradation (AASHTO T11), plasticity (AASHTO 90), and liquid limits (AASHTO T89) testing of backfill material and aggregate base course shall be performed by an independent laboratory acceptable to the Department. All costs associated with the required testing shall be borne by the Contractor.

Density testing shall be as set forth in the Density Testing Section of these Specifications.

END OF SECTION

SECTION T6

STONE RIPRAP AND FILTER FABRIC

A. DESCRIPTION

This Section sets forth the materials and procedures required in placing riprap and filter fabric for bank stabilization where required.

B. MATERIALS

1. Riprap
   Material for stone riprap shall be from an approved quarry source. Riprap shall be reasonably free from overburden spoil and well-graded between the maximum and minimum rock sizes specified. Based on any one (1) hauling unit shipment or delivery, the maximum size shall not be greater than 18 inches in any dimension and at least 50% of the material by weight shall consist of pieces weighing 35 pounds or more. Particles from quarrying or loading operations passing a 1/2 inch sieve shall not exceed 5% of the total weight.

2. Filter Fabric
   Filter fabric shall be woven or unwoven, synthetic fiber, geotextile fabric meeting the requirements of AASHTO M288 (Geotextiles). Filter fabric shall be Geotextile 801, as manufactured by Propex Geosynthetics, or approved equal.

   Fabric shall be furnished with an appropriate protective cover to provide protection from adverse radiation effects and abrasion during shipping and handling.

C. EXECUTION

The filter fabric shall be placed directly on the prepared surface. Fabric sections may be placed vertically or horizontally on the slope. The filter fabric shall be installed in such a manner that all overlapping sections are provided with a minimum lap in accordance with the manufacturer's recommendations. Fabric shall be overlapped in the direction of water flow. The fabric shall be turned down and buried approximately 12 inches at the exterior limits.

Adjacent overlapping fabric sections shall be joined with U-shaped wire pins, single shaped steel pins with metal disc heads, or similar fasteners. The fasteners shall be six (6) inches or more in length and shall hold the fabric firmly in place. Fasteners shall be inserted through both strips of overlapped fabric at intervals of approximately four (4) feet along the overlap. Additional pins shall be installed as necessary to prevent displacement of the fabric.

Care shall be taken during the placement and installation of the material to prevent damage to the fabric. Damaged material shall be repaired by placing a piece of fabric large enough to cover the damaged area and lapping and pinning the new fabric beyond the damaged area by a minimum of two (2) feet.

The stone riprap shall be placed in such a manner to produce a reasonably well-graded, smooth surfaced mass of rock with the minimum practicable percentage of voids to the lines and grades

indicated on the Plans. The area shall be well-covered but not to an excessive thickness. Material shall be placed in one operation and in such a manner to avoid displacing the underlying material. Placing riprap in layers shall not be permitted. The larger riprap stones shall be well-distributed, and the entire mass of stones shall be roughly graded to conform to the gradation specified. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Hand-placing may be required as necessary to meet the requirements of this Section. Placing riprap by dumping into chutes or by other methods likely to cause segregation shall not be permitted.

Riprap stone shall not be deposited in a manner that shall cause damage to the filter blanket. Any damage to fabric during placement of riprap shall be corrected by the Contractor prior to proceeding with the Work. Damaged fabric shall be repaired as set forth in this Section.

Particular care shall be exercised by the Contractor to restore the area where riprap rock is stockpiled to pre-construction conditions. The riprap stockpiling area shall be cleaned and seeded as specified in the Cleanup, Seeding, and Sod Section of these Specifications.

END OF SECTION

SECTION T7

CUTTING AND REBUILDING/REPAIRING FENCES

A. DESCRIPTION

This Section sets forth the appropriate materials and procedures for cutting, removing, and reestablishing fences and gates crossed during the course of construction.

B. EXECUTION

If the Plans indicate that it shall be necessary to cross a fence during the course of construction, the fence shall be replaced to pre-construction alignment as nearly as possible. Stakes or other identification used for locating the original fence alignment shall be protected by the Contractor.

Prior to the cutting of fences, the Contractor shall install a brace post assembly in the existing fence on each side of the pipeline. The exact location for the brace post assembly shall be field-determined. The tension of the existing fence shall not be reduced. Posts shall be thoroughly tamped into place with the fencing firmly attached to the posts. The Contractor shall construct temporary gates and fencing to maintain livestock, if present, in their original pasture during the construction period.

After the pipe has been installed, backfill placed and compacted, and excess material removed from the area, the Contractor shall rebuild the fence across the right-of-way. Fencing shall be replaced according to the type of fence crossed during construction, using new materials equal to or better than the original fencing. If removal, replacement, or repair of chain link, ornamental iron, wood, rock, or masonry fence shall be required, the Contractor shall obtain a qualified specialty contractor to perform the Work, unless otherwise agreed upon by the property owner. The Contractor shall provide an affidavit signed by the property owner if any deviations from these Specifications are agreed upon, including the waiver of retaining a qualified specialty contractor to perform the Work set forth in this Section.

END OF SECTION

SECTION T8

STEEL ENCASEMENT PIPE AND APPURTENANCES

A. DESCRIPTION

This Section sets forth the materials and proper execution of procedures required for the encasement of pipe, as may be required in stream or creek crossings, highway and railroad bores, water and sewer line crossings, and as otherwise required at the discretion of the Department.

B. MATERIALS

1. Carrier Pipe
   Carrier pipe shall be Special Class 50 DIP with restrained joints, conforming to the requirements of the appropriate Sections for DIP water or sewer lines set forth in these Specifications. DIP used in sewage applications shall be appropriately lined with protective coating, as set forth in the Ductile Iron Pipe and Fittings for Gravity Sewer Lines and Force Mains Section of these Specifications.

2. Casing Pipe
   All casing pipe shall be new, welded or seamless steel pipe with a minimum wall thickness as set forth below or as otherwise shown on the Plans and a minimum yield strength of 35,000 psi. The Engineer shall be responsible for performing calculations as necessary for the determination of adequate casing thickness and complying with minimum thickness as required by AHTD or the Arkansas and Missouri Railroad Company, as applicable, generally as follows:

Casing Pipe Diameter *(inches)*	**Casing Pipe Minimum Thickness for Crossing and Highway Bores** *(inches)*	**Casing Pipe Minimum Thickness for Railroad Bores** *(inches)*
≤12	1/4	1/4
14-18	1/4	5/16
20-22	1/4	3/8
24-26	3/8	7/16
28-32	3/8	1/2
34-42	3/8	9/16

Casing pipe size shall be dependant upon the carrier pipe nominal diameter as set forth below. Casing pipe for carrier pipes larger than 24 inches shall be as approved by the Department.

Carrier Pipe Diameter *(inches)*	**Minimum Casing Pipe Diameter** *(inches)*
6	12
8	16
10	20
12	20
14	24
16	24
18	30
20	30
24	36

3. Casing Spacers and End Seals

Casing spacers shall be Model SSIM, with field adjustable runners, or Model SSI, as manufactured by Advance Products and Systems, Inc., or approved equal. Spacers shall be designed to support the carrier within the casing and to maintain a maximum clearance of one (1) inch between the casing pipe and runner. Spacers shall be 8 inches wide for carrier pipes up to 14 inches in diameter and 12 inches wide for carrier pipes greater than 14 inches in diameter. The quantity of runners shall be dependant on the carrier pipe diameter as follows, unless otherwise approved:

Carrier Pipe Diameter	Quantity of Runners
≤ 14 inches	4
16 - 36 inches	6
36 – 48 inches	8

Runners shall be abrasion resistant glass-filled polymer, with a minimum length of seven (7) inches and a minimum width of one (1) inch. Risers, when required, shall be stainless steel and welded to the band. Interior surfaces of the circular stainless steel band shall be lined with a minimum thickness of 0.09 inches of EPDM, or approved alternative.

The end seals shall be watertight, AW wrap-around type as manufactured by Advance Products and Systems, Inc., or approved equal. End seals shall be neoprene rubber with a minimum thickness of 1/8 inches.

All bands, bolts, and washers shall be stainless steel.

C. EXECUTION

1. Placement of Casing Spacers and End Seals

The carrier pipe shall be inserted through the casing pipe using casing spacers and positioned as indicated on the Standard Detail Sheet. Water lines shall be centered and restrained in the casing pipe, and sewer lines shall be held to the specified grade and restrained. Casing spacers shall be installed in accordance with the manufacturer's recommendations. Three (3) casing spacers shall be located on each full joint of pipe, generally spaced every 6-8 feet. Casing spacers shall be positioned no greater than one (1) foot from the end of the casing and on either side of a pipe joint. Each end of the casing pipe shall be sealed using an end seal, as specified in this Section.

When Field-Lok Gaskets or TR Flex pipe, as manufactured by U.S. Pipe, is used as carrier pipe restraint in encasements, the assembly shall be pulled through straight casings and not pushed.

END OF SECTION

SECTION T9

PIPELINE CROSSINGS AT STREAMS AND CREEKS

A. DESCRIPTION

This Section sets forth the materials and proper execution of procedures required for crossing a stream or creek in water and sewer line construction.

B. MATERIALS

1. Carrier Pipe
   Carrier pipeline shall conform to the requirements of the appropriate Sections for DIP water or sewer lines and the Steel Encasement Pipe and Appurtenances Section of these Specifications.

2. Casing Pipe
   Casing pipe shall be as specified in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

3. Casing Spacers and End Seals
   Casing spacers and end seals shall be as specified in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

4. Concrete
   Concrete used in pipeline crossings at streams and creeks shall conform to the requirements of the Concrete and Reinforcing Steel Section of these Specifications, with the addition of one (1) extra bag of Portland cement to the originally approved mix design.

5. Riprap
   Riprap shall be as specified in the Stone Riprap and Filter Fabric Section of these Specifications.

C. EXECUTION

Stream and creek crossings shall be made at the location and grade indicated on the Plans and in conformance with these Specifications and all applicable local, state, and federal permits and regulations. Any outfall, headwall, manhole, valve box, or other associated structure shall be located so as to not interfere with the free discharge of the stream. Pipeline crossings shall be designed to cross as nearly perpendicular as practical to the stream flow and shall be free from change in grade. Pipelines shall be designed to minimize the number of required stream crossings. The top of all pipelines entering and crossing a stream or creek shall be located at a sufficient depth, as specified herein, below the natural bottom of the stream bed to protect the pipeline.

1. General
   A stream or creek crossing shall be as set forth in this Section and generally consist of excavating a trench to the appropriate depth, placing the carrier pipe in a casing pipe, and backfilling the trench to the required grade. If approved by the Department, concrete encasement of carrier pipes at stream and creek crossings may be an acceptable alternative to the installation of a casing pipe.

2. Required Depth of Cover
The required depth of cover may vary as follows, depending upon whether or not solid rock is present within a depth of 48 inches below the lowest elevation of the streambed.

a. Solid Rock Not Present
If solid rock is not present within the limits of the crossing or within a depth of 48 inches below the lowest elevation of the streambed, the minimum required depth of cover for water mains shall be as follows:

1). 36 inches of cover for 6-8 inch diameter pipe
2). 48 inches of cover for 10-12 inch diameter pipe
3). 60 inches of cover for lines greater than 12 inch diameter pipe

Cover shall be measured as the depth from the top of pipe to finished grade or adjacent curb or ditch flowline.

Gravity sewer crossings shall be at the grade shown on the Plans, but the minimum earth cover for sanitary sewer mains shall not be less than 24 inches, unless otherwise approved by the Department Engineer.

b. Solid Rock Present
If solid rock is present across the entire limits of the crossing and/or within a depth of 48 inches below the lowest elevation of the streambed, the Contractor shall install the pipe so the top of the pipe is a minimum of 12 inches below the top of the rock, but in no case shall the top of the pipe be less than three (3) feet below the lowest point in the streambed.

In the case of gravity sewer lines in solid rock, the pipe shall be encased in concrete up to a point level with the top of the rock. If the rock is at or below the top of the pipe, the pipe shall be anchored into the concrete with No. 5 steel dowels spaced at six (6) foot intervals on the pipe.

If the rock is at or near the invert of the pipe, the Department Engineer shall determine whether encasement is necessary and how much, if any, to provide.

3. Paved Stream Channel
If the crossing shall be through a paved stream channel, the top of the pipe shall be placed below the bottom of the channel pavement and in accordance with the minimum depth requirements set forth in this Section.

4. Casing Spacers and End Seals
Casing spacers and end seals shall be installed as set forth in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

5. Backfilling the Trench
If concrete encasement is used in lieu of casing pipe, the trench shall be backfilled as soon as the concrete has begun initial set. Backfill shall be placed to prevent erosion and changes in pre-construction streambed contours. Backfilling shall be in accordance with the Site Preparation, Excavation, and Fill Section of these Specifications.

6. Concrete Encasement
The pipeline shall be encased in concrete if indicated on the Plans. If in the opinion of the Department Engineer additional encasement is required, such encasement shall be provided and installed by the Contractor.

7. Placement of Concrete Encasement Under Water
   The Contractor shall be allowed to place concrete under water only upon approval by the Department Engineer and in accordance with the Concrete and Reinforcing Steel Section of these Specifications. The water must be in a static state and not flowing through the area of placement. Any concrete placed under water shall have one (1) additional bag of Portland cement added to the originally specified concrete mix.

8. Placement of Riprap
   Riprap, as required, shall be placed on each streambank in conformance with the Stone Riprap and Filter Fabric Section of these Specifications.

9. Erosion Control
   Riprap shall be placed on each stream bank in conformance with the Stone Riprap and Filter Fabric Section of these Specifications, and/or other erosion control measures and construction methods shall be employed to control siltation and erosion. Cleanup, grading, seeding, and other restoration of the construction area shall begin immediately. Exposed areas shall not go unprotected for more than seven (7) days.

10. Aerial Crossing
    Aerial crossings may be permitted as approved by the Department on a case-by-case basis. If aerial crossings over streams or creeks are permitted, the supports utilized in the crossing shall be adequate to prevent frost heave, overturning, and settlement, and the pipe shall be protected against freezing by use of insulation or other approved methods. Expansion jointing shall be provided as required. The bottom of the pipe shall be higher than the elevation of the 50 year flood, with consideration given to debris, unless otherwise specified.

END OF SECTION

SECTION T10

STREET AND COUNTY ROAD CROSSINGS

A. GENERAL

This Section sets forth the requirements for obtaining permits and posting of bonds and/or deposits required by the City of Springdale, Washington County, and Benton County; the proper execution of street and road crossings; and the restoration of said streets and roads to the satisfaction of the permitting entity. Acceptable materials and procedures for crossing street and county roads shall be as specified in this Section and as set forth by city and county specifications, where applicable.

B. MATERIALS

1. Carrier Pipe
   Carrier pipeline shall conform to the requirements of the appropriate Sections for DIP water or sewer lines and the Steel Encasement Pipe and Appurtenances Section of these Specifications.

2. Casing Pipe
   Casing pipe shall be as specified in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

3. Casing Spacers and End Seals
   Casing spacers and end seals shall be as specified in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

4. Embedment Material
   Pipe bedding material shall be as specified in the Backfill Material and Aggregate Base Course Section of these Specifications.

5. Backfill
   Backfill shall be as specified in the Backfill Material and Aggregate Base Course Section of these Specifications.

6. Asphaltic Concrete Hot-Mixed Surface Course
   ACHM shall be as specified by the City of Springdale Street Specifications.

7. Prime and Tack Coats
   Prime and tack coats shall be as specified by the City of Springdale Street Specifications and Municipal Code.

8. Concrete
   Concrete shall be as specified in the Concrete and Reinforcing Steel Section of these Specifications.

C. EXECUTION

The Contractor shall obtain the required permits and post all required bonds and/or deposits with the permitting entity. Street crossings in the City of Springdale shall be performed in accordance with the City of Springdale Municipal Code. County road crossings shall be performed in accordance with applicable county court orders and ordinances.

The Contractor must provide a street closing plan to the SWU Department Engineer and City of Springdale's Street Department Engineer at least one (1) week prior to closing a street. The Contractor shall also obtain permission from the City of Springdale and notify emergency services (i.e., fire department, ambulance service, etc.) prior to the closing of any street.

The Contractor shall provide and maintain during construction adequate barricades, construction signs, torches, lanterns, and guards as required to protect workers and other persons from injury and to prevent property damage. All piles of material, equipment, and pipe which may serve as obstructions to traffic shall be enclosed by fences and/or barricades and adequate lighted. Execution of adequate safety precautions set forth in the General Project Requirements Section in the General Requirements Chapter of these Specifications shall be the responsibility of the Contractor.

The Contractor shall cause the least interruption to traffic during construction as possible and may close through traffic for not more than two (2) consecutive blocks, including the cross street intersected. If traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections, driveways, and as otherwise necessary. The Contractor shall post adequate signs indicating street closure and other necessary detour signs for the proper maintenance of traffic.

All areas excavated for the construction of pipelines and appurtenances within city streets and/or county roads shall have embedment, pipe protection cover, and backfill placed and compacted in accordance with the applicable Sections for water or sewer lines within these Specifications and as detailed on the Plans. Casing pipe, if required, shall be installed as set forth in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

All asphaltic surfaces shall be replaced with ACHM surface course, all Portland cement concrete surfaces shall be replaced with Portland cement concrete, and all unpaved driving surfaces shall be replaced with crushed stone base, unless otherwise specified. Replacement of paved and unpaved driving surfaces shall be as specified in the Pavement Repair Section of these Specifications and as shown on the Plans.

All street and county road right-of-way disturbed by facility construction shall be restored to original or equivalent condition as required by the permitting entity.

END OF SECTION

SECTION T11

ARKANSAS STATE HIGHWAY CROSSINGS AND RAILROAD CROSSINGS

A. GENERAL

This Section sets forth requirements and provides guidance for the proper execution of Arkansas state highway and railroad crossings, including materials and proper procedures necessary to bore and insert a casing pipe or to open cut, as required. Acceptable materials and procedures for crossing an Arkansas state highway or railroad shall be as specified in this Section and the latest edition of the *AHTD Utility Accommodation Policy*. Encasement shall be required on all water and sewer lines, including service lines, which cross highways or railroads.

B. MATERIALS

1. Carrier Pipe
   Carrier pipeline shall conform to the requirements of the appropriate Sections for DIP water or sewer lines and the Steel Encasement Pipe and Appurtenances Section of these Specifications.

2. Casing Pipe
   Casing pipe shall be as specified in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

3. Casing Spacers and End Seals
   Casing spacers and end seals shall be as specified in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

C. EXECUTION

The location of the highway or railroad crossing shall be as indicated on the Plans. The crossings shall be accomplished by boring and inserting a casing pipe of the type, thickness, diameter, and length shown on the Plans.

1. Permit Application
   The Engineer shall prepare the application with the AHTD or with the Arkansas and Missouri Railroad Company for all permits to cross and perform construction on AHTD right-of-way or railroad right-of-way as shown on the Plans for the Department to review and execute. A copy of the permit issued by the AHTD or the Arkansas and Missouri Railroad Company shall be furnished to the Contractor by the Department. A copy of the license or issued permit shall be kept on the job site at all times.

   The Contractor shall notify the AHTD District Permit Office at least three (3) days prior to beginning work and again upon completion of the installation for a final inspection and release of the bond described below. Any installation which deviates from the approved permit is subject to removal from the highway or railroad right-of-way.

2. Utilities

The Contractor shall be responsible for the location of all utilities within the construction area and shall verify that these existing utilities have been disconnected and capped before commencing with crossing a highway or railroad. Procedures for uncovering existing utilities, utility crossings, proximity, and notification of intent to excavate near existing utilities shall be as specified in the Existing Utilities Section of the General Requirements Chapter of these Specifications and the latest edition of the *AHTD Utility Accommodation Policy*.

3. Traffic Control

The Contractor shall provide and maintain during construction activities adequate barricades, signs, lights, flagging, and guards as required to protect persons from injury and to prevent property damage. All piles of material, equipment, and pipe which may serve as obstructions to traffic shall be enclosed by fences and/or barricades and adequately lighted. Execution of adequate safety precautions set forth in the General Project Requirements Section in the General Requirements Chapter of these Specifications shall be the responsibility of the Contractor.

The Contractor shall post adequate signs, including those indicating street closure and other necessary detour signs, for the proper maintenance of traffic. The Contractor shall cause the least interruption to traffic during construction as possible.

Traffic control on state or federal highways shall be conducted and maintained as set forth in the *Manual on Uniform Traffic Control Devices*, as published by the U. S. Department of Transportation, FHA.

4. Borings

All highway borings shall conform to the requirements set forth herein, or according to the most recent version of the *AHTD Utility Accommodation Policy*, whichever are more stringent. Highway or railroad crossings shall be made by boring or tunneling and inserting a casing pipe into the borehole. The top of the casing pipe shall be a minimum of forty eight (48) inches below the lowest point of the roadbed cross section, including ditches, or 60 inches below the top of the subgrade at any location along the casing pipe, whichever depth is the greater. Casing pipe shall extend a minimum of six (6) feet beyond the toe of the slope of embankment sections, the bottom of existing ditches (flowline), or the back of curb in curbed sections, as applicable. The angle of the crossing should be as near to perpendicular to the highway or railroad as practical. Highway or railroad crossings through drainage structures shall not be permitted.

Gravity sewer lines that can be installed by open trench across proposed highway construction areas or bored across existing highways may not require encasement if the additional protective measures listed in the *AHTD Utility Accommodation Policy* are met and approved by the Department. Uncased carrier pipe shall provide sufficient strength to withstand the internal design pressure, dead load of the pavement structure, and traffic live loads and must have a minimum cover of four (4) feet.

Boring shall be by the dry bore or directional bore methods; wet boring is not permitted. Dry bores should be augered progressively ahead of the leading edge of the advancing pipe as spoil is augered or mucked back through the pipe. Annual void and over-breaks should be minimized by having the cutterhead sized closely to the pipe diameter and the pipe advanced with the cutterhead in close proximity. Overbore should not exceed 5% of the pipe diameter.

Bore pits should be placed outside the highway or railroad right-of-way when practical. Otherwise, bore pits should be placed on the edge of the highway right-of-way as far from the outer edge of the shoulder as possible. Bore pits shall be located and constructed in such a manner as to not interfere with footings, safe roadside clearance, or traffic operations.

If rock is encountered and all available means of making the crossing by boring or tunneling are unsuccessfully exhausted, the Engineer shall apply to the AHTD for permission to install by the open cut method.

Embedment and backfill of pipeline under existing or proposed roadways or railways shall be as set forth in these Specifications and the *AHTD Utility Accommodation Policy*.

5. Open Cut
   If approval from the AHTD to open cut is granted, the Contractor shall proceed with the installation in full accordance with all provisions and special conditions set forth by the AHTD. Any additional cost associated with deposits or bonds for open cutting shall be borne by the Contractor. As the return of the deposit required by the AHTD to the Contractor depends upon the satisfactory restoration of the road to the original or an improved condition, the Contractor shall be required to perform such restoration and cleanup to the satisfaction of AHTD.

6. Casing Spacers and End Seals
   Casing spacer and end seals shall be installed as set forth in the Steel Encasement Pipe and Appurtenances Section of these Specifications.

7. Markers
   With the exception of service lines, a marker bearing the utility owner's name shall be place at each right-of-way line where crossed, as shown on the Standard Details.

8. Restoration of Property
   Any highway property disturbed by the installation of the facility shall be restored to the original or better condition, including the establishment of sod as required by the AHTD District Engineer.

9. Other Highway Bores
   The Plans may require crossings and borings on roadways other than state highways. The Contractor shall follow the same procedures as set out in this Section for such crossings. Permits may be required by other governmental entities, and the Contractor shall be responsible for obtaining these permits.

END OF SECTION

SECTION T12

CONCRETE AND REINFORCING STEEL

A. DESCRIPTION

The following Section sets forth acceptable materials, placement techniques, testing, and conditions of evaluation and acceptance of ready-mix concrete and reinforcing steel used in the construction of potable water lines, sanitary sewer lines, and sanitary sewer manholes. Utilization of reinforced or unreinforced concrete for structural applications other than cast-in-place manholes shall be subject to individual design and specification of the responsible Engineer to meet the specific needs of the project. Design and specification shall be in keeping with current engineering practice, applicable codes of practice, and subject to the review and approval of SWU.

B. MATERIALS

1. Ready-Mix Concrete

   All concrete shall be ready-mix concrete in conformance with ASTM C94 (Ready-Mixed Concrete) and the applicable portions of these Specifications for on-site concrete mixing. The class of concrete shall be shown on the Plans in all locations where concrete is required.

   In general, Class A concrete shall be defined as concrete containing six (6) standard 94-pound bags of cement per cubic yard of concrete, with a minimum 28-day compressive strength (f'c) of 3,000 psi for all cast-in-place manholes; structures; and concrete driveway, sidewalk, and curb and gutter repair. Concrete used in concrete paving and concrete paving repair shall be as set forth by the City of Springdale Street Department Specifications.

   Class B concrete shall be defined as concrete containing five (5) standard 94-pound bags of cement per cubic yard of concrete, with a minimum 28-day compressive strength of 2,500 psi. Class B concrete shall be used for reaction backing, pipe encasement, and where otherwise directed by the Department Engineer.

   If high early strength cement is used, minimum 28-day compressive strengths specified above shall be achieved at seven (7) days.

   Concrete shall generally be composed of cement, water, and coarse and fine aggregates. All concrete shall also have air entrainment added to the mixing water at the ready-mix plant by the concrete supplier. Additional admixtures, cement replacements, and curing compounds may be used as set forth herein and as approved by the Department.

   a. Cement

      Cement shall be Portland cement conforming to the requirements of ASTM C150 (Portland Cement), Type I or IA. Type III or IIIA high early strength cement may be used if approved by the Department Engineer.

   b. Water

      Water used in mixing and curing concrete and mortar shall be potable.

c. Coarse Aggregate
Maximum size coarse aggregate is classified as that material which is no larger than 3/4 inch and no less than the No. 4 sieve. Coarse aggregate shall conform to ASTM C33 (Concrete Aggregates) and be clean, tough, durable, and of uniform quality

d. Fine Aggregate
Fine aggregate is classified as that material passing the No. 4 sieve. Fine aggregate shall be clean, sound, durable particles of properly graded sand conforming to ASTM C33.

e. Air Entraining Agents (AEA)
AEA shall conform to ASTM C260 (Air-Entraining Admixtures for Concrete) and be added to the mixing water solution at the ready-mix plant by the concrete supplier. The total air content of entrained and entrapped air shall be 6% ± 2%, unless otherwise specified.

f. Admixtures
All materials other than Portland cement, water, aggregates, and the specified air-entraining agent shall be subject to the permission of the Department.

In general, the use of calcium chloride as an accelerating admixture in steel reinforced concrete sections will not be approved. However, certain conditions may warrant the use of calcium chloride, in which case the Contractor shall obtain permission from the Department Engineer.

g. Cement Replacements
Partial replacement of Portland cement with fly ash or slag cement may be permitted if approved by the Department and shall follow the requirements set forth herein.

1.) Fly Ash
Fly ash shall comply with the requirements of AASHTO M295 (Coal Fly Ash and Raw or Calcined Natural Mixture Pozzolan for Use as a Mineral Admixture in Concrete), Class C. Class F fly ash shall not be permitted.

2.) Slag Cement
Slag cement, also known as ground granulated blast-furnace slag, shall comply with the requirements of AASHTO M302 (Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars), Grade 100 or higher.

h. Curing Compounds
Curing compounds shall be as specified in Section 501.02 of AHTD's *Standard Specifications for Highway Construction*, and as required by the City of Springdale Municipal Ordinance and Street Department as applicable.

2. Forms
Forms shall conform to the shapes, lines, and dimensions of members as indicated on the Plans and shall be sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain position and shape. Unless otherwise specified, suitable moulding or bevel strips shall be placed in the angles of forms to round or bevel the edges of the concrete as shown on the Plans or otherwise directed by the Department.

Forms shall be removed in such a manner to ensure the complete safety of the structure. In no case shall supporting forms or shoring be removed until members have acquired sufficient strength to safely support the member's self-weight and any other imposed loads.

3. Reinforcing Steel
If shown on the Plans, steel bar reinforcement for concrete shall be of the deformed type and conform to ASTM A615 (Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement) and/or

ASTM A185 (Steel Welded Wire Reinforcement, Plain, for Concrete). All reinforcing bars shall be Grade 60 as defined in the above referenced standards, unless otherwise shown on the Plans.

For concrete paving, reinforcing steel and dowel bars shall be as specified in Section 501.02 of AHTD's *Standard Specifications for Highway Construction*.

Steel reinforcing shall be free from rust, scale, mortar, dirt, or other objectionable coatings.

4. Joint Materials
Joint materials shall be as specified in Section 501.02 of AHTD's *Standard Specifications for Highway Construction*, and as required by the City of Springdale Municipal Ordinance and Street Department as necessary.

C. EXECUTION

1. Concrete Placement
Concrete placement and consolidation shall be as specified in ACI 309 (Guide for the Consolidation of Concrete). Concrete shall be supplied by a ready-mix concrete company approved by the Department Engineer. Mix designs of Class A and Class B concrete shall be submitted to the Department Engineer for prior approval. The concrete shall be delivered and placed within one (1) hour after all materials, including mixing water, have been placed in the mixing drum. Each batch shall be accompanied by an original load ticket with a copy for the RPR, indicating the concrete type, mixing proportions, and time that mixing began. Concrete shall be poured during suitable weather conditions and protected from freezing, evaporation, and other inclement conditions until initial set.

Before any concrete is placed, all equipment for mixing and transporting the concrete shall be cleaned, all debris and ice shall be removed from the spaces to be occupied by the concrete, forms shall be properly coated, and the reinforcement shall be thoroughly cleaned of ice or other deleterious coatings. Water shall be removed from the place of deposition unless a tremie shall be used or unless otherwise permitted by the Department Engineer. All laitance and other unsound material shall be removed from existing hardened concrete before additional concrete shall be placed.

a. Steel Placement
Steel shall be placed accurately and in accordance with details indicated on the Plans and properly secured into position.

b. Mixing
All concrete shall be mixed until the materials are uniformly distributed. Materials shall be completely discharged from the mixer before the mixer may be recharged.

Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set forth in ASTM C94.

c. Conveyance
Concrete shall be conveyed from the mixer to the place of final deposition by methods that prevent segregation or loss of materials. Conveyance equipment shall be capable of providing a supply of concrete to the site of placement without segregation or interruptions that may permit loss of plasticity between successive placement increments.

d. Deposition
Concrete shall be deposited as near as practical to its final position to avoid segregation from rehandling or excessive flowing. Placement shall be performed so the concrete remains plastic and readily fills the spaces between any reinforcing bars when vibrated as specified herein. Under no condition shall concrete that has partially hardened or been

contaminated by foreign materials be deposited in the structure, nor shall retempered concrete or concrete remixed after initial set be used. After placement begins, deposition of concrete shall be a continuous operation until the section is completed.

Concrete shall not be allowed to drop a free fall distance of more than six (6) feet during placement. Tremies shall be used where a drop would exceed six (6) feet.

In no case shall any concrete be placed without an RPR present. Concrete placed in violation of this provision may be rejected and removal may be required.

The top surfaces of vertically formed lifts shall be generally level.

e. Vibration

All concrete shall be thoroughly consolidated by mechanical vibration during placement and thoroughly worked around any reinforcement and embedded fixtures and into the corners of the forms. The use of form vibrators shall not be acceptable. Internal vibrators shall be capable of transmitting vibration to the concrete at frequencies as set forth in ACI 309 (Consolidation of Concrete). Duration of vibration shall be limited to the time necessary to provide satisfactory consolidation without causing segregation. The vibrator shall not be inserted into the lower lifts of concrete previously vibrated. Vibrators shall be used in a substantially vertical position and at uniformly spaced intervals not further apart than the visible effectiveness of the vibrator. Vibration shall be supplemented by spading as required by the Engineer. All concrete in manhole bases and pipe foundations need not be vibrated if other methods of consolidation produce satisfactory results.

The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after placement and shall have sufficient vibratory equipment in reserve to guard against shutdown of the Work from failure of equipment in operation.

f. Curing

Concrete shall be maintained above 50º F and kept moist condition for a minimum of the first seven (7) days after placement. High early strength concrete shall be so maintained for a minimum of the first three (3) days after placement. Supplementary strength tests in accordance with may be required to ensure that curing is proceeding as satisfactory.

Curing by high pressure steam, steam at atmospheric pressure, heat and moisture, or other processes acceptable to the Department Engineer shall be employed. Curing compounds, Visqueen, or burlene may be used, if approved by the Department Engineer. Accelerated curing methods shall provide the compressive strength and durability of the concrete at the load stage considered at least equal to the design strength and durability required at that load stage.

g. Cold-Weather Requirements

Placement of concrete during cold weather conditions shall be in accordance with ACI 306 (Cold Weather Concreting). Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. Frozen materials or materials containing snow or ice shall not be used.

All reinforcement, forms, fillers, and ground with which the concrete is to come in contact shall be free from snow and ice. All concrete placed in forms shall have a temperature of 50º F or higher after placement. Adequate means shall be provided for maintaining this minimum temperature for at least three (3) days. When high early strength concrete is used, a temperature of at least 50º F shall be maintained for at least two (2) days. Additional time as necessary to ensure proper curing of the concrete shall be provided as directed by the Department Engineer. The housing, covering, or other protection used in cold weather curing shall remain intact at least 24 hours after artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing.

h. Hot-Weather Requirements
Placement of concrete during hot weather conditions shall be in accordance with ACI 305 (Hot Weather Concreting). In hot weather, suitable precautions shall be taken to avoid excessive drying of the concrete prior to finishing operations. The use of windbreaks, sunshades, fog sprays, or other devices shall be provided as directed by the Department Engineer. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperature shall be less than 90º F unless higher temperatures are permitted by the Department Engineer.

D. TESTING

For every 50 cubic yards of concrete placed or for the amount representing a unit or portion of a finished structure (i.e., footing, wall, floor slab, column, roof slab, etc.), whichever is less, the following tests may be required at the direction of the Department Engineer:

1. Composite samples shall be collected in accordance with ASTM C172 (Sampling Fresh Concrete).

2. Three (3) specimens for each test required shall be molded and laboratory cured in accordance with ASTM C31 (Making and Curing Concrete Test Specimens in the Field).

3. Slump shall be tested for each strength test of normal weight concrete in accordance with ASTM C143 (Slump of Portland Cement Concrete). Acceptable slump shall be 2-4 inches.

4. Total air content shall be determined for each strength test in accordance with ASTM C231 (Air Content of Freshly Mixed Concrete by the Pressure Method) or ASTM C173 (Air Content of Freshly Mixed Concrete by the Volumetric Method). The total air content of entrained and entrapped air shall be 6% ± 2%, unless otherwise specified.

5. Specimens shall be tested for compressive strength in accordance with ASTM C39 (Compressive Strength of Concrete Specimens). One (1) specimen shall be tested at seven (7) days for information, and two (2) specimens shall be tested at 28 days for acceptance. Class A concrete shall have a minimum f'c of 3,000 psi, and Class B concrete shall have a minimum f'c of 2,500 psi.

6. For pavements, pavement thickness determination shall be made from two (2) inch diameter pavement cores at locations selected by the Department Engineer. All aggregate base course material that adheres to the bottom of the core shall be removed prior to thickness measurement. Contractor shall drill and fill core holes with a material approved by the Department Engineer.

Additional concrete tests may be required at the direction of the Department Engineer. The cost of all testing shall be borne by the Contractor. The testing laboratory shall be an independent laboratory certified by ACI, recommended by the Contractor, and approved by the Department Engineer.

The Engineer or approved representative shall furnish copies of all testing reports in writing to SWU within five (5) working days after completion of tests. Reports shall contain project name, date of concrete placement, name of testing agency, location of concrete batch in work, and the test results.

E. EVALUATION AND ACCEPTANCE

1. Strength
The strength of the concrete shall be considered satisfactory if both of the following requirements are met:

    a. The average of all sets of three (3) consecutive strength tests shall equal or exceed the specified design f'_c.

b. No individual strength test (average of two (2) cylinders) shall fall below required f'_c by more than 500 psi.

If either of the above requirements is not met, remedial steps may be required at the discretion of the Department. The cost of any additional testing or remedial action to ensure structural adequacy shall not be borne by the Department.

2. Field-Cured Specimens

The Department may require supplementary strength tests of cylinders cured under field conditions when the adequacy of curing and protection of concrete in the structure is in question. Field-cured cylinders shall be cured under field conditions in accordance with the appropriate portions of ASTM C31. Field-cured test cylinders shall be molded at the same time and from the same composite sample as laboratory-cured test cylinders.

Procedures for protecting and curing concrete shall be improved if the strength of field-cured cylinders at the test age designated for measuring f'_c is less than 85% of the strength of the companion laboratory-cured cylinders. If laboratory-cured cylinder strengths are appreciably higher than the design f'_c, field-cured cylinder strengths need not exceed f'_c by more than 500 psi, even if the 85% criterion is not met.

The cost of obtaining samples, transportation, and all testing shall not be borne by the Department.

Should the test cylinders fail, the Contractor may be required to reconstruct the concrete structure at no cost to the Department.

END OF SECTION

SECTION T13

PAVEMENT REPAIR

A. DESCRIPTION

This Section sets forth requirements and provides guidance for the proper execution of paved and unpaved driving surface repair, including but not limited to private and public streets, sidewalks, roads, alleys, driveways, parking lots, and others right-of-ways. This Section shall not apply to state or interstate highways, county roads, or driving surfaces within railroad right-of-ways, unless otherwise directed by the Department.

B. EXECUTION

1. Repairs
   All asphaltic, concrete, and unpaved surface repairs and traffic control procedures shall meet with the construction requirements of the City of Springdale Street Department Specifications and Municipal Code at a minimum, as well as with all applicable governing agencies, local ordinances, regulations, permits, and codes. Repairs shall be to the satisfaction of the Department. Methods of temporary repair shall meet with the requirements for permanent repairs, or as otherwise approved by the Department, to adequately maintain traffic flow and proper drainage.

2. Disposal of Excess Material
   Excavated material shall be piled adjacent to the Work for reuse in backfilling, if suitable. All unsuitable excavated material and any excess material shall be disposed of by the Contractor in a manner approved by the Department Engineer and in accordance with all applicable local, state, and federal regulations. Excess material shall not impede construction, endanger workers, or obstruct sidewalks, roads, or other structures. Gutters shall be kept clear of debris, and all other necessary provisions shall be made for street drainage.

3. Cleanup
   Cleanup shall be as set forth in the Cleanup, Seeding, and Sod Section of these Specifications.

END OF SECTION

SECTION T14

POLYETHYLENE ENCASEMENT

A. DESCRIPTION

This Section sets forth requirements for the proper materials and execution necessary for polyethylene encasement of pipe, fittings, valves, and other appurtenances as shown on the Plans and specified herein.

B. MATERIALS

1. Polyethylene Encasement
   Polyethylene (PE) shall be in conformance to ANSI/AWWA C105/A21.5 (Polyethylene Encasement for Ductile-Iron Pipe Systems). Polyethylene film used for encasement shall have a minimum nominal thickness of 0.008 inches (8 mils) and shall be provided in either flat tube or sheet form, at the option of the Contractor.

2. Tape
   Tape used in field application of polyethylene encasement shall be Polyken #900 as manufactured by Covalence Adhesives, Scotchrap #50 as manufactured by 3M, or approved equal. Tape shall be at least two (2) inches wide.

C. EXECUTION

Polyethylene encasement shall be provided on all buried ductile iron fittings, valves, and other appurtenances and on DIP as indicated on the Plans or otherwise required by the Department. Prior to construction, the Developer/Engineer may be required to obtain soil conductivity analyses at own expense as an indication of corrosional potential, as required by the Department and as necessary in locations of concern where PE encasement of DIP may be necessary. Laboratory soil tests shall be performed by an independent, qualified soils laboratory with equipment and methods acceptable to SWU. The SWU reserves the right to augment or exchange certain pipe materials in the best interest of the department when water mains are to be constructed in highly conductive soils.

PE encasement shall be installed in accordance with ANSI/AWWA C105/A21.5: Method A, B, or C. Double thickness of PE encasement shall be provided at the locations shown on the Plans or as otherwise directed by the Department. The encasement shall be protected from prolonged exposure to sunlight to prevent deterioration of the PE film. PE film shall be handled and stored to protect the film to avoid puncture and as specified in the Storage and Handling of Materials Section in the General Requirements Chapter of these Specifications. PE film with holes and significant blemishes shall not be used for encasement.

END OF SECTION

SECTION T15

DUCTILE IRON PIPE AND FITTINGS FOR WATER LINES

A. GENERAL

This Section sets forth acceptable materials and procedures for the installation of ductile iron pipe (DIP) and ductile iron (DI) fittings for water lines.

B. MATERIALS

Only pipe materials listed below shall be used for water lines, unless specifically authorized by the Department Engineer. All pipe installed shall be of the type, size, class, and thickness indicated in these Specifications and on the Plans.

1. Ductile Iron Pipe
   Unless otherwise shown on the Plans or specified, all pipe and pipe fittings furnished for underground water piping shall be ductile iron, with either push-on or mechanical type joints. Flanged DIP and DI fittings shall be used only as indicated on the Plans. Flanged pipe and pipe fittings shall conform to ANSI/AWWA C115/21.15, Class 250 psi. Flanged drilling shall conform to ANSI B16.1, Class 125 flange.

   All DIP shall conform to the requirements of ANSI/AWWA C150/A21.50 (Thickness Design of Ductile-Iron Pipe) and ANSI/AWWA C151/A21.51 (Ductile-Iron Pipe, Centrifugally Cast, for Water). DIP and DI fittings shall be designed by the pipe manufacturer based on laying condition Type 3, as described in ANSI/AWWA C150/A21.50, and the depth of bury as shown on the Plans, plus a single AASHTO H20 truck load. Pipe shall be designed for a thickness class of no less than Special Class 50. The pipe manufacturer shall check for depth of bury and furnish pipe of a heavier class if needed, in accordance with ANSI/AWWA C150/A21.50.

2. Accessory Items for Water Lines
   Items used in connection with the construction of water lines shall conform to the following:

   a. Ductile Iron Pipe Fittings
      All DIP fittings shall be compact fittings unless otherwise specified. All fittings shall be furnished with gaskets. MJ fittings shall also be furnished with bolts, nuts, and iron glands. All plugs, caps, tees, and bends deflecting 22-1/2° or more shall be provided with reaction backing as described herein. In addition to reaction backing, restrained joint pipe may also be required as set forth in these Specifications.

      All casting and mating surfaces shall be smooth and of a workmanlike quality, free from cracks, holes, scale, shrinkage, distortion, grooves, scratches, and other defects. Fittings and other castings may be rejected if found to be unacceptable by the Department in accordance with these Specifications.

      1.) Ductile Iron Pipe Compact Fittings (3-48")
         All DI compact fittings and associated bolts shall conform to the requirements of ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings for Water Service). All compact fittings 3-24 inches in diameter shall have a minimum pressure rating of

350 psi, and fittings 30-48 inches in diameter shall have a minimum pressure rating of 250 psi, unless otherwise specified.

2.) Ductile Iron Pipe Fitting (3-48")

All DI fittings and associated bolts shall conform to the requirements of ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids). All fittings 3-24 inches in diameter shall have a minimum pressure rating of 350 psi, and fittings 30-48 inches in diameter shall have a minimum pressure rating of 250 psi, unless otherwise specified.

Special fittings shall be in accordance with the pipe manufacturer's recommendations and as approved by SWU. All fittings and appurtenances placed on water lines shall meet with the requirements of the type of pipe used and shall be installed in accordance with the manufacturer's recommendations and as approved by the Department. Connections between different kinds of pipe shall be detailed on the Plans and provide self-cleansing flow and watertight joints and connections.

b. Pipe Bosses

Pipe bosses shall be provided as shown on the Plans and as explicitly approved by the Department. If the working pressure shown is 200 psi or less, bosses shall be foundry fabricated and faced and tapped with ANSI/AWWA C110 flange connections. If the working pressure shown is greater than 200 psi, bosses shall be foundry fabricated and faced and tapped with ANSI B16.1, Class 250 flange connections.

c. Ductile Iron Pipe Joints

Joints shall be mechanical joints (MJ) or push-on type joints which conform to ANSI/AWWA C111/A21.11 (Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings), unless otherwise specified. Joints shall have the same pressure rating of the pipe or fittings of which they are a part. All pipe joints other than those specified herein shall be made in strict accordance with the manufacturer's recommendations and as approved. All joints shall be made watertight in accordance with the latest applicable AWWA and ASTM standards.

d. Restrained Joints

1.) Mechanical Joint

Restrained joints of the MJ type incorporated into the design of the follower gland shall consist of individually actuated wedges that increase resistance to pull-out as pressure or external forces increase. The device shall be capable of full MJ deflection during assembly, and the flexibility of the joint shall be maintained after burial. The joint restraint ring and wedging components shall conform to ASTM A536 (Ductile Iron Castings). The ductile iron gripping wedges shall be heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be compatible with the standardized MJ bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings for Water Service) or ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids) as applicable. Torque limiting twist-off nuts shall be used to ensure proper actuation of the restraining wedges. Gaskets without torque limiting twist-off nuts shall require 90 ft-lb of bolt torque through the 8 inch size and 120 ft-lb through the 24 inch size.

The MJ restraint shall be available in the 3-48 inch sizes, with a rated working pressure of 350 psi for sizes 16 inch and smaller, and 250 psi for sizes 18-48 inch. The restraint devices shall be UL listed through the 24 inch size and approved by FM through the 12 inch size. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 DI or better. For applications requiring restraint of pipe 30 inches and greater, an alternate grade

of iron meeting the material requirements of ASTM A536 shall be acceptable, providing the device shall meet all end product performance requirements. The restraint shall be the Megalug Series 1100 as produced by EBAA Iron, Inc., MJ Field-Lok Gaskets Series DI as produced by U.S. Pipe, or approved equal.

2.) Push-On Joint

a.) Integrated into Pipe

Restrained joints of the push-on joint type incorporated into the design of the pipe shall provide a locking interface between the bell interior surface and a retainer weldment on the spigot end of the pipe. Restrained joint pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.5 (Ductile Iron Pipe, Centrifugally Cast, for Water and Other Liquids) and ANSI/AWWA C111/A21.11. The device shall be capable of full push-on joint deflection during assembly, and the flexibility of the joint shall be maintained after burial. When restrained joints require factory welded, all welding procedures and welders used to produce the product shall be qualified per the requirements of a documented quality assurance system based on ANSI/AWS D11.2.

Dimensions of the gland shall be compatible with the standardized push-on joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 as applicable.

The push-on restraint shall be available in the 4-64 inch sizes, with a rated working pressure of 350 psi for sizes 24 inch and smaller, and 250 psi for sizes 30-48 inch. The restraint devices shall be UL and FM listed through the 12 inch size. The restraint shall be the TR Flex as produced by U.S. Pipe, Flex-Ring as produced by American Ductile Iron Pipe, Co., or approved equal.

b.) Gripper Gasket

Restrained joints of the push-on joint type incorporated by the insertion of a gripper gasket into the pipe bell shall provide a locking interface between the bell interior surface and the spigot end of the pipe. Stainless steel locking segments shall be vulcanized into the gasket. Restrained joint pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.5 and ANSI/AWWA C111/A21.11. The device shall be capable of full push-on joint deflection during assembly, and the flexibility of the joint shall be maintained after burial. Restrained joint pipe with gripper gaskets shall be used only on straight laid pipe within casings or as approved in special locations by the Department Engineer.

Dimensions of the gland shall be compatible with the standardized push-on joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 as applicable.

The push-on restraint shall be available in the 4-36 inch sizes, with a rated working pressure of 350 psi for sizes 24 inch and smaller, and 250 psi for sizes 30-36 inch. The restraint devices shall be UL and FM listed. Restraint shall be the Field-Lok Gasket to be used with Tyton pipe as produced by U.S. Pipe, or approved equal.

Field-Lok Gaskets shall not be used in aboveground applications. Long-term cyclic movements can produce gradual joint separation to the point that the seal on the gasket bulb is compromised. In vertical applications, provisions

must be made to keep the joint extended and not allow the teeth to become disengaged from the pipe.

3. Interior Lining
   All DIP for water service shall receive the following interior lining:

   a. Cement-Mortar Lining
      All DIP and DI fittings for water service shall have a standard thickness, cement-mortar lining, and seal coat in conformance to ANSI/AWWA C104/A21.4 (Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water). Cement linings are not typically provided for caps, plugs, or sleeves.

4. Exterior Coating
   All DIP and DI fittings shall have an exterior coating as set forth below:

   a. Factory Primed Pipe
      Unless otherwise shown on the Plans, all exposed pipe and fittings within the limits of structure walls or exposed pipe and fittings located aboveground shall be delivered to the job site factory-blasted, cleaned, and primed with one (1) coat of Tnemec Series N140 Pota-Pox Plus, or approved equal compatible paint system.

   b. Bituminous Coating
      All pipe and fittings indicated for buried service shall have a petroleum asphaltic coating approximately one (1) mil thick factory-applied to the outside of all pipe and fittings. The finished coating shall be continuous, smooth, neither brittle when exposed to the cold nor sticky when exposed to the sun, and shall be strongly adherent to the pipe or fitting. The bituminous coating shall not be applied to the first six (6) inches of the exterior of the spigot ends.

5. Polyethylene Encasement
   Polyethylene encasement shall be as specified in the Polyethylene Encasement Section of these Specifications.

6. Ductile Iron Pipe Joint Lubricant
   Joint lubricant shall be provided by the pipe manufacturer and applied as per the manufacturer's recommendations and in accordance with ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings). Lubricant shall be non-toxic, not support the growth of bacteria, have no deteriorating effects on the gasket or pipe material, and not impact taste or odor to the water. Lubricant containers shall be appropriately identified and labeled with the manufacturer's name. Each lubricant container shall have printed instructions for usage and joint assembly.

7. Embedment Material
   Pipe embedment material is defined as that material placed beneath and around the pipe up to required depth specified herein. All embedment material shall be free from cinders, ashes, refuse, vegetable or other organic material, boulders and other large rock, frozen soil, or other inorganics and materials that in the opinion of the Engineer or SWU is unsuitable.

   Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Class I or Class II materials, as defined in ASTM D2321 (Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe) with soil types classified according to ASTM D2487 (Standard Classification of Soils for Engineering Purposes) and as described below. Class III, IV, and V bedding materials shall be unacceptable.

   Class I or Class II materials shall include but not be limited to, AHTD aggregate base course designation Class 7, as specified in the *Standard Specifications for Highway Construction* published by the Arkansas State Highway Commission, and other approved crushed stone.

a. Class I
These materials provide maximum stability and pipe support due to the angularity of the particles. Class I materials can be installed at relatively high densities over a wide range of moisture contents and aid in drainage control. Class I materials shall consist of clean, manufactured, angular, granular material, with a maximum particle size of 1-1/2 inches (40 mm), a minimum size of 1/4 inches, and no more than 5% passing the No. 200 sieve.

b. Class II
These materials provide a relatively high level of pipe support but less than that provided by Class I materials due to the presence of rounded particles. Class II materials shall consist of clean, coarse sands and gravels with a maximum particle size of 1-1/2 inches (40 mm), including variously graded sands and gravels, and no more than 5% passing the No. 200 sieve. Class II materials shall be generally granular, non-cohesive, USCS soil types GW, GP, SW, and SP, as defined in ASTM D2487 and below.

GW – Clean, well-graded gravels and gravel-sand mixtures with 50% or more retained on the No. 4 sieve. Material shall contain little or no fines, with no more than 5% passing the No. 200 sieve.

GP – Clean, poorly-graded gravels and gravel-sand mixtures with 50% or more retained on a No. 4 sieve. Material shall contain little or no fines, with no more than 5% passing the No. 200 sieve.

SW – Clean, well-graded sands and gravelly sands with more than 50% passing a No. 4 sieve. Material shall contain little or no fines, with no more than 5% passing the No. 200 sieve.

SP – Clean, poorly-graded sands and gravely sands with more than 50% passing the No. 4 sieve. Material shall contain little or no fines, with no more than 5% passing the No. 200 sieve.

8. Initial Backfill
Initial backfill shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

9. Pipe Protection Cover
Pipe protection cover shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

10. Final Backfill
Final backfill shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

11. Concrete
Concrete used for reaction backing, pipe cover, and pipe encasement shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications.

12. Tracer Wire and Ports
Tracer wire and ports shall be used on all ductile iron water piping and shall be 14 gauge coated copper for underground burial. Tracer wire and ports shall be installed as set forth herein and as shown in Standard Details M-1, “Tracing Wire Connection Port” and S-18, “D.I. Pressure Water Pipe Trench”.

13. Affidavits of Compliance and Independent Laboratory Inspection
All pipe and fittings shall be inspected and tested by the manufacturer. The manufacturer shall furnish to the Department Engineer, prior to delivery, certificates stating that all pipe and fittings shall be manufactured in compliance with these Specifications and all other applicable standards.

The manufacturer's certificate shall also fully describe the pipes and fittings proposed to be furnished.

C. EXECUTION

1. Handling and Storage
   Handling and storage shall be as specified in the Storage and Handling of Materials Section in the General Requirements Chapter of these Specifications.

2. Construction Sequence
   Unless otherwise directed by the Department, water pipe shall be placed with the bell ends facing in the direction of installation. For lines on an appreciable slope, bells shall, at the direction of the Department, face upgrade. Any deviation from this procedure shall be made only with the approval of the Department Engineer.

3. Alignment and Grade
   Water lines shall be laid and maintained to the required lines and grades with fittings, valves, hydrants, and other appurtenances at the required locations; spigots shall be centered in bells; and all valve and hydrant stems shall be plumb.

4. Temporary Plugs or Caps
   All dirt, debris, and other foreign matter shall be removed from the inside of all pipe and fittings before being lowered into the trench. Pipes and fittings shall be kept clean during and after placement, and care shall be taken to keep dirt out of the jointing space. At the end of each day's work and also if pipe installation is discontinued for an appreciable period, the open ends of the pipe shall be closed with a watertight cap firmly secured in place. The use of plywood forms or similar means of closure shall not be acceptable. Plugs shall be of the mechanical friction type. Pressurized air plugs shall not be permitted.

5. Requirements Preparatory to Trench Excavation
   In all areas where water lines, valves, or other appurtenances shall be constructed, the existing surface shall be removed prior to excavating the trench as set forth in the Surface Removal Section of these Specifications.

6. Dewatering
   Under no conditions shall pipe be laid in a trench that has not been properly dewatered. Dewatering and stabilization shall be as specified in the Site Preparation, Excavation, and Fill Section of these Specifications.

7. Excavation Support and Protection
   Excavation support requirements shall be as specified in the Excavation Support and Protection article under the Excavation paragraph in the Site Preparation, Excavation, and Fill Section of these Specifications.

8. Trench Excavation
   The trench shall be excavated to the alignment, depth, and width required and only so far in advance of the pipe laying as set forth in the paragraph on Trench Length in this Section. The bottom of the trench shall be excavated to provide a uniform and continuous bearing and support for the pipe on solid, undisturbed ground between bell holes. The bell shall not support the weight of the pipe or soil.

   The Contractor shall proceed with caution in the trench preparation and excavation so the exact location of underground structures and conflicts, known and unknown, may be accurately determined. The Contractor shall be held responsible for the repair of such facilities when broken or otherwise damaged from carelessness. Excavation shall be as set forth in the Excavation

paragraph in the Site Preparation, Excavation, and Fill Section of these Specifications and also as set forth herein.

Excavation work shall include the necessary removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; placement of all necessary sheeting, shoring, and trench protection; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; construction of fills and embankments; and other pertinent activities.

Excavation should be performed in accordance and compliance with all applicable local, state, and federal safety regulations, including but not limited to 29 CFR 17, Part 1926, Subpart P – OSHA - Excavations.

a. Trench Depth
The trench shall be excavated to at least four (4) inches below the grade required to provide proper pipe embedment and a minimum earth cover as set forth in the General Design Considerations Section in the General Requirements Chapter of these Specifications and listed below:

1). 36 inches of cover for lines 6-8 inch pipe
2). 48 inches of cover for lines 10-16 inch pipe
3). 60 inches of cover for lines greater than 16 inch pipe

However, ledge rock, boulders, large stones, and gravel formations with loose cobbles greater than eight (8) inches in diameter shall be removed to provide a clearance of at least six (6) inches below and on all sides of all pipe, valves, and fittings for pipes 24 inches in diameter or less, and a clearance of at least nine (9) inches for pipes larger than 24 inches in diameter. A layer of embedment material shall then be placed on the bottom of the trench, tamped, and leveled to the appropriate depth.

Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workers. All pipe bedding material shall be shaped and graded to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel. Bell holes shall be excavated to accommodate the pipe bells so that the bells do not support the weight of the pipe.

b. Trench Width
The trench width shall be ample enough to permit proper installation and jointing of the pipe, backfill, and compaction. Trench widths set forth in ANSI/AWWA C600 and as shown on the Standard Detail Sheet shall serve as a general guide. Larger trench widths may be necessary for the placement of a trench support system or as otherwise required.

c. Trench Length
The Department shall have the right to limit the amount of trench excavated in advance of laying the pipe. In general, such excavation shall not exceed 300 feet, and the length of trench excavated to grade shall not exceed 100 feet or that length of installation which may reasonably be completed during a workday.

Trenches located in rock shall be fully opened at least 50 feet in advance of the place where pipe is being installed or concrete or masonry work is in progress.

d. Over-Excavation
All over-excavation less than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with adequate pipe bedding material or compacted Class 7 aggregate base course. The additional material required shall be placed in three (3) inch lifts and thoroughly compacted. This procedure shall be

repeated until the established grade has been reached. All pipe bedding shall be compacted so as to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel.

All over-excavation greater than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with compacted Class 7 aggregate base course as described in the Undercutting paragraph in this Section.

If over-excavation of the trench width occurs, additional pipe bedding gravel or concrete shall be provided as necessary to prevent crushing of the pipe due to excessive earth loads. Additional pipe embedment material shall be provided to completely fill the over-excavated width beyond the specified width of the trench.

9. Undercutting

Where the soil at the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic materials, unstable Class IV or V soil, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, and/or large fragments of inorganic material, which in the judgment of SWU should be removed, the Contractor shall excavate and remove the unsuitable material to the width and depth required by the Department. Before the pipe is placed, the subgrade shall be backfilled with Class 7 aggregate base course in 6-8 inch uncompacted layers. The layers shall be machine tamped, as directed by the Department, to 95% Modified Proctor, to provide a uniform and continuous bearing and support for the pipe at all points along the pipe length.

10. Installing Ductile Iron Pipe

Ductile iron pipe and fittings shall be installed in conformance with the recommendations of ANSI/AWWA C600 (Installation of Ductile-Iron Water Mains and Their Appurtenances) and with the Specifications set forth herein.

Subject to the approval of the Department, other fittings may be added to or substituted for those shown on the Plans, should the need arise during construction. This shall in no way relieve the Contractor of the responsibility for furnishing and installing all fittings required for a complete and proper installation of pipeline as detailed on the Plans.

Pipes, fittings, and other appurtenances shall be inspected carefully before being placed in the trench. Any pipe, joint, fitting, or other appurtenance found to be cracked or otherwise damaged to the point of impaired usefulness shall be plainly marked so the marking shall not rub or wash off. Damaged materials shall be removed from the site as soon as feasible. All pipe and fittings shall be lowered carefully into the trench in such a manner to prevent damage to or contamination of the pipe, linings, fittings, or other appurtenances. Pipe, fittings, and other appurtenances shall not be dropped or dumped into the trench.

If needed, the pipe shall be cut in a neat, safe, and professional manner, without causing damage to the pipe or pipe lining. Cut ends and rough edges shall be ground smooth and recoated as required.

Whenever necessary to deflect pipe from true alignment, in either the vertical or horizontal plane, the degree of deflection at any joint shall not be greater than that which will provide adequate gasket space entirely around the spigot end of pipe. The joint opening shall be approximately 1/8 inch. Joint deflections shall not exceed the maximum recommended by the pipe manufacturer or as set forth in ANSI/AWWA C600, whichever is less.

As the Work progresses, pipe shall be cleaned of all foreign material and maintained clean until accepted or put into service.

If required by the Department, the pipe manufacturer shall provide a qualified installation representative at the start of construction to demonstrate proper installation techniques for each size and type of pipe to be installed.

Joints shall be installed as set forth in ANSI/AWWA C600 and as follows:

a. Slip-Type or Push-On Joints
Prior to jointing, the bell and spigot end of the pipe shall be thoroughly cleaned to remove all foreign matter, using a wire brush as necessary. Particular care shall be exercised in cleaning the gasket seat. The spigot and bell shall be checked for cleanliness immediately before insertion of the spigot into the bell.

Joints shall be made in strict accordance with the recommendations of the pipe manufacturer. The rubber gasket shall be cleaned and inserted in the gasket seat within the bell. Lubricant shall be applied in accordance with the manufacturer's recommendations. The spigot end of the pipe shall be inserted in the bell of the pipe to which connection is being made and forced to a firm contact with the bell shoulder. After initial insertion is made, the pipe may then be deflected.

b. Mechanical Joints
The bell and spigot end of the pipe and the rubber gasket shall be cleaned and lubricated as specified in the paragraph above. The gland shall also be cleaned in a similar manner.

After the gland and gasket are placed a sufficient distance from the spigot end to avoid fouling the bell, the spigot end shall be inserted into the fitting bell and forced to firm contact with the bell shoulder. The rubber gasket then shall be advanced into the bell and seated in the gasket seat. Care shall be exercised to center the spigot end within the bell of the preceding pipe and properly seated.

The gland shall be brought into contact with the gasket, bolts shall be installed, and nuts shall be hand-tightened. Deflection shall be made after joint assembly but before tightening the bolts. The joint shall be made tight by turning the nuts with a wrench by partially tightening a nut and then partially tightening the opposite nut, continuing in this manner around the pipe with uniformly applied tension until the required torque is applied to all nuts. The torque loads may be applied with a torque-measuring or torque-indicating wrench, which may also be used to check the human application of approximate torque loads. Required torque ranges and indicated wrench lengths for standard bolts shall be those set forth in ANSI/AWWA C600:

Pipe Size *(inches)*	Bolt Size *(inches)*	Range of Torque *(ft-lbs)*	Length of Wrench *(inches)*
3	5/8	45 - 60	8
4 - 24	3/4	75 - 90	10
30 - 36	1	100 - 120	14
42 - 48	1-1/4	120 - 150	16

11. Embedment and Backfill
After the trench has been excavated as set forth herein, the DIP shall be placed in accordance with the Type 3 Standard Laying Condition, as set forth in ANSI/AWWA C600 and ANSI/AWWA C150/A21.50, unless structural or foundation requirements indicate that more stringent bedding conditions shall be necessary. The pipe shall be bedded in a minimum of four (4) inches of select material by the full width of the excavated ditch. The intent shall be to cradle the pipe so the full length of each joint is uniformly supported on firm bedding with the weight of the pipe and fill borne uniformly by the pipe barrel.

Backfilling of pipes shall include the refilling and consolidation of the fill material in the excavation up to the surrounding ground surface or road grade at crossings. Initial backfill shall consist of select material, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, and shall be hand-placed and consolidated by hand or other approved mechanical methods above the embedment material to the top of the pipe. After the select material has been placed to the required depth and compaction, pipe protection cover, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, shall be hand-placed and hand-tamped to a depth of 12 inches above the pipe. If the material excavated from the trench is completely free of rock larger than 1-1/2 inch, the trench may be machine-backfilled. After placement of the pipe protection cover, the excavation shall be backfilled to grade with final backfill material free from rocks larger than eight (8) inches.

12. Compaction

After the minimum required pipe protection cover is placed over the top of the pipe, all subsequent final backfill material shall be placed in eight (8) inch lifts and compacted using a mechanical, hydraulically-powered, vibratory trench compactor or other equivalent equipment. Heavy compaction equipment shall not be used within 36 inches of the top of the pipe.

All trench backfill not located under paved areas or other special areas as noted on the Plans shall be compacted to a minimum of 90% of the adjacent undisturbed soil as determined in accordance with ASTM D2922 (Standard Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)).

If trenches are under existing or proposed pavement, driveways, parking areas, sidewalks, or public streets of the City of Springdale, the entire trench shall be backfilled up to the subgrade with Class 7 aggregate base course in eight (8) inch lifts and compacted by approved mechanical methods to 95% Modified Proctor Density as determined by AASHTO T180, unless otherwise directed by the Department or required by other governing authorities.

Field density shall be determined as set forth in the Density Testing Section of these Specifications. All backfill not meeting the compaction requirements set forth herein shall be replaced and/or recompacted until the compaction requirements are met.

13. Disposal of Excavated Material

Excavated material shall be piled adjacent to the Work to be used for backfilling, if suitable. All unsuitable excavated material and any excess material shall be disposed of in a manner in accordance with all applicable local, state, and federal regulations and as approved by the Department Engineer. Excess material shall not impede construction, endanger workers, nor obstruct sidewalks, roads, or other structures.

14. Connection to Existing Lines

Unless otherwise approved by the Department, no connection to existing water lines shall be made until the newly constructed facilities meet with all required construction standards, pass all required tests, and are approved by the Department for connection.

15. Concrete Reaction Backing

All fittings shall have concrete reaction backing even if restrained joints are shown on the Plans. Reaction backing shall be placed between undisturbed earth and the fitting to be anchored. The area of bearing on the pipe shall be taken as that shown on the Detail Sheet of the Plans or as directed by the Department Engineer. The backing shall, unless otherwise indicated, be placed so the pipe and fitting joints shall be accessible for repair. All DI fittings and appurtenances shall be wrapped in accordance with the Polyethylene Encasement Section of these Specifications prior to the placement of reaction backing.

16. Concrete Encasement

If shown on the Plans or otherwise directed by the Department Engineer, the pipe shall be encased in concrete to the dimensions indicated. Where additional concrete encasement is

required by the Department Engineer, the additional material shall be provided and installed by the Contractor. All pipes to be encased shall be suitably supported, blocked in proper position, and anchored against flotation.

17. Replacement and Repair of Driving Surfaces
    Replacement and repair of driving surfaces shall be made in accordance with the Pavement Repair Section of these Specifications.

18. Explosives
    The utilization of explosives for excavation shall be as specified in the Use of Explosives Section in the General Requirements Chapter of these Specifications.

19. Cleanup
    Cleanup shall be as specified in the Cleanup, Seeding, and Sod Section of these Specifications.

D. TESTING

The interior of all lines shall be free of mud, muck, dirt, gravel, and debris prior to testing and acceptance. The Department reserves the right to visually inspect all pipeline construction by means of televised camera equipment prior to acceptance. The Contractor shall be required, at own expense, to clean or repair any defects found through inspection.

Ductile iron water lines shall be tested in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

If pipe repair is necessary due to leakage or test failures, replacement of pipe utilizing solid sleeves shall be required. The use of bell clamps or other bell repair devices shall be strictly prohibited. Complete replacement of the line shall be required of any section 400 feet in length or greater which has three (3) or more point failures.

END OF SECTION

SECTION T16

TAPPING

A. DESCRIPTION

This Section sets forth adequate materials and procedures for the tapping water lines.

B. MATERIALS

1. Tapping Sleeves
   Sleeves used for tapping into existing water lines shall be stainless steel or steel sleeves with epoxy coating and stainless steel bolts, designed for a minimum working pressure as required by the project. All full body MJ tapping sleeves shall conform with ANSI/AWWA C223 (Fabricated Steel and Stainless Steel Tapping Sleeves). For design pressures up to 150 psi, JCM models 414 and 432, Ford Meter Box models FAST and FTSS, and approved equal tapping sleeves shall be acceptable. For design pressures greater than 150 psi, Mueller models H304 and H615 (with a rated working pressure of 250 psi for sizes 4-12 inch and 200 psi for sizes 14-24 inch), or approved equal, shall be acceptable. A test plug shall be furnished through the body for hydrostatic pressure testing on 12 inch and larger sleeves. Cast iron mechanical type sleeves shall be required for taps on pipes of the same diameter. The outlets shall conform to ANSI B16.1 (Cast Iron Pipe Flanges and Flanged Fittings), Class 125 flanges designed to accept tapping valves. Sleeves shall be designed to properly fit the type and class of pipe specified. Sleeves may be cast iron, ductile iron, or steel; steel sleeves shall be stainless steel or epoxy-coated. All bolts shall be of a corrosion resistant alloy material. Sleeves which are designed so the watertight seal around the outlet is achieved by a gasket placed between the sleeve body and the pipe barrel shall be provided with a recess in the sleeve body to accommodate the gasket.

2. Steel Couplings
   Couplings shall be mechanical type with follower rings and gaskets, designed for a working pressure of at least 225 psi and to properly fit the type and class of pipe specified. The bolts and coating shall conform to the Tapping Sleeves paragraph above.

3. Tapping Valves
   All tapping valves shall be resilient-seated gate valves, conforming to the Gate Valves Section of these Specifications. Tapping valves 18 inches and larger shall be designed for horizontal installation and geared. Gears shall be cut-tooth, and gear cases shall be totally-enclosed.

C. EXECUTION

1. Installation of Tapping Sleeves and Saddles.
   The pipe shall be free of dirt and debris before attached the tapping sleeve or saddle, and the section of pipe to be in contact with the gasket of the tapping saddle shall be smooth. The tapping saddle or sleeve shall be bolted securely to the pipe, and the face of the outlet shall be plumb. MJ glands for tapping sleeves shall be installed in accordance with the Restrained Joints paragraph in the Ductile Iron Pipe and Fittings for Water Lines Section of these Specifications. The strap bolts for tapping saddles shall be alternately tightened to the torque required and in accordance with the manufacturer's recommendations.

The tapping valve shall be bolted securely to the tapping sleeve or tapping saddle outlet flange. The tapping valve shall be supported by concrete cap blocks to remove the weight from the valve and sleeve or saddle. All tapping sleeves shall have concrete thrust blocking installed, as specified in the Concrete and Reinforcing Steel Section of these Specifications. Concrete thrust blocking shall be installed only after the section passes pressure testing as set forth in the Hydrostatic Pressure Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

END OF SECTION

SECTION T17

WATER METERS, SERVICE LINES, AND APPURTENANCES

A. DESCRIPTION

This Section sets forth adequate materials and procedures for the installation of single and double 5/8 inch x 3/4 inch water meters, single one (1) inch water meters, service lines, and other water line appurtenances. The Department shall install meter assemblies and service tubing for meters two (2) inches and larger, at the cost of the Developer, upon completion and acceptance of all improvements. At the discretion of the Department, the Contractor may be allowed to construct larger meters in accordance with these Specifications. Meters larger than two (2) inches shall be reviewed on an individual basis and shall require an engineered design, provided by the Engineer upon request of the Department. The cost of all meter services shall be borne by the Developer.

B. MATERIALS

1. Water Service Lines

   Water service lines shall be defined as that portion of the water distribution system which extends from the City water main to the meter or wherever City maintenance terminates. All service lines shall meet with the requirements for pipe, fitting, and joint materials outlined in this Section. The minimum size of any service line shall be one (1) inch nominal diameter. Water services lines may be constructed of PE or copper tubing. In residential applications and where otherwise required by the Department, water service lines shall be cased in a 2 inch Schedule 40 PVC pipe with end seals. The water service line shall be encased in locations where the water main is located on the opposite side of the street from the meter location, and cased sections shall extend from the back of the side walk on the main side to the back of the side walk on the service side. Cased sections shall be on all city maintained streets.

   a. Polyethylene Tubing

      Polyethylene tubing, 1 inch and 2 inch, shall be manufactured from extra high molecular weight (EHMW), high density polyethylene (HDPE) conforming to the dimensional and performance characteristics set forth in ASTM D2737 (Polyethylene (PE) Plastic Tubing) and ANSI/AWWA C901 (Polyethylene (PE) Pressure Pipe and Tubing, 1/2 Inch (13 mm) Through 3 Inch (76 mm) for Water Service).

      PE tubing shall have a minimum standard thermoplastic material designation code of PE 3408 and cell classification of 345564C as described in ASTM D3350 (Polyethylene Plastics Pipe and Fitting Materials). Material used to manufacture PE pipe shall meet all the requirements for listing as a PE 3408 product, at a minimum, by the Plastics Pipe Institute (PPI). Material shall be homogeneous; free from visible cracks, holes, inclusions, and other defects; and as uniform in color, opacity, and density as practicable.

      PE tubing shall be rated for a minimum working pressure of 200 psi and a minimum hydrostatic design basis of 1,600 psi with water at 73°F. Tubing dimensions and tolerances shall conform to ASTM D2737 for SDR 9 copper tube size (CTS-OD) as listed below.

Nominal Size *(inches)*	OD *(inches)*	Minimum Wall Thickness *(inches)*
1	1.125	0.125
2	2.125	0.236

Upon request, the manufacturer shall supply certification that the materials used to manufacture the tubing meet the above requirements. All materials, which come in contact with water, including lubricants, shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 61 (Drinking Water System Components), and tubing shall be evaluated, tested, and certified for conformance with ANSI/NSP Standard 14 (Plastic Piping System Components and Related Materials).

Tubing shall be permanently identified as PE 3408 water service tubing and marked with nominal size, ASTM designation code, manufacturer's name, pipe class, SDR, NSF logo, and production date at ASTM specified intervals. Acceptable tubing shall be DriscoPlex 5100 Ultra-Line as manufactured by Chevron Phillips Chemical Co. LP.

b. Copper Tubing
Copper tubing shall be one (1) inch Type K, soft tempered, and seamless for underground installation. Tubing shall be in accordance with ASTM B88 (Seamless Copper Water Tube) and Federal Specification WW-T-799 (Seamless Copper Tubing for Use with Solder-Type or Flared-Tube Fittings).

c. Encasement
Encasement for water service lines shall be 2 inch Schedule 40 PVC with end seals. Couplings shall not be located within the encasement.

2. Tapping Saddles for Meter Services
All service saddles shall be made from ductile or malleable iron, provided with a shop coat, and designed for a working pressure of 200 psi. A rubber gasket shall be provided between the casting and pipe surface. Saddle straps and bolts shall be high strength, corrosive resistant, alloy steel. All saddles six (6) inches and larger shall be provided with double straps. The outlet threads shall be compatible with AWWA CC type one (1) inch corporation stops.

3. Corporation Stops
Corporation stops shall conform to ANSI/AWWA C800 (Underground Service Line Valves and Fittings) without a positive stop. The inlet shall be AWWA/CC tapered threads, and the outlet shall have a compression coupling. The compression outlet shall utilize a Buna-N beveled gasket to provide a watertight connection, and a split clamp locking device. The split clamp shall be grooved and provided with a stainless steel screw to draw down the clamp for the prevention of mechanical pullout. The corporations shall be AWWA red brass with precision machined castings and compatible with conventional tapping machines.

4. Meter Setting
Yoke-type meter setters shall be used to accommodate 5/8 inch x 3/4 inch water meters. The water meter and expansion connector (spud) shall be provided by SWU. An angle key valve shall be provided at the yoke inlet, and an angle check valve shall be provided at the yoke outlet. The yoke bar shall be constructed of cast iron and coated with a primer to prevent corrosion. Inlet and outlet connections shall be AWWA red brass precision-machined castings. The inlet valve shall have a tee head with padlock wing for locking valve in closed position, 90° motion, and a flow design which assures a minimum loss of pressure. The angle check valve shall have a stainless steel, spring-assisted seating with Buna-N rubber disc for a positive seal against the brass seat in the valve body. Positive sealing shall be accomplished at a pressure differential of 0.25 psi.

a. Inlet Connections
Inlet connections shall be constructed of AWWA red brass precision machined castings. The one (1) inch tube size compression inlet shall utilize a Buna-N beveled gasket to provide a watertight connection and also be provided with a split clamp locking device. The split clamp shall be grooved and provided with a stainless steel screw to draw down the clamp for the prevention of mechanical pullout. All connections shall conform to ANSI/AWWA C800 (Underground Service Line Valves and Fittings).

1.) Split Services

Angle branch pieces shall be used to set two (2) meters in one (1) box. The outlet threads shall be 3/4 inch MIP, and the inlet connection shall be the one (1) inch compression fitting specified in the Inlet Connections paragraph above.

2.) Single Service

An ell compression coupling shall be used to connect service tubing with the yoke angle valve. The outlet threads shall be 3/4 inch MIP, and the inlet connection shall be the one (1) inch compression fitting specified in the Inlet Connections paragraph above.

b. Outlet Connections

Outlet connections shall be constructed of Type M copper and provided with 3/4 inch brass male pipe threads at each end. The connection shall have a proper hydraulic design to ensure minimum pressure loss. Tubing and brass fittings shall be jointed with solder as manufactured by Sil-Fos, or approved equal. As an alternate, red brass fittings may be used to accomplish outlet connections from the meter box.

c. Red Brass Pipe and Fittings

All red brass pipe and fittings shall be of the highest quality and conform to ANSI/AWWA C800.

d. Service Fittings

Service fittings shall be lead free and shall be the manufactured by the following companies:

Description	Catalog No.	Manufacturer
Service Tap Saddle	F202	Ford Meter Box
	202	Romac Industries
	313	Rockwell
	402	JCM
	DR2A	Mueller
1" Corporation Stop	F1000-4-NL	Ford Meter Box
	P-15008N	Mueller
1" PE Service Tubing	SDR-9	Chevron-Phillips DriscoPlex
Yoke Bar (1”)	Y504	Ford Meter Box
Yoke Bar (1”)	H-5040	Mueller
Yoke Bar (1”)	14-4	A Y McDonald
Yoke Bar (5/8”)	Y502	Ford Meter Box
Yoke Bar (5/8”)	H-5020	Mueller
Yoke Bar (5/8”)	14-2	A Y McDonald
Yoke Angle Key Valve (1”)	AV91-444-NL	Ford Meter Box
Yoke Angle Key Valve (1”)	H-14278N	Mueller
Yoke Angle Key Valve (1”)	74604Y 1X04	A Y McDonald
Yoke Angle Key Valve (5/8”)	AV91-323-NL	Ford Meter Box
Yoke Angle Key Valve (5/8”)	H-14278N	Mueller
Yoke Angle Key Valve (5/8”)	74604Y 3/4X02	A Y McDonald
Yoke Angle Check Valve (1”)	HA91-444-NL	Ford Meter Box
Yoke Angle Check Valve (1”)	H-14248N	Mueller
Yoke Angle Check Valve (1”)	702-4YE 44	A Y McDonald
Yoke Angle Check Valve (5/8”)	HA91-323-NL	Ford Meter Box
Yoke Angle Check Valve (5/8”)	H-14248N	Mueller

Yoke Angle Check Valve (5/8”)	702-3YE 33	A Y McDonald
Single Inlet Connection (1”)	L84-44-NL	Ford Meter Box
Single Inlet Connection (1”)	P-15531N	Mueller
Single Inlet Connection (1”)	74779M-22	A Y McDonald
Single Inlet Connection (5/8”)	L84-34-NL	Ford Meter Box
Single Inlet Connection (5/8”)	P-15531N	Mueller
Single Inlet Connection (5/8”)	74779M-22 1X3/4	A Y McDonald
Angle U-Branch (5/8”)	UA48-43-65-NL	Ford Meter Box
Angle U-Branch (5/8”)	P-15369N	Mueller
Angle U-Branch (5/8”) *(6-1/2" spacing)*	708T2M 1X3/4X6.5	A Y McDonald
Outlet Connection (1”)	L88-44-NL	Ford Meter Box
Outlet Connection (1”)	H-15538N	Mueller
Outlet Connection (1”)	710JPP 44X90X8	A Y McDonald
Outlet Connection (5/8”)	L88-33-NL	Ford Meter Box
Outlet Connection (5/8”)	H-15538N	Mueller
Outlet Connection (5/8”)	710JPP 33X90X8	A Y McDonald
Expansion Connection (1”)	EC-4-NL	Ford Meter Box
Expansion Connection (1”)	H-14234N	Mueller
Expansion Connection (5/8”)	EC-23-NL	Ford Meter Box
Expansion Connection (5/8”)	H-14234N	Mueller

Valves, fittings, service saddles, and meter setters shall be free of metal chips and filings in the waterway. Lubricated valves shall be free of excess lubrication in the waterway. Castings shall be sound, clean, and without defects that could impair their service.

5. Meter Boxes

Meter boxes shall be constructed of high density polyethylene (HDPE), as defined in ASTM D883 (Standard Terminology Relating to Plastics), with a minimum wall thickness of 1/2 inches. The exterior color shall be black to provide UV protection, and the interior color shall be bright white for easy meter reading. All white boxes shall be acceptable as well. Boxes shall withstand a minimum side wall load of 400 lbs. The meter box exterior shall be free from seams and parting lines, and all edges and corners shall be smooth and free of sharp edges so the unit can be handled safely without gloves. Meter boxes shall be Model 34P24 A-Type (18”x24”x24”D) as manufactured by East Jordan Iron Works or approved equal.

6. Meter Box Cast Iron Ring and Lid

Meter box rings and lids shall be cast iron conforming to ASTM A48 (Cast Iron Castings), Class 35B or better. Castings may vary from drawing dimensions ± 1/16 inches per foot. Casting weights may vary ± 5% from the drawing weight. Castings shall be ground smooth and cleaned by shot-blasting to attain a uniform quality surface, free from defects and distortions. The manufacturer’s ID or logo, the casting part number, and the county of origin shall be cast into the ring and lid. Rings shall be attached to the meter box using four (4) 1/4 inch bolts with lock nuts per ring. Cast iron lids shall be East Jordan Iron Works, 12-5/8 inches in diameter, Style A with a 2-inch reader hole to accommodate a MXU (Meter Transceiver Unit) antenna and lock. The locking mechanism shall be brass with a stainless steel coil spring. Cast iron meter rings shall be East Jordan Iron Works, Model 34P.

7. Crushed Stone Base

Crushed stone used as a base for the support of the meter box shall be Coarse Aggregate Standard Size No. 67, as specified by ASTM D448 (Sizes of Aggregate for Road and Bridge Construction). The crushed stone base shall be placed and manually compacted in lifts of a minimum thickness of six (6) inches.

8. Tracer Wire
   Tracer wire shall be used on all non-metallic piping and shall be 14 gauge coated copper for underground burial.

9. Lead-Free
   All materials installed in potable water systems are required to comply with the Federal definition of “lead-free” contained in Public Law 111-380.

C. EXECUTION

1. Installation of Water Service Tubing

   PE tubing may be curved when placed; however, bends shall not occur closer than 10 diameters away from any fitting or valve. Minimum radius of curvature for bends shall be 30 diameters or the manufacturer’s recommendation, whichever is less. PE tubing that becomes kinked during handling or installation shall not be used. Care shall be taken to ensure that kinking does not develop after installation. Consideration for thermal expansion and contraction shall be given by "snaking" the pipeline in the trench. Typically, an additional six (6) inches of pipe per 100-foot length per 45° F temperature change shall be adequate compensation for thermal contraction.

   All service piping shall be solid pipe. Fusion, mechanical joints, and other couplings for joining shall not be allowed. Lubricants other than water shall be strictly prohibited for use with PE tubing. Tracer wire shall be installed on all PE tubing, from the corporation stop on the main to the branch piece on the meter setting, by either taping or wrapping the tracer wire around the PE tubing at least every six (6) feet. Where the tracer wire is tied to the corporation stop and the branch piece on the meter setting, the tracer wire shall be stripped of its insulation. Additionally, three (3) feet of excess tracer wire shall be coiled in the meter box.

   PE tubing shall be installed in accordance with ANSI/AWWA C901 and ASTM D2774 (Underground Installation of Thermoplastic Pressure Pipe) in trench bottoms that provide continuous support and are uniform and free from rock, stone, and debris. Potable water service tubing installation is prohibited in soils of known or potential chemical contamination such as organic solvents or petroleum distillates or near underground chemical or petroleum storage tanks.

   Embedment and initial backfill of service tubing shall be from three (3) inches below the pipe to six (6) inches above the top of the pipe. Embedment and initial backfill material shall be sand or soil types GW, GP, SW, SP, GM, GC, SM, and SC as set forth in ASTM 2774, ANSI/AWWA 901, and the Pipe Backfill Material and Aggregate Base Course Section of these Specifications; however, the particle size of material in contact with the pipe shall not exceed 1/2 inch in diameter.

   Final backfill shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications. Backfill shall be placed for minimum of 30 inches of total cover above the top of the line except in the last 18-inch horizontal distance before the meter box where the tubing is allowed to transition into the meter box. After the minimum required cover is placed, all subsequent final backfill material shall be placed in eight (8) inch lifts and compacted using a mechanical, hydraulically-powered, vibratory trench compactor or other equivalent equipment. Heavy compaction equipment shall not be used within 36 inches of the top of the pipe.

   All trench backfill not located under paved areas or other special areas as noted on the Plans shall be compacted to a minimum of 90% of the adjacent undisturbed soil as determined in accordance with ASTM D2922 (Standard Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

If trenches are under existing or proposed pavement, driveways, parking areas, sidewalks, or public streets of the City of Springdale, the entire trench shall be backfilled up to the subgrade with Class 7 aggregate base course in eight (8) inch lifts and compacted by approved mechanical methods to 95% Modified Proctor Density as determined by AASHTO T180, unless otherwise directed by the Department or required by other governing authorities.

Field density shall be determined as set forth in the Density Testing Section of these Specifications. All backfill not meeting the compaction requirements set forth herein shall be replaced and/or recompacted until the compaction requirements are met.

Pipe should not be subjected to excessively hot water or operating pressures in excess of 200 psi at 73° F.

2. Installation of Meter Boxes

The location for the meter box shall be excavated to incur the least disruption to the adjacent areas, minimizing the width of excavation at a depth of 30 inches below the final grade. Any over-excavation shall be filled with crushed stone base. A minimum of six (6) inches of crushed stone base shall be placed and compacted to a depth and grade required to achieve final grade of the meter box. The yoke assembly and associated service pipe and fittings shall be oriented on the top of the crushed stone base. The inlet and outlet openings for the meter box shall be the minimum size that allows for the protrusion of the inlet and outlet piping. The annular spacing between the inlet and outlet piping and the meter box shall be backfilled with crushed stone base to a minimum vertical distance of six (6) inches above the meter box base. The remaining excavated volume shall be backfilled to final grade with compacted, select on-site material.

In the event additional adjustment is required to bring the meter box to final grade resulting from settlement or modification of the surrounding grade, the meter box shall be carefully excavated to prevent any damage to the meter box or yoke assembly. The service line shall be excavated along the line a sufficient distance to allow the vertical adjustment of the meter box and yoke assembly, as required. Additional crushed stone base shall be placed as required to facilitate the vertical grade adjustment of the meter box.

3. Approval

For two (2) inch and larger meters, the service line connection to the main line shall not be made until after the main line has been hydrostatically tested, disinfected, and approved by the Department for service.

D. TESTING

Hydrostatic testing and disinfection shall be conducted in conjunction with the main water line. All service tubing and meter settings shall be in place prior to testing and disinfection.

END OF SECTION

SECTION T18

FIRE HYDRANTS

A. GENERAL

This Section sets forth requirements for the proper construction and installation of fire hydrant assemblies.

B. MATERIALS

1. Fire Hydrants
   All fire hydrants shall be three-way, dry barrel, breakable or traffic model hydrants in conformance with ANSI/AWWA C502 (Dry-Barrel Fire Hydrants) and shall be designed for a minimum working pressure of 250 psi. When assembled, hydrants shall be designed to withstand a hydrostatic pressure test of not less than 300 psi or twice the rated working pressure, whichever is greater, without functional impairment or damage. Three-way hydrants shall be Super Centurion hydrants, Model A-423, as manufactured by Mueller.

   a. Hydrant Inlet
      Hydrants shall have a six (6) inch minimum MJ inlet in conformance to the dimensions set forth in ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids) and ANSI/AWWA C502.

   b. Seat
      The valve-seat ring for the main valve shall be bronze and threaded either into a bronze retainer ring or into a heavy bronze bushing in the shoe. The seat shall be O-ring pressure sealed. The seat shall be removable, using a short, light-weight wrench which shall fit all depths of bury.

   c. Main Valve Openings
      Three-way hydrants shall have a minimum 5-1/4 inch valve opening.

   d. Fire Hydrant Connecting Pipe
      The connecting pipe shall be DIP as specified in the Ductile Iron Pipe and Fittings for Water Lines Section of these Specifications. Hydrants shall have six (6) inch connecting pipes at a minimum and be fully restrained to the main.

   e. Hydrant Barrels and Extensions
      All fire hydrants shall be equipped with a barrel made of two (2) sections, with a flange at least two (2) inches above the ground line but not more than six (6) inches. The hydrant bury depth shall be clearly marked on the hydrant lower barrel. The Contractor shall provide Mueller A-320 extensions, as necessary to set the hydrants to the proper elevations at each location. A maximum of two (2) extensions shall be allowed by the Department.

      Lower/upper barrel inside diameter shall be a minimum of seven (7) inches to ensure maximum flow performance.

The union between the upper and lower barrel shall consist of a torque-diverting breakable coupling made of coated steel, cast iron, or bronze with breakable bolts and/or nuts or two-part breakable flanges.

f. Nozzles

Three-way hydrants shall be equipped with two (2) 2-1/2 inch hose nozzles and one (1) 4-1/2 inch pumper nozzle. Nozzle arrangement shall be oriented in the same plane. Nozzles shall be provided with caps chained securely to the upper barrel. Nozzle cap washers shall be a thermoset plastic with high resistance to dynamic and static wear, and a weather cap shall also be provided.

g. Operating Mechanism

The operating nut shall be ASTM B584 (Copper Alloy Sand Castings for General Applications) bronze, nominal 1-1/2 inch (as measured from flat side to point of pentagon) designed to open left (counterclockwise). An arrow shall be cast on the bonnet flange to indicate the specified opening direction. The operating nut shall be affixed to the bonnet by means of a bronze hold-down nut with a resilient weather seal, threaded in such a manner as to prevent accidental disengagement during the opening cycle of the hydrant. The use of Allen head set screws as a means of retention shall be prohibited. Operating threads shall be oil lubricated and shall have O-ring seals. Stem threads shall be sealed from the waterway in both the open and closed position.

h. Lubrication System

The bonnet assembly shall provide an oil reservoir and lubrication system that automatically circulates lubricant to all stem threads and bearing surfaces each time the hydrant is operated. The lubrication system shall be sealed from the waterway and any external contaminants by O-ring seals. An anti-friction washer shall be in place above the thrust collar to further minimize operating torque. The oil reservoir shall be factory filled with a low viscosity, NSF approved, FDA approved, non-toxic, oil lubricant which will remain fluid in the range of ambient temperature.

i. Drain Outlet

Two (2) barrel drain outlets with a bronze seat shall be provided to drain the barrel when the hydrant is closed and seal when the hydrant is opened. Drains shall operate without the use of springs, levels, or other similar synchronizing mechanisms.

j. Safety Stem Coupling and Safety Flange

All fire hydrants shall be equipped with a safety stem coupling and flange intended to fail upon vehicle impact but without damage to the stem or main valve.

k. Interior and Exterior Coatings

Any interior or exterior ferrous parts shall be subjected to SSPC-SP-6 commercial blast cleaning before being coated. No paint shall be applied to the top operating nut or cap chains.

Aboveground exterior ferrous parts shall be painted with a coat of Rustoleum V2100 System Silver Aluminum Enamel Aerosol, or approved equal. Prior to final acceptance of the project, the Contractor shall coordinate with Springdale Water Utilities to determine the flow rate and shall paint the bonnet and cap of the hydrant according to the chart below. Paint for cap and bonnet shall be Rustoleum V2100 System Spray Enamel in the colors listed in the chart below. Interior ferrous surfaces may be painted only with coatings in conformance with ANSI/AWWA C550 (Protective Epoxy Interior Coatings for Valves and Hydrants). Exterior ferrous surfaces shall be painted in conformance with ANSI/AWWA C502-05 (Dry Barrel Fire Hydrants).

Touch-up priming and/or painting as specified may be required by the Department at the Contractor's expense as necessary to restore the exterior paint to its original factory

condition. Hydrants to be touched-up or repainted shall be clean; dry; and free of rust, oil, grease, and other contaminants before priming and painting.

Class	Flow (gpm)	Color
AA	1500 or greater	Light blue
A	1000-1499	Safety Green
B	500-999	Safety Orange
C	Less than 500	Safety Red

l. Swivel Fire Hydrant Adapter and Tee
Fire hydrants shall be set using MJ-MJ, swivel joint fittings having a retainer lip and swivel rotatable gland for positive restraint without tie rods. Swivel fire hydrant adapters and tees shall be designed for a working pressure of at least 250 psi and to fit standard MJ fittings as per ANSI/AWWA C110/A21.10. One end of the swivel adapter and the branch of the tee shall be provided with a gland that may be rotated 360° on the fitting. Lengths of swivel adapter shall be as specified.

m. Retainer Glands
Retainer glands or other necessary means of thrust restraint shall be installed at designated locations and where required by SWU.

n. Affidavits of Compliance and Independent Laboratory Inspection
All hydrants shall be inspected and tested by the manufacturer. The manufacturer shall furnish to the Department Engineer, prior to delivery, certificates stating that all fire hydrants and materials used in construction of the hydrants conform to the requirements of these Specifications, ANSI/AWWA C502, and all other applicable standards; that all tests specified therein have been performed; and all test requirements have been met.

2. Auxiliary Gate Valves, Valve Boxes, and Valve Box Collars
All fire hydrant installations shall have auxiliary gate valves, valve boxes, and valve box collars meeting all provisions specified in the Gate Valve Section of these Specifications.

3. Connecting Pipe
The fire hydrant assembly shall have a connecting pipe between the MJ end of the auxiliary gate valve and the fire hydrant. The connecting pipe shall be the length indicated on the Plans and shall be a locked hydrant adapter so joint separation will not occur under pressure.

4. Concrete
All concrete used for reaction backing and valve box collars shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications.

C. EXECUTION

All fire hydrants shall be installed at the locations shown on the Plans or as otherwise directed by the Department Engineer, in accordance with ANSI/AWWA C600 (Installation of Ductile-Iron Water Mains and Their Appurtenances), ANSI/AWWA 502, and these Specifications.

1. Initial Inspection
Prior to installation, all hydrants shall be inspected for direction of opening, cleanliness of inlet elbow, handling damage, and cracks.

2. Alignment
All hydrants shall stand plumb within a horizontal tolerance of ± 1/8 inch. Nozzles shall be parallel with or at right angles to the street, with the pumper nozzle facing the curb or street. Hydrants shall be set to the established grade with the nozzle centerline at least 18 inches above

final grade, but no more than 24 inches, unless otherwise directed by the Department Engineer. The Contractor shall take care to protect the weep hole during backfilling to prevent plugging.

3. Location
   The location of all hydrants and appurtenances shall be within the street right-of-way or dedicated utility easement, and a minimum of four (4) feet behind any curb and gutter or sidewalk. Unless otherwise shown on the Plans, the hydrants shall be placed as set forth herein and spaced as called for by the local, state, and federal fire codes.

4. Connection to Mains
   Each hydrant shall be connected to the main with a six (6) inch DIP branch and independent six (6) inch gate valve. The six (6) inch branch of the main line fittings shall be equipped with a retaining lip and swivel gland for positive restraint without tie rods. The gate valve shall be placed adjacent to the hydrant as shown on the Standard Detail Sheet. All pipe fittings from the main to the fire hydrant shall be restrained. If the distance from the main to the hydrant is greater than one (1) pipe joint, an additional gate valve shall be provided where the hydrant lead connects to the main and restrained to the main appropriately.

5. Hydrant Drainage
   Drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand from the top of the concrete reaction backing to at least six (6) inches above the waste opening in the hydrant and to a distance of one (1) foot around the elbow when set in pervious soil and three (3) feet around the elbow when set in impervious soil. No drainage system shall be connected to a sewer. The waste opening shall not be blocked by PE film or concrete encasement.

6. Traffic Protection
   Traffic hydrants must have adequate soil resistance to avoid transmitting shock to the lower barrel and inlet connection. Bollards (guard posts) may be required by the Department in areas where traffic damage to the hydrant is likely and where otherwise specified. Bollards shall be four (4) inch Schedule 40 steel pipe, painted safety yellow, and have a concrete cap and white reflective striping tape, unless otherwise specified. The number and location of bollards shall be at the discretion of the Department, generally orientated as shown on the Standard Detail Sheet.

7. Concrete Reaction Backing
   The bowl of each hydrant shall be braced against unexcavated earth at the end of the trench with concrete reaction backing as shown on the Plans or as otherwise directed by the Department Engineer. The pipe, hydrant, and fittings shall be wrapped in PE film, as outlined in the Polyethylene Encasement Section of these Specifications, to prevent permanent bondage to the concrete. In no case shall the concrete reaction backing block or impede flow from the fire hydrant drain ports.

D. TESTING

Hydrants shall meet all test requirements set forth in ANSI/AWWA C502 and as required by UL and FM. Hydrants shall be checked for valve operation and hydrant flow after the pressure test has been successfully completed.

END OF SECTION

SECTION T19

CAST-IN-PLACE MANHOLES

A. DESCRIPTION

This Section sets forth requirements for the proper construction of cast-in-place manholes for sewers up to 24 inches in diameter. Manholes with sewers greater than 24 inches shall be subject to individual design. Brick and precast manholes shall be explicitly prohibited for use in the City of Springdale's municipal sanitary sewage collection system. All manholes shall be constructed in accordance with the Standard Detail Sheets or as otherwise approved by the Department.

B. MATERIALS

1. Concrete
   Concrete used in the construction of standard and drop cast-in-place manholes shall be as specified in the Concrete and Reinforcing Steel Section of these Specifications.

2. Non-Shrink Grout
   Non-shrink grout shall achieve 3,000 psi within 24 hours of placement, as set forth by ASTM C109 (Compressive Strength of Hydraulic Cement Mortars), and exhibit 0% shrinkage at 90% R.H. as set forth by ASTM C490 (Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete). Furthermore:

   a. Non-shrink grout used in the construction of manholes shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based, premixed product requiring only the addition of water for the required consistency;
   b. Manufacturer's instructions shall be printed on each bag or container in which the materials are packaged; and
   c. The chemical formulation of the non-shrink grout shall be as recommended by the non-shrink grout manufacturer for the specific application

   .

   After the addition of water to the dry mix, mixing shall continue until the grout has a consistency that can easily be handled and spread with a trowel. Placement shall be as directed by the manufacturer, and grout shall not be used after the set period. Masonry cement shall be strictly prohibited for use in any part of manhole construction.

   Non-shrink grout shall be Strong-Seal Systems Quick Set Repair (QSR) as manufactured by The Strong Co., Inc. Rapid-Setting Hydraulic Cement, as manufactured by Unitex shall be allowed at the express consent or direction of the Department.

3. Manhole Rings and Lids
   All castings for manhole frames, covers, and other purposes shall be in conformance with AASHTO M306 (Drainage, Sewer, Utility, and Related Castings), and shall be of tough quality, cast iron or ductile iron; free from cracks, holes, scale, shrinkage, distortion, grooves, scratches, and other defects; and have a quality finish. Cast iron castings shall conform to the requirements of ASTM A48 (Gray Iron Castings), Class 35B or greater. Ductile iron castings shall conform to the requirements of ASTM A536 (Ductile Iron Castings), Grade 80-55-06 or greater, unless otherwise specified by the Department. Castings shall be non-rocking with all bearing and mating

surfaces machine-fitted and smooth. The quality shall be such that a blow from a hammer shall produce an indentation on a rectangular edge of the casting without flaking the metal. Before leaving the foundry, all castings shall be thoroughly cleaned and subjected to a hammer inspection.

Manhole rings and lids shall be in accordance with the dimensions shown on the Plans and the Standard Detail Sheets. The words "SANITARY SEWER" or “CITY OF SPRINGDALE – SANITARY SEWER” shall be cast on the lids in two (2) inch tall letters. Lids shall be of solid construction and shall have no openings except for pick holes. All cast iron manhole ring pickholes shall be the closed pick hole, Type 2, unless otherwise specified by the Department.

Acceptable manhole rings and lids shall be as follows; however, the selected manhole and ring unit to be used in a given application shall be at the ultimate discretion and preference of the Department. Weights shall be within ± 5% tolerance of the specified weights, as set forth by AAHSTO M306. Sealed “watertight” rings and lids shall be provided in flood zone areas, regions of potential flooding, and where required by the Department.

a. Locations within streets and other driving surfaces:
   1.) East Jordan Iron Works 1348, with a combined weight of 260 pounds and a minimum clear access opening of 22 inches.

b. Locations within major arterial streets and heavy traffic areas:
   1). East Jordan Iron Works 1050 extra heavy duty unit, consisting of a 1050 ring with a 1020 extra heavy duty cover, with a combined weight of no less than 540 pounds and a minimum clear access opening of 21 inches.

c. Locations outside of streets and other driving surfaces:
   1). East Jordan Iron Works 1348, with a combined weight of 260 pounds and a minimum clear access opening of 22 inches; or

   2). Pamrex, as manufactured by CertainTeed, with a hinged lid, combined weight of 195 pounds, and a minimum clear access opening of 24 inches. Penta Locking Kits shall be provided for all Pamrex manhole lids.

d. Locations where watertight manholes are required:
   1). East Jordan Iron Works V-2150-1, with a combined weight of 514 pounds and a minimum clear access opening of 19.25 inches.

Substandard manhole rings and lids shall be replaced with new manhole rings and lids, as specified herein. Any adjustment to existing water and sewer facilities due to site grading or paving shall be at the Contractor’s expense.

4. Stubouts

Stubouts, consisting of the material noted on the Plans, shall be placed in manhole walls at the discretion of SWU and as indicated on the Plans. Stubouts shall extend outside the manhole wall so that a bell joint shall be made approximately two (2) feet outside the manhole wall. A waterstop sleeve or collar, as specified herein, shall be used on all stubouts. A watertight plug shall be placed in the end of the pipe and blocked as necessary for low pressure air testing. The manhole and stubout shall be tested together.

5. Concrete Manhole Adapters (CMA)

Waterstops for pipe connections to manholes shall be Fernco Concrete Manhole Adaptors, or approved equal, furnished in the appropriate size for the type and class of pipe used. The adapter shall be designed to provide a positive, watertight seal between the manhole and the pipe, mortared in place with non-shrink grout as specified herein.

6. Waterstops

Waterstops shall be required on all sewer pipes entering manhole walls or bases and at the joints between concrete pours. Waterstops shall be symmetrical, dense, homogenous, and free from imperfections. Flexible PVC and pre-formed hydrophilic waterstops shall be as set forth below. The type of waterstop to be used shall be at the ultimate discretion and preference of the Department, with the use of pre-formed hydrophilic waterstops to be prior approved by the Department. The bonding agent for the waterstop, if required, shall be the manufacturer's recommended adhesive for wet, rough concrete.

a. Flexible PVC Waterstops

Flexible PVC waterstops shall be manufactured with factory-installed metal eyelets, for embedment into concrete to prevent passage of fluids through joints, and with factory-fabricated corners, intersections, and directional changes. PVC waterstops shall be extruded from virgin, elastomeric PVC compound that is resistant to chemical action with Portland cement, alkalis, acids, and mildew. Flexible waterstops shall be either the flat ribbed or dumbbell type, six (6) inches wide and 3/8 inches thick, as manufactured by Greenstreak or Vinylex Corporation,

b. Pre-Formed Hydrophilic Waterstops

Pre-formed hydrophilic waterstops shall be a manufactured rectangular or trapezoidal strip, consisting of Bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete. Hydrophilic waterstops shall be resistant to chemical action with Portland cement, alkalis, acids, and mildew. Hydrophilic waterstops shall be one (1) inch wide and 1/4 inch thick Hydrotite waterstops, as manufactured by Greenstreak

Hydrophilic waterstops shall be of the type that expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast. Waterstops shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete. The minimum expansion ratio of modified chloroprene shall be not less than a 2:1 volumetric change in distilled water at 70° F.

7. Manhole Steps

Manhole steps shall not be allowed on sanitary sewer manholes, unless otherwise required by the Department.

8. Manhole Interior Coating

If required, protective interior coating of manholes shall be as specified in the Protective Coating for Manholes Section of these Specifications and in accordance with the manufacturer's recommendations. The protective coating shall also be factory applied to manhole rings and lids, at the discretion of the Department, to prevent corrosion and other undesirable chemical reactivity associated with exposure to sanitary sewers.

9. Interior Drop

Internal drop bowls shall be Reliner, as manufactured by Duran Inc., or approved equal. Drop bowls shall be manufactured from a fiberglass reinforced polyester, resistant to corrosion typical of sanitary sewers. All hardware associated with the interior drop shall be stainless steel. Drop pipe shall be PVC as set forth in the PVC Pipe for Gravity Sewer Lines Section of these Specifications. The connection from the drop bowl to the drop pipe shall be a flexible external pipe coupler. The turn-out at the base of the drop pipe shall be a cast-in Reliner Drop End Flume System or a 45° PVC elbow.

C. EXECUTION

1. Excavation for Manholes

Excavation for manholes shall be of such dimension and depth as to allow the construction of the manhole as shown on the Plans. Surface removal shall be as specified in the Surface Removal

Section of these Specifications. The area of excavation for the manhole base shall be only that necessary, with the manhole sides and bottom poured against undisturbed earth. All over-excavation below the required grade shall be filled with concrete poured monolithically with the base, unless otherwise approved by the Department.

2. Base

The concrete base shall have a minimum thickness of eight (8) inches below the invert and shall be poured on undisturbed earth, unless otherwise specified by the Department. The base shall be poured monolithically with the barrels or formed separately so the top of the base shall be no less than three (3) inches above the top of any pipe entering the manhole bottom. If the base is formed separately, the base shall have walls at least one (1) foot thick formed in the top to provide a firm foundation for the manhole barrels to rest upon. The base shall have a keyway formed in the top as shown on the Standard Detail Sheet. The base shall have a minimum radius two (2) feet greater than the outside of the finished manhole barrel. The base shall be placed only in an adequately dewatered excavation.

3. Connections to New Manholes

In order to ensure that the pipe shall not break immediately adjacent to the manhole, care shall be taken that excavation for the manhole bottom is limited to the area to be filled with concrete. The Contractor shall support the pipe entering the manhole to solid bedding by backfilling under the pipe and up to the springline with concrete. Each pipe entering the manhole shall have a joint approximately two (2) feet outside the manhole wall.

Manholes shall not be placed over existing vitrified clay pipe (VCP). The VCP sections thru the manhole shall be replaced with PVC pipe a minimum distance of two (2) feet from the base.

4. Connection to Existing Manholes

Connections to existing brick or otherwise substandard manholes shall not be made. In such cases, the brick or substandard manhole shall be replaced with a new cast-in-place manhole as specified herein. Connections to adequate, existing manholes shall not be made until all other manholes and lines have been completed, cleaned, tested, inspected, and approved for connection by the Department.

If gravity outfall lines discharge into an existing manhole, the flow of sewage must be diverted around the construction. The Contractor shall intercept the sewage flow at the first upstream manhole from the construction and shall provide suitable pumping equipment and a rerouting conduit to pump the sewage around the construction in a safe and sanitary manner that shall not result in surcharging or overflow either upstream or downstream. Discharge or rerouted flow shall be into an adequate manhole downstream from the construction and as approved by the Department.

Care shall be taken in making a connection to an existing manhole. Connections to existing manholes or inlets where no plugged stubs exist shall be made by coring a hole in the wall of the existing structure, using suitable coring equipment. A CMA gasket, as specified herein, shall be installed on the pipe prior to placement in the cored hole. The pipe shall be inserted into the hole, filling around the pipe with non-shrink grout, as specified herein, and troweling the inside and outside surface of the joint to a neat finish.

The bottom of the manhole shall be shaped to fit the invert of the sewer pipe. The connection shall be such that a joint is made approximately two (2) feet from the manhole wall. Subject to these requirements, the details of making a connection, including securing the end of the pipe in place, shall be reviewed and approved by the Department.

5. Future Connections and Manhole Stubouts

Individual stubouts shall be extended from the manhole for anticipated connection to future construction or where otherwise required by the Department. The stubout shall be the same size of pipe required for the future construction or as required by the Department. The stubout shall

be constructed so that a joint may be made approximately two (2) feet beyond the manhole wall. The stubout shall be sealed with a watertight plug as necessary for low pressure air testing. The plug shall remain in the stubout until future connection is made. The manhole and the stubout shall be tested together. The stubout shall be backfilled under the pipe and up to the springline with concrete. The Contractor shall support the pipe stub entering the manhole to undisturbed earth by backfilling under the pipe and up to the springline with concrete.

6. Invert

The entire diameter of each pipe entering the manhole barrel shall be either cut smooth with the interior of the manhole barrel or may extend through the manhole barrel no more than four (4) inches. The invert of the manhole shall be hand-placed and shaped from the concrete placed for the base, prior to initial set. The invert shall be shaped throughout, from all inlet pipes to the outlet pipe, creating a trough to prevent the free fall of sewage. The invert shall be shaped and smoothed so the manhole shall be self-cleaning and free of areas where solids may accumulate from flow through the manhole.

The sidewall depth of the invert shall be approximately 1/2 the diameter of the largest abutting pipe, and the shape shall approximate the bottom half of the pipe. Inverts shall be troweled smooth. The flowline of the invert shall connect with the flowline of all main pipes entering the manhole bottom. The flow channel shall be constructed so that all pipes entering the manhole maintain a constant grade throughout each invert, providing as large of a curve as possible.

The centerline of all pipes entering and leaving the manhole shall pass through the center of the manhole. In all cases, pipes extending entirely through the manhole shall have a joint approximately two (2) feet outside the manhole wall. The Contractor shall support the pipe stub entering the manhole to undisturbed earth by backfilling under the pipe and up to the springline with concrete. A CMA gasket, as specified herein, shall be used on all pipes entering manhole walls or bases.

Additional smoothing of manhole inverts may be necessary. Mortar for smoothing inverts shall be as specified herein.

7. Manhole Barrels

Manhole barrels shall have a minimum thickness of eight (8) inches. The manhole barrel shall be of such construction that the finished manhole shall have an inside diameter dependent on the sewer pipe diameter, as depicted on the Standard Detail Sheet and as follows:

Pipe Diameter	Manhole Diameter
≤ 12 inches	4’-0”
14 – 20 inches	5’-0”
≥ 24 inches	6’-0”

The barrel may be either poured monolithically with the base, or the barrel forms may be set when the concrete base has cured enough to support the forms. If the latter option is used, a keyway, as shown on the Standard Detail Sheet and specified herein, shall be formed in the manhole base. Construction joints shall be provided with a keyway, which shall have a three (3) inch layer of grout applied to the previous pour immediately before the next wall lift is placed. A waterstop, as specified herein, shall be installed at the keyway and any other cold joint.

Excluding shallow manholes less than four (4) feet in depth, the top section or cone shall be concentric, unless otherwise directed by SWU. When manholes are less than four (4) feet in depth, a flat top section may be required by SWU. In such cases, structural design shall be submitted to and reviewed by SWU.

8. Construction of Keyways

Construction joints shall be keyed, unless otherwise indicated or directed. Keyways shall be beveled, forming right angles to the direction of the shear. Except where otherwise specified or

shown on the Plans, keyways shall be at least 1.5 inches in depth over a minimum of 25% of the area of the section. Dowels shall be placed in the keyway, using #4 reinforcing bars at 12 inches on center, as shown on the Standard Detail Sheet.

9. Installation of Waterstops

    a. PVC Waterstop
    The waterstop shall be placed symmetrically between concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. The concrete shall be thoroughly worked around the waterstop to ensure maximum density and bond. The exposed half of the waterstop shall be protected from damage, sunlight, and other inclement conditions until fully embedded.

    In placing PVC waterstops, means shall be provided to prevent them from being folded over by the next concrete lift as it is placed. Waterstops shall be held in place with light wire ties on 12 inch centers, which shall be passed through hot rings at the edge of the waterstop and tied to the reinforcing steel, unless otherwise directed or indicated.

    b. Pre-Formed Hydrophilic Waterstop
    Pre-formed hydrophilic waterstops shall be installed according to the manufacturer's recommendations and as near as possible to the center of the joint.

10. Forms
    Prior to setting the forms in place, any water that may have accumulated in the excavated area shall be pumped out, and the concrete base shall be thoroughly cleaned, if required, of dirt and debris. Concrete shall not be poured in an insufficiently dewatered excavation.

    The forms shall be removed after the initial set of the concrete so that holes may be cut into the manhole barrel for the installation of pipes entering the manhole at points other than adjacent to the manhole base. After these pipes have been placed, the barrel shall be repaired using a grout mixture as specified herein. If honeycombing of the barrel is found to be present after removal of the forms, the concrete shall be repaired by sparging the area with hydraulic cement, or as otherwise directed by the Department Engineer. Manholes with excessive honeycombing shall not be accepted by SWU.

11. Manhole Height
    Manholes shall be built to the existing ground surface unless otherwise noted on the Plans or directed by the Department Engineer. The tops of the manhole rings and covers shall be level, except in public rights-of-ways where the top shall be set flush with the pavement, sidewalk, or another surface area.

    The manhole rings and covers shall be attached by casting into the top of the manhole or grouting into the completed manhole, as directed by the Department Engineer. If manhole rings are grouted to completed manholes, a keyway shall be formed in the top of the manhole outside of where the manhole ring will rest. Grout shall be as specified herein. Details for the construction of manholes shall be shown as on the Standard Detail Sheet.

12. Drop Manholes
    Drop manholes, unless otherwise shown on the Plans, shall be constructed such that the difference in invert elevation between the influent and effluent lines is two (2) feet or more. Internal drops shall only be used on 5 foot diameter manholes or larger and shall be of the same materials and dimensions as standard manholes. Base elbows shall be encased in concrete, as shown on the Standard Detail Sheet. Drop manholes greater than 14 feet, measured from the flowline to finished grade, shall have epoxy lined ductile iron pipe and fittings, as specified herein, encased in concrete.

In lieu of external drops, internal fiberglass drops as specified herein shall be permitted at the prior consent of the Department. Bowl size shall be adequately sized in accordance with incoming pipe size and flow rates and installed as per manufacturer's instructions. Interior drops shall have a minimum of two (2) stainless steel support brackets with a maximum spacing of four (4) feet, or as otherwise directed by the Manufacturer.

13. Watertight Manholes
    Construction of watertight manholes shall be of the same materials and dimensions as standard manholes, with the exception of the manhole ring and cover, as shown on the Standard Detail Sheet and specified herein.

14. Concrete Placement and Curing
    Concrete placement and curing shall be as set forth in the Concrete and Reinforcing Steel Section of these Specifications.

15. Backfilling
    Backfilling of pipelines entering manholes shall be done in accordance with the requirements of the pipe material as set forth in the appropriate Sections for sewer lines in these Specifications. Manholes shall be tested for leakage prior to backfilling as specified in this Section.

    Extra care shall be exercised around manholes to ensure that backfill material is evenly distributed around the perimeter of the manhole and to the top of the highest pipe entering the manhole. Backfilling around manholes shall not commence until adequate concrete strength has been obtained to support the backfill without damage to the manhole. In no case shall backfilling around manholes be allowed until the concrete is at least 48 hours old, except as otherwise approved by the Department.

D. TESTING

Cast-in-place manholes shall be vacuum tested for watertightness as set forth in the Vacuum Testing of Manholes Section of these Specifications.

END OF SECTION

SECTION T20

PROTECTIVE COATING FOR MANHOLES AND OTHER STRUCTURES

A. DESCRIPTION

This Section sets forth requirements for the proper spray application of protective coatings for cast-in-place manholes, wetwells, and other structures when such protective coating is required by the Department.

B. MATERIALS

The spray-on protective coating shall be the Raven 405 coating system as produced by Raven Lining Systems or the Zebron 386 coating system as produced by Zebron. The material shall be a 100% solids, solvent-free, two (2) component system, thixotropic (gel property of becoming liquid when shaken or stirred) in nature, and containing select fillers to minimize permeability and provide sag resistance acceptable to these Specifications.

Protective coating materials shall be kept dry, protected from weather, and stored under cover. Protective coating materials shall be stored between 50-90° F, away from flame, heat, and strong oxidants. Handling, storage, and use of protective coating materials shall be in strict accordance with the appropriate material safety data sheets (MSDS).

C. EXECUTION

Any active flows shall be dammed, plugged, or otherwise diverted as required, ensuring that overflows or surcharging will not occur either upstream or downstream. The protective coating material shall be spray-applied by a Certified Applicator (Applicator) of the protective coating manufacturer.

1. Surface Preparation

   The Applicator shall initially inspect all surfaces specified to receive a protective coating prior to surface preparation. All contaminants including oil, grease, unsound or incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

   Repair materials shall be used to fill voids as determined necessary by the Department Engineer and the Applicator. Repair materials shall be compatible with the specified coating and applied in accordance with the manufacturer's recommendations. Repair materials shall be approved by the Department in advance of delivery to the job site.

   Concrete shall be allowed to sufficiently cure according to the manufacturer's recommendations prior to the application of the protective coating.

   Surfaces to receive the protective coating shall be cleaned and abraded to produce a sound concrete surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Generally, adequate surface preparation may be achieved with high pressure water cleaning as per NACE Standard No. 6/SSPC-SP-13, using equipment

capable of delivering 5,000 psi at a minimum of 4 gpm, with a zero-degree, rotating nozzle. Other methods such as high pressure water jetting as set forth by NACE Standard No. 5/SSPC-SP-12 (Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultra-Pressure Water Jetting Prior to Recoating), abrasive blasting, shotblasting, grinding, hand tooling, or scarifying may also be used. Detergent water cleaning and hot water blasting may be necessary to remove oil, grease, or other hydrocarbon residues from the concrete. Certain conditions may warrant a chemical cleaning method such as acid etching, in which case care must be taken to remove all residual acid prior to coating application. Whichever method is used, performance procedures shall be in a manner that shall provide a uniform, sound, clean, and neutralized surface.

The prepared surfaces shall be tested, after cleaning but prior to application of the coating, to determine if a specific pH or moisture content of the concrete shall be required according to the manufacturer's recommendations.

2. Application

Application procedures, handling, mixing, environmental controls during application, safety, and equipment shall conform to the recommendations of the protective coating manufacturer. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating material and shall be regularly maintained in proper working order.

The protective coating material must be spray-applied by a Certified Applicator of the protective coating manufacturer. The temperature of the surface to be coated shall be maintained between 40° F and 120° F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or any other intense heat source to the structure being coated. If varying surface temperatures exist, the coating shall be applied when the surface temperature is heating rather than cooling.

Interior manhole surfaces, including the invert and the area of the manhole casting, shall be coated by spray application of a moisture tolerant, solvent-free, 100% solids, protective coating as described herein. Average wet film thickness shall be 100 mils with an 80 mil minimum thickness. Specific areas may require a higher film thickness, as directed by the Department Engineer. However, in no case shall this material be applied above the thickness per coat recommended by the manufacturer.

Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating. Air-assisted spray application equipment shall not be acceptable, except upon written approval of the Department Engineer. If subsequent top-coating or additional layers of the protective coating are required after the initial coating, such additional coating shall be applied as soon as the basecoat becomes tack free, ideally within 12 hours but no later than the recoat window for the specified product. Additional surface preparation procedures shall be required if the recoat window is exceeded.

The Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE, and SSPC standards, as well as the protective coating manufacturer's recommendations.

3. Inspection and Testing

All inspection and testing shall be as recommended by the manufacturer. The Applicator shall visually inspect the applied coating for pinholes, blisters, and confirm even coloring, coverage, and cure.

During application, a wet film thickness gage, meeting ASTM D4414 (Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages) and as available through Paul N. Gardner Company, Inc., shall be used by the Applicator to ensure a monolithic coating and uniform thickness. After the coating has set and is hard to the touch, measurement

of the thickness by an ultrasonic thickness gage or other means may be required by the Department.

The coating shall then be inspected by the Applicator with high-voltage holiday detection equipment, as set forth in NACE RPO188 (Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates), for electrical detection of minute discontinuities in liquid-applied coating systems. All detected holidays shall be marked and repaired by the Applicator per manufacturer's recommendations.

Measurement of the bond strength of the protective coating to the substrate shall be required if requested by the Department Engineer. Bond strength shall be measured in accordance with ASTM D4541 (Pull-Off Strength of Coatings Using Portable Adhesion Testers). Repairs shall be made by the Applicator in accordance with the manufacturer's recommendations to any areas detected to have inadequate bond strength.

4. Warranty

The Contractor shall warrant all Work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, beginning on the date of final acceptance of the project. The Applicator shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop and any other damage to other Work caused by such defects during the one (1) year warranty period at the Applicator's expense.

END OF SECTION

SECTION T21

SEWAGE PUMPING FACILITIES

Revised April 4th, 2021

A. DESCRIPTION

This specification governs the construction of publically operated wastewater lift stations and provides a set of design and construction criteria to ensure a level of quality and standardization for wastewater lift station construction within the City of Springdale Water and Sewer Commission's sewer service area.

B. GENERAL

1. Requirements
    a. The construction of sanitary sewer lift stations shall only be considered if no feasible gravity flow alternative exists. Prior to beginning detailed design work, the engineer of record shall obtain written approval of the Department for a lift station to serve the subject development. The Department must approve all plans.
    b. A registered Civil Engineer shall seal the civil portion of the drawings. A registered Electrical Engineer shall seal the electrical portion of the drawings. A licensed geotechnical engineer shall supervisor all backfill for concrete structures. All engineers shall be registered in the State of Arkansas.
    c. Lift station design and construction shall conform with the latest edition of the "Recommended Standards for Wastewater Facilities" as reported by the Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (10 States Standards).
    d. These specifications are to be used as a guide only. The Department may have additional site specific requirements.
    e. It shall be considered that lift stations are to be designed to accommodate sanitary sewage flows from all proposed upstream drainage basins.
    f. Buoyancy of the wastewater pumping station structures shall be considered, and if necessary, adequate provisions shall be made for protection.
    g. Lift station site and access drive shall be deeded to the City of Springdale Water and Sewer Commission.
    h. All sanitary sewer lift stations shall consist of a wet well, duplex submersible pumps, valve vault, and above-ground electrical controls housed in a climate-controlled environment. Any alternative configuration requires prior approval from the Department.
    i. Multiple pumps shall be provided. Where only two pumps are provided, they shall be of the same size. Pumps shall have capacity such that, with any pump out of service, the remaining units will have capacity to handle the design peak flow. All pumps should be warranted by the manufacturer.
    j. Electrical service to the lift station shall be 277/480 Volt, 3 phase, 4-wire WYE. Confirmation of service availability shall be required prior to construction.
    k. Emergency backup power shall be provided for all lift stations. Backup power generation shall be capable of operating all pumps and ancillary equipment. The fuel source shall be natural gas. In the event natural gas is unavailable, propane or diesel shall be used with a minimum fuel tank/storage sized to run the entire site, including all pumps, at full speed and at at full load, for 48 hours.
    l. Communications and SCADA control system shall be provided for all lift stations.
    m. Lift stations over 300 GPM shall have a segmented wet well and a minimum of three pumps. Additional requirements beyond these specifications may be required and shall reviewed and designed on an individual basis. Such additional requirements may include odor control equipment, area lighting, and site layout.
2. Submittal Requirements

    Submittals of all materials and components shall be submitted to the Department for written approval. Cut sheets of all materials shall be provided to the Department for approval prior to ordering.

3. Hydraulic Capacity
    a. A hydraulic study shall be provided for the basis of design of wastewater lift stations. At a minimum, the report shall include:

i. Narrative of the methodology used in determination of wastewater flows.
ii. Maps showing the extent of drainage basins including topographic contour data, existing land use, potential areas of redevelopment, and comprehensive growth zones.
iii. Population projections of the proposed service area assuming 3 persons per living unit. See Specification Section G4,C,5.
iv. Design average and peak flow of the sewer collection system.
v. Peaking Factor shall be calculated by the following equation, where P is the total population served divided by 1,000: $PF = Q\ peak\ hourly\ /\ Q\ design\ average$ = (18+$\sqrt{P}$) / (4+$\sqrt{P}$) or 1.5, whichever is greater
vi. The design fill time and minimum pump cycle time shall be considered in sizing the wet well. The effective volume of the wet well shall be based on the design average flow with a filling time not to exceed 30 minutes. The pump manufacturer's duty cycle recommendations shall be utilized in selecting the minimum cycle time. Where possible, sufficient storage shall be present so that the Department may have 30 minutes of response time in the event of loss of power.
vii. Hydraulic calculations showing all major and minor losses, including head loss in the discharge pipe, fittings, and force main run at both C-150 and C-120 values.
viii. Pump Curves for all proposed pumps, including showing a plot against system head curve.
ix. Downstream gravity sewer capacity analysis.

b. The sizing of wastewater facilities receiving flows from new wastewater collection systems shall be based an average daily flow of 100 gallons per capita plus wastewater flow from industrial plants and major institutional and commercial facilities unless water use data, wastewater flow monitoring data, or other justification upon which to better estimate flow is provided.
c. The 100 gal/cap/d value shall be used in conjunction with a peaking factor to cover normal infiltration for systems built with modern construction techniques. However, an additional allowance should be made where conditions are unfavorable.
d. If the new collection system is to serve existing development the likelihood of I/I contributions from existing service lines and non-wastewater connections to those service lines shall be evaluated and wastewater facilities designed accordingly.
e. Projections shall be made from actual flow data to the extent possible.
f. The probable degree of accuracy of data and projections for all critical design flow conditions shall be evaluated. This reliability estimation should include an evaluation of the accuracy of existing data, and an evaluation of the reliability of estimates of flow anticipated due to infiltration/inflow (I/I), or flow due to elimination of sewer bypasses and backups or hydraulic restrictions.
g. A description of all critical data and methodology used shall be included in all reports.

4. Site Requirements
   a. All site work shall conform to city ordinances regarding the development of lands.
   b. Minimum lot size shall be 60’ X 100’.
   c. A concrete pad shall be provided around the wet well and valve vault, at the same grade as the asphalt pavement.
   d. A paved access road shall be provided from the curb to the lift station. The drive shall have a minimum width of 12’, maximum cross slope of no more than 3%, and maximum longitudinal slope of no more than 10%. An unobstructed access to the lift station shall be provided and maintained. A minimum of 6” of compacted base material is required. Base material and compaction shall be in accordance with the latest edition of ARDOT Standard Specifications (Division 300). Paving materials and construction methods shall be in accordance with the latest edition of the ARDOT Standard Specifications (Division 400). Base material, compaction, and pavement recommendations shall be provided by a qualified geotechnical engineer and approved by the Department.
   e. Depending on entrance drive length, a turn-around may be required to accommodate Department vehicular equipment.
   f. Lift station lot shall be asphalt. A minimum of 6” of compacted base material is required. Base material and compaction shall be in accordance with the latest edition of the ARDOT Standard Specification (Division 300). A minimum of 3” of asphalt is required. Paving materials and construction methods shall be in

accordance with the latest edition of the ARDOT Standard Specifications (Division 400). Concrete may be approved by the Department on a case-by-case basis.

g. The site shall be designed with ample maneuvering room for a 9' W x 40' L vacuum truck to service the lift station and turn around so as not to back out of the site or onto an adjacent street. Pavement grades in maneuvering areas shall be a minimum of 1% and a maximum of 5%. All drainage shall flow away from all concrete structures and buildings.
h. All concrete structures shall be a minimum of 12" above the surrounding pavement and a minimum of 3 feet above the 100-year flood hazard elevation. A flood hazard certification by an Arkansas Registered Professional Engineer shall be provided to the Department
i. A steel frame wood privacy fence (see detail M-5) (or if HOA or other controlling entity requires alternate design, alternate materials as approved by the Department) with posts set 1' inside the asphalt with two swing gate is required. The fence shall be stained and sealed with the stain and sealant chosen by the Department. The each swing gate shall have solid rubber tires. Grade shall be such that allows wheels to make contact with the paved surface at all times. All areas inside of the fence shall be paved.
j. A potable water supply shall be provided for wash down. An RPZ shall be installed on the service line entering the facility. The water supply shall consist of a meter service with a Frost Proof Yard Hydrant Assembly equipped with a vacuum breaker. The frost-free hydrant "Bury Hydrant" shall be installed inside the fence of the lift station. See Detail M-2.
k. Site lighting shall be provided on the Controls Building which shall adequately illuminate the wet well area during night time hours by utilizing a photocell and directional LED wallpack(s) or flood light(s). LED lighting shall be provided inside and outside the building to adequately illuminate the control panel and site.
l. A weatherproof, insulated and air-conditioned building shall be provided for the station electrical equipment. The building shall be a split-face concrete masonry unit structure. Floor sills and roof overhangs shall be weatherproof. Doors shall be of sufficient size to provide ample room for installation and removal of all electrical cabinets and components. The Building shall be of sufficient size to such that workspace dimensions comply with NEC 110.26 and OSHA 29 CFR 1910.333. The building shall have a light and switch with 120 volt spare receptacle.
m. An intrusion alarm shall be provided. An acceptable intrusion alarm system may utilize an Allen-Bradley 802T limit switch and an 800T-H3115A keyed two position selector cylinder-style key switch mounted in a 800T-1TZ Enclosure. The limit switch is to be mounted on the door. When the key switch is in the OFF position and the door is open, no alarm shall be active SCADA system.
n. When the door is open and the key switch is in the ON position, an alarm shall be active on SCADA system.
o. Steel pipe bollards shall be provided for protection of the building, generator, vault, transformer, and other above-ground features in or adjacent to traffic areas.
p. All structural design, geotechnical investigations, and all engineered fill shall be supervised and designed by a professional Arkansas licensed geotechnical engineer.

C. <u>MATERIALS</u>

1. <u>Wet Well Requirements</u>
   a. The lift station will be constructed of concrete with reinforcement material. The lift station will be constructed of min. 3,500psi concrete with reinforcement material per ACI 350 and ACI 315 (Latest Edition). All plumbing entering or leaving the wet well shall be grouted and mechanically sealed to prevent infiltration.
   b. Wet well walls shall be steel reinforced. The base of the wet well shall be designed to resist the buoyance/floating with the wet well empty. Wet well access shall be cast-in-place, grout will not be accepted. Steel reinforcement shall be designed by a professionally licensed Structural Engineer of the State of Arkansas.
   c. All interior concrete walls of new lift station wet wells shall be epoxy coated prior to lift station approval and being brought into service. The three manholes downstream of the force main discharge shall be lined and epoxy coated. Epoxy coating shall be as specified in SECTION T20.
   d. All plumbing entering or leaving the wet well shall have a water stop, provisions for thrust resistant, and grouted to prevent infiltration.
   e. The wet well shall be vented. Venting systems shall be appropriately sized and at a minimum be vented by a 4" stainless steel pipe with bird screen.
   f. Wet wells shall be a minimum of 8' in diameter and a minimum of 10' in depth. Additional Storage (i.e. equalization basin) may be required at certain locations, which will be determined by the Department.

g. Wet well shall be cast-in-place. No precast structures will be allowed.
h. Access covers and safety grates shall be of aluminum construction and designed for access to submersible pumps. Covers shall be equipped with a guide bar bracket, safety chain hook, electric cable support, and a hasp for a padlock. Covers shall be of a size compatible with the pumps. Wet well hatch shall open toward the control panel in a way which does not make contact with electrical equipment and resist a live-load of at minimum 300 pounds per square foot. Door shall open to 90º, lock automatically in position, have closed position lock hasp, and retractable grip for opening and closing with one hand. Access hatches shall be manufactured by Haliday or Bilco.
i. All lift station mounting rails, guide rails, support brackets, cross bracing, anchors, bolts, nuts, washers and other hardware shall be stainless steel type 316.
j. Stainless steel chains, hooks and cord grip shall be provided for all pump cables in wet well.
k. Each pump shall have an individual intake. Wet well and intake design should be such as to avoid turbulence near the intake and to prevent vortex formation.
l. A monorail type overhead hoist system, davit crane, or jib crane installed in a way that allows each pump to be loaded on the back of a 2-Ton pick-up truck.

2. Pump Requirements
   a. Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of each pumping cycle, and shall meet the requirements of the National Electrical Code for such units.
   b. All submersible type pumps shall be capable of passing a 3 inch (minimum) solid sphere.
   c. All pumps shall have a minimum horsepower rating of 5 HP and rated for a 277/480V, 3 phase, 4-wire WYE service. Pumps not meeting this criteria shall require prior approval from the Department.
   d. An effective method to detect shaft seal failure or potential seal failure shall be provided.
   e. Submersible pumps shall be readily removable and replaceable without the necessity of personnel entering or dewatering the wet well or disconnecting any piping in the wet well. All lift stations require rail mounted submersible pumps as manufactured by Flygt (N-Series) or Fairbanks and interchangeable without alteration to the piping or electrical system. Proposed pumps other than Flygt or Fairbanks shall require prior approval from the Department.
   f. Pump motor power cords shall be designed for flexibility and serviceability under conditions of hard usage and shall meet the requirements of the National Electrical Code standards for flexible cords in wastewater pump stations. Ground fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent the entry of moisture into the cable, shall be provided with strain relief appurtenances, and shall be designed to facilitate field connecting.
   g. All pumps will meet or exceed the minimum requirements to pump the anticipated flow for the known number of houses, units, or number of persons. The pumps will meet or exceed required head values based on design. Pumps shall operate within the manufacturer's preferred operating range. At a minimum, all lift stations shall be duplex, two pumps of the same size that alternate pumping.
   h. Any time it is determined through an analysis that a development or subdivision impacts or exceeds the capacity or the flow of an existing lift station, the existing lift station shall be upgraded. The existing lift station shall be upgraded with equipment including pumps, piping and control panel components that are consistent with the existing equipment.

3. Discharge Piping
   a. The "Discharge Pipe" is defined as all pipe and fittings required from the pump discharge to the check valve connection and through the valve vault. Piping shall be sized to meet flow needs. Discharge pipes shall be designed and constructed such that normal velocities are between 2 ft. /s and 8 ft. /s.
   b. The exterior of the DIP in the valve vault shall be epoxy coated with Tnemec G435 epoxy coating.
   c. All lift station piping shall be 4" diameter or greater and be flanged DIP, epoxy lined pressure sewer pipe or Type 316L stainless steel (in accordance with ASTM A312 and 150 psi minimum).
   d. Pumps shall be mounted on stainless steel slide rails and use watertight pump connectors as recommended by the pump manufacturer.

e. All lift stations that have the planned ability to pump in excess of 1,000 GPM shall have a flanged magnetic flow meter installed with a gate valve on the upstream side, and bypass piping to allow for maintenance of the magmeter.

4. Valves & Valve Vault
    a. Gate Valves and Check Valves are required on both discharging lines. Valves shall be located in a vault separate from the wet well.
    b. Valve vault walls shall be a minimum of 8" thick. Valve vault base shall be a minimum of 12" thick. Valve vault top shall be a minimum of 8" thick with steel reinforcement. Reinforcement is required and all structural steel shall be designed by a structural engineered registered as a Professional Engineer in the State of Arkansas. The base of the valve vault shall be designed to resist the buoyance/floating with the wet well empty.
    c. A sump pit shall be installed and concrete sloped to the sump pit. Provisions shall be made to drain accumulated water from the valve chamber to the wet well through a 2" stainless steel or PVC drain line using a sump pump.
    d. Gate valves shall be resilient seat type and meet the requirements of AWWA C515 latest revision. Valves shall have non-rising stems and close right (clockwise). Valves shall have flanged ends and have hand wheel. Acceptable manufacturers for all sizes include; American, Clow, Kennedy, Mueller or approved equal. Gate valves shall be mounted horizontally in valve vault.
    e. Vaults and wet wells shall be of all concrete construction incorporating a double aluminum access hatch. Access shall be provided for the valve vault.
    f. The base of all piping shall be mounted a minimum of 24" above the floor of the vault with steel support stands.
    g. All valves must be provided with hand wheels.
    h. A stainless steel liquid filled pressure gauge shall be furnished and installed on the force main for the purposes of confirming pump and force main performance. The gauge shall be furnished with a diaphragm seal assembly, stainless steel isolation ball valve, and connected to the force main with stainless steel SCH40 pipe. A ½" tap shall be provided on the force main in the valve vault. If force main pressure exceeds 50PSI, a tapping saddle shall also be provided.
5. Electrical
    a. The electrical layout, conduit placement, and all conduit shall be approved by the Department.
    b. All electrical components shall be installed by a licensed electrician and comply with all applicable building and electrical codes. All equipment shall be UL listed.
    c. Electrical systems shall comply with Arc Flash requirements per NEC 240.87 and NFPA 70E. An arc flash analysis shall be done, a report provided to the Department, and stickers provided on each panel.
    d. A continuous ground loop shall be installed around the building, generator, and antenna structure. Rebar in each concrete structure shall be connected and grounded to the ground loop. Wire size shall be as required by NEC code, with a minimum size as shown on the drawings.
    e. Electrical systems and components (e.g., motors, lights, cables, conduits, switch boxes, control circuits, etc.) in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class I, Division 1, Group D locations. No electrical equipment shall be located inside the wet well with the exception of pump cable and level sensing equipment. Each flexible cable shall be provided with a watertight seal and separate strain relief. A breaker type disconnect located above ground shall be provided for the main power feed for all pumping stations. Utilizing an automatic transfer switch with a disconnect accessible without opening the cabinet is an acceptable means to accomplish this.
    f. All electrical boxes and cabinets shall be rated NEMA 3R. When such equipment is exposed to weather, it shall meet the requirements of weatherproof equipment NEMA 4X, at a minimum.
    g. Lightning and surge protection systems should be incorporated in the electrical design on all wiring entering or leaving the panels, including incoming power and Ethernet.
    h. Ground Fault Circuit Interruption (GFCI) protection shall be provided on one outdoor outlet mounted to the Controls Building nearest to the wet well.
    i. An automatic transfer switch shall be incorporated for any backup power source.
    j. All conduit shall be robroy or stainless steel. All conduit elbows shall be long sweep elbows. Conduits and conductors between transformers and main disconnect to be sized in accordance with NEC standards.

Conduits to be minimum 30” depth. All conduits inside wet well shall be type 304 or 316 stainless steel. All cabinets, stands, and any hardware mounted outdoors shall be type 304 or 316 stainless steel.

k. Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well and through use of watertight seals.
l. Control Panel (277/480V 3-phase)
    i. All pumps rated at 30 HP and smaller shall be installed with a variable frequency drive, or “across the line” magnetic contactor, or “soft start” per pump sized to HP and NEMA standards shall be provided and installed with overload protection sized to motor specifications.
    ii. Lift stations requiring greater than 40 HP pumps shall be operated by variable frequency drives as manufactured by Schneider Electric or approved equal. VFDs shall be sized in accordance with pump motor specifications.
    iii. Component spacing within the panel and mechanical ventilation shall be provided to meet airflow requirements.
    iv. All operator controls, overload resets, circuit breakers, etc., shall be accessible without removing the dead-front panel.
    v. A disconnect for the High Voltage panel shall be provided to disconnect power before the panel can be opened.
    vi. One combination circuit breaker/overload disconnect unit with magnetic trip elements sized for individual protection shall be provided for each pump.
    vii. Each pump will have separate Terminals (Bussman or equivalent) provided for each pump and mounted a minimum of 4” above the bottom of the control panel.
m. 3-phase power monitor must be installed to protect pump from low voltage, single phasing and phase reversal. (Motor Saver Model 460)
n. A 120 Volt Surge arrester shall be used for control circuit protection.
o. A backup float system shall operate relays that allow both pumps to run without the need of a PLC. For duplex lift stations, one float shall turn both pumps off, and two additional floats shall turn each pump on. Lift Stations with more than two pumps require Department approval of the backup method. The float cord shall be of sufficient length to reach the lowest inlet without splicing.
p. 480/240VAC 1PH control transformer, protected by combination circuit breaker/overload shall provide protection on both the primary and secondary control circuit. Neutral and ground wires shall be bonded inside the transformer.
q. All terminals coming from the wet well shall be manufactured by Bussman or equivalent and must be mounted a minimum of 4” above the bottom of the control panel.
r. All terminal connections must be a minimum of 4” above the bottom of the control panel.
s. All pumps shall be protected by seal fail and high temp relays.
t. Station Low Voltage service panel shall operate on 220 Volts AC with a minimum of ten breakers.
u. A lightning arrester shall be installed for pump protection and mounted below and outside of the control panel.
v. The power company shall be contacted prior to design to determine type of electrical service and transformer requirements. Three-phase 277/480V power must be used. No single phase power will be accepted on duplex stations.
w. A time hour meter for each pump must be mounted on operator’s control panel.
x. Electrical connections in the wet well are not allowed.
y. An intrusion alarm system shall be provided operated based on the position of the door to the controls building, which shall provide an output to the SCADA system.

6. <u>Generator / Emergency Power Generation</u>
    a. The generator sets under 100 KW shall be manufactured by Generac, Cummins, or Caterpillar. Generator sets over 100 KW shall be manufactured by Cummins or Caterpillar.
    b. The generator set shall be minimally rated at the kW rating as indicated on the drawings when operating at 277/480 volts, 0.8 lagging power factor. The generator set shall be capable of this rating while operating in an ambient temperature condition of 122°F (50°C).
    c. The generator shall have a properly sized battery charger and block heater installed.

d. The generator set shall be capable of starting motor loads as indicated on the drawings along with a minimum station load of 5 kW and a maximum voltage dip of 25%.
e. The engine shall deliver power at a governed speed of 1800 rpm.
f. The generator shall be anchored to a concrete foundation sufficient to resist excessive vibration and be designed by an Arkansas Registered Professional Engineer.
g. Sound Attenuated Weather Protective Enclosure
    i. Manufacturer shall have a minimum five years of experience in the design and construction of weather-protected generator-set enclosures.
    ii. The enclosure panels shall be assembled with modular, bolt-together construction. c. Enclosure shall include the following features:
        1. Foam insulation on all interior surfaces
        2. Sound level not to exceed 68 dba within 7 meters of enclosure surface in any direction
        3. All exterior and interior surfaces finished with baked-on powdercoat
        4. Bottom flange with multiple mounting holes
        5. Stainless steel door hardware and lift-off hinges
        6. Lockable doors
        7. Gasketed access doors

7. Automatic Transfer Switch (ATS)
    a. It is the intent of this specification to secure automatic transfer switches that have been prototype tested, factory built, production tested, and site tested, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. Automatic transfer switches with number of poles, voltage and current ratings as shown on the plans shall be provided. Each ATS shall consist of an inherently doublethrow power transfer switch unit and a control module interconnected to provide complete automatic operation. All equipment shall be new and of current production by a firm which manufactures the generator, controls, and transfer switch. The company selected will assemble the standby generator set and system as a matched unit so that there is one-source responsibility for warranty, parts and service through a local representative with factory-trained personnel.
    b. ATS shall be service-entrance rated and the same amperage capacity as the electrical service, 480 volt, 3 phase, 4 wire, 3 pole with solid neutral.
    c. Submit motor starting calculations and generator sizing calculations for approval.
    d. Two (2) dry status contacts shall be provided for connection to the SCADA System for monitoring.
    e. A 2-hour load bank test at 100% load shall be performed.

8. Controls
    a. NEMA 4X stainless steel for outdoor, or NEMA3R for indoor, enclosures with draw pull catch, provisions for padlocking and suitable for indoor or outdoor mounting shall be provided. All floor mounted panels must be placed on a 4” min. concrete housekeeping pad.
    b. The control panel shall incorporate the following features as a minimum:
        i. Individual selector switches to provide "hand-off-auto" control of each pump.
            1. HAND POSITION - In this position, the pump controlled by the (HOA) switch will run regardless of the wet well level. The pumps will continue to run until the switch is turned “off” or in “auto” position
            2. AUTO POSITION –The (HOA) switch shall operate the pumps and will be controlled automatically by the PLC and level sensors in the wet well. The control center will be designed to provide automatic operation, while maintaining motor protection.
        ii. Pump HI TEMP pilot lights (red)
        iii. Pump SEAL FAIL pilot lights (amber)
        iv. Pump running pilot lights (green)
        v. Hour meters will be provided for each pump
        vi. Circuit breaker with external disconnect handle for each pump
        vii. Level indicator
        viii. Overload reset (if applicable to type of starter)
        ix. Low Level Float Alarm

x. High Level Float Alarm

c. The Department's SCADA system shall be modified so that all alarms shall be transmitted to the AVEVA InTouch HMI workstations operated by the Department.
d. The chase way coming through the wet well for pump cords shall be properly sized and be of robroy or stainless steel. A sealing fitting shall be provided, and filled with Eaton Chico Sealing Compound or approved equal to prevent H2S gases from entering any enclosure.
e. Alternator shall be provided in the PLC ladder logic for all lift stations.
f. The level control system sensors shall be a Radar 4 to 20 milliamps, Krohne Optiwave 1400 or equivalent. A float backup system shall be installed. Terminals shall be provided for connection of the level sensors.
g. All duplex pump stations shall be controlled with a PLC and have circuit protection for disconnect. See Specification T22. The SCADA RTU power supply and PLC shall have a 600VA APC battery backup . Battery backup to be placed in bottom of SCADA panel.

C. EXECUTION

1. Installation
Excavation, installation, and backfilling shall be in general accordance with these Specifications and with the manufacturer's instructions and recommendations. Installation and layout of the pump station shall be as set out in the applicable Standard Details.
2. Welding
All welding shall be in accordance with standard AWS practices, with proper fillet section and continuity to assure a sound, watertight structure. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across the weld not less than that of the thinner of the connected sections, and shall be watertight. All welds in contact with soil or water shall be tested with a dye penetrant to ensure the watertight integrity of the weld system.
3. System Operation
    a. On wet well level rise, the lead pump shall start at the lead pump ON elevation. With the lead pump operating, the wet well level shall lower to all pumps OFF and turn off the pump. After each operating cycle the lead and lag positions will alternate.
    b. If the wet well level continues to rise when lead pump is operating, the lag pump shall be started. Both lead and lag pumps shall operate together until low level switch turns off both pumps. If level continues to rise when both pumps are operating, alarm level switch shall energize and signal the alarm.
    c. If one pump should fail for any reason, the second pump shall operate on the override switch.
    d. If the pumps fail to turn off for any reason after receiving the signal for all pumps OFF, a low level alarm shall signal.
    e. All level controls shall be adjustable for level setting from the surface.
    f. A manual selector switch shall also be provided so that the operator can designate either pump to stay in the lead position continuously. Adjustable time relays shall be provided to prevent simultaneous starting of the pumps after power failure.
4. Wiring
All wiring shall comply with the NEC and all applicable federal, state, and local codes. Wiring shall be completely factory installed except for the power lines that run to the control panel continuously from the external disconnect switch, and any wires connecting to any operating devices not mounted in the station. All wiring within the equipment chamber and outside the control panel shall be run in PVC rigid conduit (robroy) or stainless steel except for the liquid tight metallic flexible conduit to connect the pump motors. Underground conduit may be PVC. It shall be the responsibility of the Contractor to furnish and install correctly sized service wires from the service pole outside the equipment chamber to the control panel. It shall also be the responsibility of the Contractor to furnish and install, if required, any exterior disconnects or switching mechanisms. All conduit shall have 60% free space inside after wires have been pulled, or as required by NEC if more stringent.

5. Startup
After the installation is complete, the manufacturer shall provide the services of a factory trained representative for a minimum period of one (1) day to perform initial start-up of the pump station and to instruct personnel in the operation and maintenance of the equipment.

6. Guarantee

The manufacturer/Contractor shall guarantee for a period of one (1) year from the date station is placed into operation and accepted by the Department that the entire station and all equipment therein shall be free from defects in design, materials, and workmanship. In the event a component fails or is proven defective during the guarantee period, the Contractor will provide a replacement part without cost, upon return of the defective part. Normal use items, such as grease, light bulbs, mechanical seals, packing, and belts are excluded.

7. Final Acceptance
    a. The water meters shall be installed before a final inspection is requested.
    b. The lift station final inspection and development final inspections are separate inspections and will take place at separate appointments.
    c. The electric account shall be setup with Power Company by the Contractor and after the final inspection shall be transferred to the Department upon acceptance of the overall development and lift station.
    d. All panels, disconnects and breakers will be labeled. The correct voltage shall be displayed on all panels. All disconnects shall be Lock Out/Tag Out compatible, and locked in "ON" position.
    e. The auxiliary generator must be test run and a 2 hour load bank tested at 100% load to ensure proper operation, and to ensure the correct rotation of the pumps.
    f. The Developer / Contactor will provide 3 copies of operation & maintenance manuals, as well as one PDF digital copy. This manual shall include – Identification and contact information for all suppliers, installers, and programmers, hydraulic report, force main plans, station component cut sheets, valve vault components, electrical schematics, and electrical catalog, pump serial numbers, and pump curves. The books shall be submitted to the Department prior to final inspection.
    g. The Contractor shall provide a basic parts list to the Department for the Electrical and Communications Panel.

D. **TESTING**

All components shall be tested for complete operation of the lift station.

a. The pumps shall be tested at the specified rated speed, capacity, efficiency, brake horsepower, and other conditions of head and capacity as to properly establish and provide a certified performance curve. The standards of the Hydraulic Institute shall govern the procedures and calculations for these tests.

All new water-holding concrete structures shall be watertight, show no visible evidence of infiltration or leakage, and be tested in accordance with these Specifications. Water-holding structure testing shall be conducted by the Contractor in coordination with the Department. All visible leaks shall be repaired regardless of the amount of leakage. The test shall be repeated until satisfactory results are obtained.

1. Prior to Testing
   The concrete must be cured and at design compressive strength, all joint sealants must be cured, and all pipes must be installed prior to any cleaning, leakage testing, backfill, installation of equipment, or other Work that will cover the exposed faces of concrete walls. Testing shall be performed after all pipe sleeves have been installed and prior to installation of equipment.

   Water-holding concrete structures shall be cleaned and free of all debris, foreign materials, and standing water that would interfere with observing the exposed faces of concrete walls. The Contractor shall inspect prior to filling the structure all concrete surfaces, concrete joints, pipes, fittings, openings, and wall penetrations. The epoxy liners shall be cured and thickness and holiday tested. Any defects shall be repaired prior to filling the structure.

2. Leakage Test Procedure
   Water-holding concrete structures to be subjected to leakage tests shall be filled with city water to the normal liquid level line, unless directed otherwise by the Engineer. Contractor is responsible for all filling costs. Filling of water shall not exceed 3 feet of depth per hour and shall be filled at a uniform rate over a 24-hour period.

   Any running leaks which appear during filling shall be repaired before continuing. The concrete structures, exposed concrete surfaces, concrete joints, pipes, fittings, openings, and wall penetrations shall be inspected

during the filling process and after the structure has been kept full for 96 hours. If any flow of water, visible leakage or damp spots are observed from the structure or on the structure exterior surface, including joints or cracks, then the defect causing the leakage or damp spot shall be repaired in a manner acceptable to the Engineer

If any leakage is noted or observed during the filling of the structure and/or for 24 hours after the structure is filled then it is deemed to be unacceptable by the Engineer, then the Contractor shall then drain the structure, repair all leakage and damp spots, and repeat the Leakage Test procedure.

All repairs, additional filling, and additional testing shall be made by the Contractor at no additional cost to the Owner.

3. Acceptance

Any water-holding concrete structure that is not watertight shall not be accepted by the Department. All water-holding structures which fail the leakage test shall be repaired, or a new water-holding structure shall be constructed at the expense of the Contractor. Water-holding structures which initially fail testing shall be retested after remedial measures are completed. If a water-holding structure fails the leakage test three (3) times, the inadequate water-holding structure shall be removed and a new water-holding structure shall be constructed.

END OF SECTION

SECTION T22

SCADA INSTRUMENTATION AND CONTROL SYSTEM

Revised February 11th, 2021

A. DESCRIPTION

The Work to be included under this Section of the Specifications shall consist of furnishing all materials, labor, equipment, tools, supplies, and incidentals necessary for the installation of the lift station SCADA system. The Work shall include every item of construction necessary for a complete and acceptable installation as shown on the Plans and as hereinafter specified. The Contractor shall be responsible for furnishing and installing all items of hardware, software, programming, and configuration for every input/output circuit described in these Specifications.

The Contractor shall subcontract with an authorized System Integrator approved by the Department as specified herein.

B. GENERAL

1. Application and Software Driver Licenses
   The PLC configurations, the HMI configurations, the database application, and any other support or driver software that is developed by the Contractor shall be licensed to and shall remain the property of the Department. The Department shall be granted an unlimited license to install the software on any number of computers, operate the software on any number of computers, modify any configuration or application, or sell all or any part of the computer code that is written in the execution of this specific project.

2. Spare Parts
   Supply spare parts equal to the greater of 25 percent or one field-replaceable system components unless noted otherwise. At a minimum, provide spares for each processor unit(s), each unique I/O module(s), radio, specialty module(s), power supplies, cables, and any other unique component installed. Provide two or 25 percent of installed quantity, whichever is greater. All spare parts shall be packaged in clearly marked factory packaging or as recommended by the manufacturer to prevent damage during long-term storage.

3. Submittal Requirements
   A controls schematic showing alarms and statuses, along with all pump controls, for the PLC/SCADA system shall be submitted to the Owner for approval. Timers and control relays shall be clearly labeled on the schematic. Once installation occurs, an as-built schematic shall be provided.

C. MATERIALS

All meters, instruments, control units, and other components shall be the most recent field-proven models marketed by their respective manufacturers at the time of the submittal of the shop drawings, unless otherwise specified, to match existing equipment.

1. Programmable Logic Controllers (PLCs)
   PLCs shall be made up of the list of components specified below and as shown on the Plans. PLCs shall be capable of receiving outside status, process indications and sending control signals to other equipment. PLCs shall be solid-state devices that have programmable memory to accomplish specific functions. PLCs shall be designed to operate in harsh industrial environments. The equipment shall be capable of operating in temperatures ranging from 0-55° C in 5-95% relative humidity without fans or cooling units. PLCs shall be Allen-Bradley Model CompactLogix Modular Controllers. No substitutions shall be allowed to maintain the Department's system compatibility.

2. PLC Components
   PLCs shall consist of the following components that are required at each individual site based on the I/O requirements:

   a. 1769- L33ER controller.

b. 1769-IA16 16-channel digital input module.
c. 1769- IF4XOF2- 4-channel, analog input/2-channel, analog output module.
d. 1769-0W16 output module
e. 1769-PA4 power supply
f. Blank slot cover plate.
g. Necessary interface cables, communications cables, power cables, and bus extension cables.
h. Transient voltage surge suppression for the PLC unit communication ports and at the terminal strip of all analog channels.

Any I/O card with more than four (4) inputs or outputs shall be furnished with removable terminal blocks to simplify card replacement.

3. Remote Radio

The system integrator shall place in satisfactory service a radio system which efficiently conveys data from each PLC though the Owner's existing master radio and to each of the Owner's existing HMI station. The communications system, including the master PLC and radio, shall be modified by the system integrator so that the Owner has a complete, satisfactory usable system that does not reduce the capacity of other RTU's or remote PLCs and radios. Acceptable radios to maintain compatibility shall be: GE MDS SD Radio - SD09-MDCESNNSNN (Transparent Mode), or MDS Orbit MCR Radio - MXNXL9CNNNNNNS1F5SUNN transmitting frequency 928.24375 MHz, and receiving frequency 952.24375 MHz. No substitutions shall be allowed to maintain the Department's system compatibility.

4. Antennae

Select antenna as required that is rated at 14dBi or greater rated for 928-952MHZ to maintain compatibility. The remote antenna shall be L-COM HG914YE yagi antenna or equal. Coax used shall be LDF5-50A 7/8" Heliax Coax Cable Manufactuered by Andrew, or equal. Antenna tower shall be provided and shall be Rohn 25G series, 40' minimum height with all sections and appurtenances required for a complete installation.

5. Lightning Surge Arrester

Coaxial type bulkhead lightning arrester with type N connection shall be fastened to the enclosure and in line with the coaxial cables between the radio and antenna. The lightning arrester shall be rated at 1 kilowatt with a minimum 500V and maximum 2000V breakdown voltage. Coaxial lightning arrester shall be PolyPhaser or equal.

6. Power Supplies

A minimum of two 24VDC power supplies shall be provided. Field Instruments shall be powered by a separate 24VDC power supply from the PLC power output. The communications transceiver shall be furnished with a separate power supply. The power supply shall be rated 4.0 amperes, 115 VAC, plus or minus 10 percent, 60 Hz input with a 24 VDC output. The power supply shall be UL/CUL and CE certified and DIN-rail mountable. Equip each power supply with a power on/off circuit breaker.

Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

7. Service

The incoming service for each panel shall be 120 volts, single-phase, 60 Hz, alternating current. A surge arrestor shall be supplied and connected to each line of the incoming side of the power-input terminals. The arrestor shall protect the control against damage from transient voltage surges caused by lightning interference, switching loads, and power line interference. A properly sized control power circuit breaker shall be provided and shall supply power to all control wiring within each control enclosure.

8. Signals

Analog measurements and control signals shall be electrical and shall vary in direct linear proportion to the variable being measured. All analog signals, whether input or output control, shall be 4-20 milliamperes direct current, unless otherwise noted or specified by the Department. The analog input signals shall maintain loop integrity with the installation of a properly sized resistor across the input terminals.

9. Enclosures

Contractor shall utilize the appropriate SCADA enclosure, as specified below and determined by the project site

conditions.

a. Housed
Enclosures that are to be housed inside a building out of the weather shall be wall mounted type and rated NEMA 3R. The enclosure shall be equal to Hoffman Catalog No. A36R3612HCR with an A36P36 painted steel interior subpanel.

b. Exposed
Enclosures that are to be housed outside in the weather shall be single-door wall mounted type and rated NEMA 4X and constructed from Type 304 stainless steel material. The enclosure shall be equal to Hoffman Catalog No. A36H3612SSLP with an A36P36 painted steel interior subpanel.

10. Current Loop Power Supply
The instrument transmitters shall be furnished with a separate power supply to provide the loop power for these 2-wire instruments. The power supplies shall be rated 2.5 amperes, 120 VAC, 60 Hz input with a 24 VDC output. The power supplies shall be UL/CUL and CE certified and as manufactured by Phoenix Contact, Inc or equivalent.

11. Power Surge Arrester
The secondary surge arrester shall be a Square “D” catalog number SDSA1175, or approved equal.

12. Terminals
Wire terminal blocks shall be installed at the bottom of the enclosure. Field wiring shall terminate at the terminal block. The terminal blocks shall be as manufactured by WAGO, Inc., or approved equal.

13. Level Transmitter
A level transmitter shall be provided with remote equipment and integrated into the SCADA system, as specified in the Sewage Pumping Facilities Section of these Specifications. A 6” color touchscreen display with Ethernet shall be provided on the SCADA RTU enclosure door to show wetwell level and setpoints, C-More model EA6 or approved equal.

D. EXECUTION

1. Installation
All of the elements, instruments, accessories, and assemblies shall be installed in accordance with the manufacturer's installation instructions and as detailed on the Plans. The Contractor shall subcontract with an authorized System Integrator approved by the Department. The Contractor shall coordinate with the Electrical Contractor and the approved System Integrator to insure that all of the items required are furnished, installed, wired, and configured as required by the Plans and the Specifications.

SWU shall perform the site study to determine the feasibility of radio transmission. The System Integrator shall provide the Contractor/Developer with quotations to provide and install the control panel, Microwave Data radio, yagi antenna, radio coax, UPS, Rohn 25G tower, tower components, all other necessary components, and startup services. The System Integrator shall purchase end connections from others and install said connections. Base section shall be installed by the Contrator/Developer in a concrete footing of sufficient depth and width to support the required tower sections. Provisions shall be included for electrical grounding.

Shielded instrumentation cables shall be used for all low-level signals from the instruments to the PLC panels. Separate conduits shall be used for instrument power and instrument signal lines. The Contractor shall furnish and install the necessary enclosures, racks, power supplies, surge arrestors, communications modules, and I/O modules to the PLC unit. The Contractor shall install the necessary relays and wiring to connect the digital outputs from the PLC unit to the motor controls. The Contractor shall make the necessary power connections and signal connections with shielded instrumentation cable from the field devices (i.e., level transmitters, motor control, etc.) to the PLC unit.

The Contractor shall be required to perform the following items of work in building, developing, installing, and starting up the lift station SCADA system:

a. Assemble all hardware (i.e., PLC unit and communication components).

b. Integrate the software and develop the graphical user interface screens, database logging and reporting functions, PLC unit programming, control functions, etc.

c. Make interconnections to a network of all hardware components together at the factory test site to replicate the hardware architecture shown on the Plans as near as possible. Perform all necessary initial testing on the completed system.

d. After the Department is satisfied that the system is working as intended, the Contractor shall then be authorized to ship and install the system. The Contractor shall be available to answer any questions that the Electrical Subcontractor may have in the course of the installation.

e. After the installation of the system is complete, the Contractor shall check all field-wiring for proper placement into the system and startup the system at the facility. During the system checkout and startup, Department personnel shall be allowed to observe all of the procedures being performed on the system.

2. Panel Layout

Develop drawings or sketches and coordinate size and configuration of enclosure(s) with the Engineer for approval.

Panels shall be sized, configured, and install to minimize exposure to arc flash and given proper operations space to allow for a safe distance from arc flash hazards, and as required by NEC. Approval from the Owner or Engineer does not negate this requirement.

Spacing and configuration shall be as required by the manufacturer to insure adequate cooling. The system integrator shall provide the Engineer with calculations to assure adequate cooling. The enclosure must be designed and operated so that all equipment remain within the required temperature and humidity range.

Each power supply, input module, output module, and other modules with separately derived power requirements, shall have separate independent circuit breakers. There shall also be a circuit breaker between the UPS and the power for the panel, as well as for the PLC itself.

All 4-20mA signals shall be in shielded cables, ran away from transformers and 480VAC power and ran in separate conduits. Each 4-20mA signal shall be properly conditioned if necessary, and protected from surges by the use of a 24VAC/4-20mA data surge protection device, and protected from any possible interference

Incoming power for the radio and control system (telemetry system) shall have a UPS sized for a minimum of 15 minutes of PLC and radio usage.

Provide all necessary cables, cords, and connective devices for interface with other system components.

3. Alarms/Statuses For SCADA System

The following run statuses or alarms shall be incorporated as part of the complete controls system. It is the system integrator's responsibility to ensure all of these are included in a schematic to be submitted to the Owner and all parts, materials, and labor shall be done as necessary to provide these run statuses and alarms to the existing Owner's existing SCADA system. The Owner shall be consulted with for any additional alarms. Additional components and instrumentation for the generator, automatic transfer switch, pump controls, and all other alarms or statuses indicated below shall be provided as needed for these statuses/alarms. At a minimum, the following alarms/statuses shall be provided and programmed for the Owner's SCADA system for all lift stations:

a. Pumps:
    i. Pump 1 Run
    ii. Pump 1 Drive Fail or Pump Fail
    iii. Pump 1 High Temperature
    iv. Pump 1 Seal Fail
    v. Pump 1 Run Hours
    vi. Pump 2 Run
    vii. Pump 2 Drive Fail or Pump Fail
    viii. Pump 2 High Temperature
    ix. Pump 2 Seal Fail

x. Pump 2 Run Hours

b. Check Valves:
   i. Pump 1 Check Valve Fail
   ii. Pump 2 Check Valve Fail

c. Generator:
   i. EPS supplying load (generator run)
   ii. Low battery voltage
   iii. Low coolant temperature warning
   iv. General Alarm

d. Automatic Transfer Switch:
   i. Normal Power
   ii. General Automatic Transfer Switch Failure

e. Power Systems:
   i. Phase-loss
   ii. Control Voltage Failure

f. Level:
   i. High Level Float
   ii. Low Level Float
   iii. Level Alarm (From non-contact level transmitter)

g. PLC:
   i. Battery Low
   ii. Communication/Heartbeat Failure

h. Facility:
   i. Intrusion Alarm

4. HMI Screens

The Contractor shall consult with the Department and the Engineer before creating and configuring the HMI screens for the lift station control application.

5. O&M Manuals

The Contractor shall furnish the Department with O&M manuals for all of the components included in the lift station SCADA control system, as specified in the Operations and Maintenance Manuals Section in the General Requirements Chapter of these Specifications.

6. Final Documentation

At the conclusion of the project and after all necessary changes have been completed to the system configuration, the Contractor shall fully document all of the PLC I/O lists using the HMI documentation program. The Contractor shall print copies of all commented control ladder diagrams as completed. The Contractor shall also print copies of all of the HMI display screens with the configuration of each display screen documented.

The Department shall be furnished with two (2) copies of the above listed documentation. The copies shall be bound in D-ring binders to facilitate updating the system documentation. Any necessary "AutoCAD" drawings required for documenting the SCADA control system shall be no larger than ledger size (11"x17") so the drawings can be easily folded into the D-ring binders. The Contractor shall use the following list of software to document the SCADA control system.

a. All documentation drawings shall be furnished in "AutoCAD", "DWG" format.

b. All documentation text files shall be created and maintained in "Microsoft Word" format.

At the completion of the project, the Contractor shall also furnish copies of all applications and the documentation specified above on CD-ROM to the Department.

7. Technical Support

The Contractor shall include professional technical support for this system and for all of the hardware and software that is provided with the system. The technical support shall be provided for a period of twelve (12) months. The period shall commence at the date of final acceptance.

Technical support shall include the following at a minimum:

a. Voice telephone and/or remote computer access support for the supplied software applications.

b. Two (2) eight-hour days, during the twelve (12) months immediately following the project final acceptance, of on-site technical support to aid the Department in implementing new items into the system, including field point definitions, graphic displays, and PLC unit programming. This on-site support shall be provided at the discretion ofthe Department, but will be limited to the time frame specified herein. Travel time for the Contractor shall not be counted as part of the professional support days. All travel expenses shall be provided by the Contractor for the one (1) trip to the site.

8. Training

After the SCADA control system has been installed and accepted by the Department and the Engineer, the Contractor shall provide training sessions with the Department's personnel at the facility. The training sessions shall be of sufficient length to give the operations personnel a general understanding of the SCADA control system use, function, configuration, operation, and maintenance.

The training sessions shall be coordinated with the Department. The Department may at their discretion videotape any or all of the training sessions for future in-house use.

At the discretion of the Department, the Contractor shall provide training described as follows:

b. Eight (8) hours for conducting a system introduction and orientation.

c. Eight (8) hours of operator training describing and working closely with small groups of people at a time showing the proper operation of the system screens and functions.

d. Eight (8) hours of configuration training shall be provided with the instruction of one or two Department personnel showing the proper methods of designing screens and adding functions to both the process controllers and the operator workstation.

END OF SECTION

SECTION T23

DUCTILE IRON PIPE AND FITTINGS FOR GRAVITY SEWER LINES AND FORCE MAINS

A. DESCRIPTION

This Section sets forth acceptable materials and procedures for the installation of ductile iron pipe (DIP) and ductile iron (DI) fittings for gravity sewer lines and force mains.

B. MATERIALS

Only pipe materials listed below and in the PVC Pipe for Gravity Sewer Lines Section and PE Pipe for Force Mains Section of these Specifications shall be used for gravity sewer lines and force mains, respectively, unless specifically authorized by the Department Engineer. All pipe installed shall be of the type, size, class, and thickness indicated in these Specifications and on the Plans.

Sewers at a depth of 14 feet or greater, measured from flowline to finished grade, shall be DIP. Ductile iron sewer pipe shall be used on all sewer lines where the grade is 15% or greater. All DI pipe, fittings, and appurtenances shall have a protective interior coating suitable for sanitary sewage as specified herein.

1. Ductile Iron Pipe (Force Main)
   All sanitary sewage force mains shall be of equal design, material, and construction as potable water pipe, as set forth in the Ductile Iron Pipe and Fittings for Water Lines Section of these Specifications, with the exception that the interior coating of sewer force mains shall be as specified in the Interior Coating paragraph set forth in this Section.

2. Ductile Iron Pipe (Gravity Sewer)
   All pipe and pipe fittings furnished for underground sewer piping shall have either push-on or mechanical type joints. Flanged DIP and DI fittings shall be used only as indicated on the Plans. Flanged pipe and pipe fittings shall conform to ANSI/AWWA C115/21.15, Class 250 psi. Flanged drilling shall conform to ANSI B16.1, Class 125 flange.

   All DIP, 8 inch through 36 inch, shall conform to the requirements of ANSI/AWWA C150/A21.50 (Thickness Design of Ductile-Iron Pipe) and ASTM A746 (Ductile Iron Gravity Sewer Pipe) or ANSI/AWWA C151/A21.51 (Ductile Iron, Centrifugally-Cast for Water). The minimum acceptable size of all gravity sewer mains shall be eight (8) inches. DIP and DI fittings shall be designed by the pipe manufacturer based on laying condition Type 5, with an additional four (4) inches initial backfill above the top of the pipe, as described in ANSI/AWWA C150/A21.50, and the depth of bury as shown on the Plans, plus a single AASHTO H20 truck load. Pipe shall be designed for a thickness class of no less than Special Class 50. The pipe manufacturer shall check for depth of bury and furnish pipe of a heavier class if needed, in accordance with ANSI/AWWA C150/A21.50.

   a. Service Lines
      Service lines shall be defined as that portion of the sanitary drainage system which extends from the City sewer main to the right-of-way or the property line, or wherever City maintenance terminates. All service lines shall meet with the material and performance requirements for pipe, fittings, and joints set forth in this Section.

The minimum size of any service line shall be four (4) inch nominal diameter. Sizes of service lines for multi-family or commercial applications shall be at a minimum, as required by the Arkansas State Plumbing Code, unless otherwise directed by SWU. Service lines may be constructed of PVC with an SDR of 26 or DIP Special Class 50, as set forth herein.

b. Steep Grades
Sewers or force mains on 20% slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:

1.) grades 20% – 35%, maximum center-to-center spacing of 36 feet
2.) grades 35% – 50%, maximum center-to-center spacing of 24 feet
3.) 50% and greater, maximum center-to-center spacing of 16 feet

3. Accessory Items for Sewer Lines
Items used in connection with the construction of sewer lines shall conform to the following:

a. Ductile Iron Pipe Fittings
All DIP fittings shall be compact fittings unless otherwise specified. All fittings shall be furnished with gaskets. MJ fittings shall also be furnished with bolts, nuts, and iron glands. All plugs, caps, tees, and bends deflecting 22-1/2˚ or more shall be provided with reaction backing. In addition to reaction backing, restrained joint pipe may also be required as set forth in these Specifications.

All casting and mating surfaces shall be smooth and of a workmanlike quality, free from cracks, holes, scale, shrinkage, distortion, grooves, scratches, and other defects. Fittings and other castings may be rejected if found to be unacceptable by the Department in accordance with these Specifications.

A wye shall be installed for each anticipated future connection of sewer service.

a. Ductile Iron Pipe Compact Fittings (3-48”)
All DI compact fittings and associated bolts shall conform to the requirements of ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings for Water Service). All compact fittings 3-24 inches in diameter shall have a minimum pressure rating of 350 psi, and fittings 30-48 inches in diameter shall have a minimum pressure rating of 250 psi, unless otherwise specified.

b. Ductile Iron Pipe Fittings, (3-48”)
All DI fittings and associated bolts shall conform to the requirements of ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids). All fittings 3-24 inches in diameter shall have a minimum pressure rating of 350 psi, and fittings 30-48 inches in diameter shall have a minimum pressure rating of 250 psi, unless otherwise specified.

Special fittings shall be in accordance with the pipe manufacturer’s recommendations and as approved by SWU. All fittings and appurtenances placed on sanitary sewer lines shall meet with the requirements of the type of pipe used and shall be installed in accordance with the manufacturer's recommendations and as approved by the Department. Connections between different kinds of pipe shall be detailed on the Plans and provide self-cleansing sanitary flow and watertight joints and connections.

b. Pipe Bosses
Pipe bosses shall be provided as shown on the Plans and as explicitly approved by the Department. If the working pressure shown is 200 psi or less, bosses shall be foundry fabricated and faced and tapped with ANSI/AWWA C110 flange connections. If the

working pressure shown is greater than 200 psi, bosses shall be foundry fabricated and faced and tapped with ANSI B16.1, Class 250 flange connections.

c. Ductile Iron Pipe Joints

Joints shall be mechanical joints (MJ) or push-on type joints which conform to ANSI/AWWA C111/A21.11 (Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings), unless otherwise specified. Joints shall have the same pressure rating of the pipe or fittings of which they are a part. All pipe joints other than those specified herein shall be made in strict accordance with the manufacturer's recommendations and as approved. All joints shall be made watertight in accordance with the latest applicable AWWA and ASTM standards.

d. Restrained Joints

1.) Mechanical Joint

Restrained joints of the MJ type incorporated into the design of the follower gland shall consist of individually actuated wedges that increase resistance to pull-out as pressure or external forces increase. The device shall be capable of full MJ deflection during assembly, and the flexibility of the joint shall be maintained after burial. The joint restraint ring and wedging components shall conform to ASTM A536 (Ductile Iron Castings). The ductile iron gripping wedges shall be heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be compatible with the standardized MJ bell conforming to ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings) and ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings for Water Service) or ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids) as applicable. Torque limiting twist-off nuts shall be used to ensure proper actuation of the restraining wedges. Gaskets without torque limiting twist-off nuts shall require 90 ft-lb of bolt torque through the 8 inch size and 120 ft-lb through the 24 inch size.

The MJ restraint shall be available in the 3-48 inch sizes, with a rated working pressure of 350 psi for sizes 16 inch and smaller, and 250 psi for sizes 18-48 inch. The restraint devices shall be UL listed through the 24 inch size and approved by FM through the 12 inch size. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 DI or better. For applications requiring restraint of pipe 30 inches and greater, an alternate grade of iron meeting the material requirements of ASTM A536 shall be acceptable, providing the device shall meet all end product performance requirements. The restraint shall be the Megalug Series 1100 as produced by EBAA Iron, Inc., MJ Field-Lok Gaskets Series DI as produced by U.S. Pipe, or approved equal.

2.) Push-On Joint

a. Integrated into Pipe

Restrained joints of the push-on joint type incorporated into the design of the pipe shall provide a locking interface between the bell interior surface and a retainer weldment on the spigot end of the pipe. Restrained joint pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.5 (Ductile Iron Pipe, Centrifugally Cast, for Water and Other Liquids) and ANSI/AWWA C111/A21.11. The device shall be capable of full push-on joint deflection during assembly, and the flexibility of the joint shall be maintained after burial. When restrained joints require factory welded, all welding procedures and welders used to produce the product shall be qualified per the requirements of a documented quality assurance system based on ANSI/AWS D11.2.

Dimensions of the gland shall be compatible with the standardized push-on joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 as applicable.

The push-on restraint shall be available in the 4-64 inch sizes, with a rated working pressure of 350 psi for sizes 24 inch and smaller, and 250 psi for sizes 30-48 inch. The restraint devices shall be UL and FM listed through the 12 inch size. The restraint shall be the TR Flex as produced by U.S. Pipe, Flex-Ring as produced by American Ductile Iron Pipe, Co., or approved equal.

b. Gripper Gasket

Restrained joints of the push-on joint type incorporated by the insertion of a gripper gasket into the pipe bell shall provide a locking interface between the bell interior surface and the spigot end of the pipe. Stainless steel locking segments shall be vulcanized into the gasket. Restrained joint pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.5 and ANSI/AWWA C111/A21.11. The device shall be capable of full push-on joint deflection during assembly, and the flexibility of the joint shall be maintained after burial. Restrained joint pipe with gripper gaskets shall be used only on straight laid pipe within casings or as approved in special locations by the Department Engineer.

Dimensions of the gland shall be compatible with the standardized push-on joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 as applicable.

The push-on restraint shall be available in the 4-36 inch sizes, with a rated working pressure of 350 psi for sizes 24 inch and smaller, and 250 psi for sizes 30-36 inch. The restraint devices shall be UL and FM listed. Restraint shall be the Field-Lok Gasket to be used with Tyton pipe as produced by U.S. Pipe, or approved equal.

Field-Lok Gaskets shall not be used in aboveground applications. Long-term cyclic movements can produce gradual joint separation to the point that the seal on the gasket bulb is compromised. In vertical applications, provisions must be made to keep the joint extended and not allow the teeth to become disengaged from the pipe.

4. Interior Coating

All DIP, fittings, valves, service wyes, and other appurtenances for gravity sewer or force mains shall receive the following interior lining treatment:

a. Epoxy Lining

All DIP and DI fittings shall be lined with a high-build, multi-component amine-cured novalac epoxy lining, containing at least 20% ceramic quartz pigment, by volume. The lining system shall be Protecto 401 Ceramic Epoxy as manufactured by Vulcan Painters, Inc. The lining Applicator shall have a successful history of applying linings to the interior of DIP.

b. Condition of Ductile Iron Prior to Surface Preparation

All DIP and DI fittings shall have a high-build protective lining on the interior. All DIP and DI fittings shall be delivered to the application facility without any lining on the interior surface. As removal of old linings may not be possible, the intent of this Specification is that the entire interior of DIP and DI fittings shall not have been lined with any substance prior to the application of the lining specified herein.

c. Surface Preparation

Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, and other substances. Any areas where oil, grease, or another substance is detected and can be removed by solvent shall be solvent-cleaned using the guidelines outlined in SSPC-SP-1 (Solvent Cleaning). After the surface has been made free of grease, oil, and other substances, all areas to receive the protective compounds shall be abrasive blasted with sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, and other sources of roughness shall be removed from the surface. If rust reappears before coating, the affected areas must be reblasted.

d. Lining

Within eight (8) hours after surface preparation, the interior of the pipe shall receive approximately 40 mils dry film thickness of the protective lining. Lining shall not occur if the substrate or ambient temperature is below 40º F. The surface shall be dry and dust-free before lining. The linings shall not be used on the face of any flanged pipe or fitting, unless otherwise specified. All fittings shall be lined with approximately 40 mils of the protective lining. The 40 mils system shall not be applied in the gasket grooves.

e. Coating of Gasket and Spigot Ends

Due to the tolerances involved, the gasket area and exterior spigot end, up to six (6) inches back from the end of the spigot end, must be coated with 6 mils nominal, 10 mils maximum Protecto Joint Compound, or approved equal. This coating shall be applied by brush to ensure coverage. Care shall be taken so the coating is smooth, without excess buildup in the gasket groove or on the spigot end. All materials for the gasket groove and spigot end shall be applied after the application of the lining.

f. Number of Coats

The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The time between coats shall never exceed that time recommended by the lining material manufacturer. No material shall be used for lining which is not indefinitely recoatable without roughening of the surface.

g. Touchup and Repair

Protecto Joint Compound, or approved equal, shall be used for touchup or repair. Procedures for touchup and repair shall be in accordance with manufacturer's recommendations.

h. Inspection and Certification

1.) Inspection

All DIP and DI fitting linings shall be checked for thickness using a magnetic film thickness gage. The thickness testing shall be as set forth in SSPC-PA-2 (Measurement of Dry Coating Thickness With Magnetic Gages).

The interior lining of all pipe and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defects shall be repaired prior to shipment.

Each pipe joint and fitting shall be marked with the date of application of the lining system and the numerical sequence of application on that date.

2.) Certification

The pipe or fitting manufacturer shall supply a certificate attesting that the Applicator met the requirements of this Specification, the material used was as specified, and the material was applied as required.

5. Exterior Coating
   All DIP and DI fittings shall have an exterior coating as set forth below.

   a. Factory Primed Pipe
      Unless otherwise shown on the Plans, all exposed pipe and fittings within the limits of structure walls or exposed pipe and fittings located aboveground shall be delivered to the job site factory-blasted, cleaned, and primed with one (1) coat of Tnemec Series N140 Pota-Pox Plus, or approved equal compatible paint system.

   b. Bituminous Coating
      All pipe and fittings indicated for buried service shall have a petroleum asphaltic coating approximately one (1) mil thick factory-applied to the outside of all pipe and fittings. The finished coating shall be continuous, smooth, neither brittle when exposed to the cold nor sticky when exposed to the sun, and shall be strongly adherent to the pipe or fitting. The bituminous coating shall not be applied to the first six (6) inches of the exterior of the spigot ends.

6. Polyethylene Encasement
   Polyethylene encasement shall be as specified in the Polyethylene Encasement Section of these Specifications.

7. Ductile Iron Pipe Joint Lubricant
   Joint lubricant shall be provided by the pipe manufacturer and applied as per the manufacturer's recommendations in accordance with ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings). Lubricant shall be non-toxic, not support the growth of bacteria, have no deteriorating effects on the gasket or pipe material, and not impact taste or odor to the water. Lubricant containers shall be appropriately identified and labeled with the manufacturer's name. Each lubricant container shall have printed instructions for usage and joint assembly.

8. Embedment Material
   Pipe embedment material is defined as that material placed beneath and around the pipe up to the required depth specified herein. All embedment material shall be free from cinders, ashes, refuse, vegetable or other organic material, boulders and other large rock, frozen soil, or other inorganics and materials that in the opinion of the Engineer or SWU is unsuitable.

   Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Coarse Aggregate Standard Size No. 67 as specified by ASTM D448 (Sizes of Aggregate for Road and Bridge Construction).

9. Initial Backfill
   Initial backfill shall be the same as the embedment material set forth in this Section.

10. Pipe Protection Cover
    Pipe protection cover shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

11. Final Backfill
    Final backfill shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

12. Concrete
    Concrete used for reaction backing, pipe cover, and pipe encasement shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications.

13. Tracer Wire and Ports
    Tracer wire and ports shall be used on all ductile iron force main piping and shall be 14 gauge coated copper for underground burial. Tracer wire and ports shall be installed as set forth herein and as shown in Standard Details M-1, “Tracing Wire Connection Port” and S-18, “D.I. Pressure Pipe Trench for Force Mains”.

14. Affidavits of Compliance and Independent Laboratory Inspection
    All pipe and fittings shall be inspected and tested by the manufacturer. The manufacturer shall furnish to the Department Engineer, prior to delivery, certificates stating that all pipe and fittings shall be manufactured in compliance with these Specifications and other applicable standards. The manufacturer’s certificate shall also fully describe the pipes and fittings proposed to be furnished.

C. EXECUTION

1. Handling and Storage
   Handling and storage shall be as specified in the Storage and Handling of Materials Section in the General Requirements Chapter of these Specifications.

2. Construction Sequence
   Unless otherwise directed by the Department, the construction of sanitary sewers shall begin at the low point of the line and continue in orderly succession throughout the work, with the bell ends facing upstream. Any deviation from this procedure shall be made only with the approval of the Department Engineer.

3. Alignment and Grade
   The sewer line or force main shall be laid and maintained to the required lines and grades with fittings, valves, and other appurtenances at the required locations; spigots shall be centered in bells; and all valves shall be plumb.

4. Temporary Plugs or Caps
   All dirt, debris, and other foreign matter shall be removed from the inside of all pipe and fittings before being lowered into the trench. Pipes and fittings shall be kept clean during and after placement, and care shall be taken to keep dirt out of the jointing space. At the end of each day’s work and also if pipe installation is discontinued for an appreciable period, the open ends of the pipe shall be closed with a watertight cap firmly secured in place. The use of plywood forms or similar means of closure shall not be acceptable. Plugs shall be of the mechanical friction type. Pressurized air plugs shall not be permitted.

5. Requirements Preparatory to Trench Excavation
   In all areas where sewer lines, valves, or other appurtenances shall be constructed, the existing surface shall be removed prior to excavating the trench as set forth in the Surface Removal Section of these Specifications.

6. Dewatering
   Under no conditions shall pipe be laid in a trench that has not been properly dewatered. Dewatering and stabilization shall be as specified in the Site Preparation, Excavation, and Fill Section of these Specifications.

7. Excavation Support and Protection
   Excavation support requirements shall be as specified in the Excavation Support and Protection article under the Excavation paragraph in the Site Preparation, Excavation, and Fill Section of these Specifications.

8. Trench Excavation

The trench shall be excavated to the alignment, depth, and width required and only so far in advance of the pipe laying as set forth in the paragraph on Trench Length in this Section. The bottom of the trench shall be excavated to provide a uniform and continuous bearing and support for the pipe on solid, undisturbed ground between bell holes. The bell shall not support the weight of the pipe or soil.

The Contractor shall proceed with caution in the trench preparation and excavation so the exact location of underground structures and conflicts, known and unknown, may be accurately determined. The Contractor shall be held responsible for the repair of such facilities when broken or otherwise damaged from carelessness. Excavation shall be as set forth in the Excavation paragraph of the Site Preparation, Excavation, and Fill Section of these Specifications and also as set forth herein.

Excavation work shall include the necessary removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; placement of all necessary sheeting, shoring, and trench protection; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; construction of fills and embankments; and other pertinent activities.

Excavation should be performed in accordance and compliance with all applicable local, state, and federal safety regulations, including but not limited to 29 CFR 17, Part 1926, Subpart P – OSHA - Excavations.

a. Trench Depth

The trench shall be excavated to at least four (4) inches below the grade required to provide proper pipe embedment and a minimum earth cover of 24 inches.

However, ledge rock, boulders, large stones, and gravel formations with loose cobbles greater than eight (8) inches in diameter shall be removed to provide a clearance of at least six (6) inches below and on all sides of all pipe, valves, and fittings for pipes 24 inches in diameter or less, and a clearance of at least nine (9) inches for pipes larger than 24 inches in diameter. A layer of embedment material shall then be placed on the bottom of the trench, tamped, and leveled to the appropriate depth.

Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workers. All pipe bedding material shall be shaped and graded to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel. Bell holes shall be excavated to accommodate the pipe bells so that the bells do not support the weight of the pipe.

b. Trench Width

The trench width shall be ample enough to permit proper installation and jointing of the pipe, backfill, and compaction. Trench widths set forth in ANSI/AWWA C600 and as shown on the Standard Detail Sheet shall serve as a general guide. Larger trench widths may be necessary for the placement of a trench support system or as otherwise required.

c. Trench Length

The Department shall have the right to limit the amount of trench excavated in advance of laying the pipe. In general, such excavation shall not exceed 300 feet, and the length of trench excavated to grade shall not exceed 100 feet or that length of installation which may reasonably be completed during a workday.

Trenches located in rock shall be fully opened at least 50 feet in advance of the place where pipe is being installed or concrete or masonry work is in progress.

d. Over-Excavation

All over-excavation less than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with adequate pipe bedding material or compacted Class 7 aggregate base course. The additional material required shall be placed in three (3) inch lifts and thoroughly compacted. This procedure shall be repeated until the established grade has been reached. All pipe bedding shall be compacted so as to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel.

All over-excavation greater than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with compacted Class 7 aggregate base course as described in the Undercutting paragraph in this Section.

If over-excavation of the trench width occurs, additional pipe bedding gravel or concrete shall be provided as necessary to prevent crushing of the pipe due to excessive earth loads. Additional pipe embedment material shall be provided to completely fill the over-excavated width beyond the specified width of the trench.

9. Undercutting

Where the soil at the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic materials, unstable Class IV or V soil, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, and/or large fragments of inorganic material which in the judgment of SWU should be removed, the Contractor shall excavate and remove the unsuitable material to the width and depth required by the Department. Before the pipe is placed, the subgrade shall be backfilled with Class 7 aggregate base course in 6-8 inch uncompacted layers. The layers shall be machine tamped, as required by the Department, to 95% Modified Proctor, to provide a uniform and continuous bearing and support for the pipe at all points along the pipe length.

10. Installing Ductile Iron Pipe

Ductile iron pipe and fittings shall be installed in conformance with the recommendations of the applicable section of ANSI/AWWA C600 (Installation of Ductile-Iron Water Mains and Their Appurtenances), ASTM A746 (Ductile Iron Gravity Sewer Pipe), and with the Specifications set forth herein.

Subject to the approval of the Department, other fittings may be added to or substituted for those shown on the Plans, should the need arise during construction. This shall in no way relieve the Contractor of the responsibility for furnishing and installing all fittings required for a complete and proper installation of pipeline as detailed on the Plans.

Pipes, fittings, and other appurtenances shall be inspected carefully before being placed in the trench. Any pipe, joint, fitting or other appurtenance found to be cracked or otherwise damaged to the point of impaired usefulness shall be plainly marked so the marking shall not rub or wash off. Damaged materials shall be removed from the site as soon as feasible. All pipe, fittings, and other appurtenances shall be lowered carefully into the trench in such a manner to prevent damage to or contamination of the pipe, fittings, and linings. Pipe, fittings, and other appurtenances shall not be dropped or dumped into the trench.

If needed, the pipe shall be cut in a neat, safe, and professional manner, without causing damage to the pipe or pipe lining. Cut ends and rough edges shall be ground smooth and recoated as required.

Whenever necessary to deflect pipe from true alignment, in either the vertical or horizontal plane, the degree of deflection at any joint shall be not greater than that which will provide adequate gasket space entirely around the spigot end of pipe. The joint opening shall be approximately 1/8 inch. Joint deflections for force mains shall not exceed the maximum recommended by the pipe

manufacturer or as set forth in ANSI/AWWA C600, whichever is less. Deflection of pipe joints in gravity sewer pipe shall not be allowed.

As the Work progresses, pipe shall be cleaned of all foreign material and maintained clean until accepted or put into service.

If required by the Department, the pipe manufacturer shall provide a qualified installation representative at the start of construction to demonstrate proper installation techniques for each size and type of pipe to be installed.

Joints shall be installed as set forth in ANSI/AWWA C600 and as follows:

a. Slip-Type or Push-On Joints
Prior to jointing, the bell and spigot end of the pipe shall be cleaned thoroughly to remove all foreign matter, using a wire brush as necessary. Particular care shall be exercised in cleaning the gasket seat. The spigot and bell shall be checked for cleanliness immediately before insertion of the spigot into the bell.

Joints shall be made in strict accordance with the recommendations of the pipe manufacturer. The rubber gasket shall be cleaned and inserted in the gasket seat within the bell. Lubricant shall be applied in accordance with the manufacturer's recommendations. The spigot end of the pipe shall be inserted in the bell of the pipe to which connection is being made and forced to a firm contact with the bell shoulder. After initial insertion is made, the pipe may then be deflected.

b. Mechanical Joints
The bell and spigot end of the pipe and the rubber gasket shall be cleaned and lubricated as specified in the paragraph above. The gland shall also be cleaned in a similar manner.

After the gland and gasket are placed a sufficient distance from the spigot end to avoid fouling the bell, the spigot end shall be inserted into the fitting bell and forced to firm contact with the bell shoulder. The rubber gasket then shall be advanced into the bell and seated in the gasket seat. Care shall be exercised to center the spigot end within the bell of the preceding pipe and properly seated. .

The gland shall be brought into contact with the gasket, bolts shall be installed, and nuts shall be hand-tightened. Deflection shall be made after joint assembly but before tightening the bolts. The joint shall be made tight by turning the nuts with a wrench by partially tightening a nut and then partially tightening the opposite nut, continuing in this manner around the pipe with uniformly applied tension until the required torque is applied to all nuts. The torque loads may be applied with a torque-measuring or torque-indicating wrench, which may also be used to check the human application of approximate torque loads. Required torque ranges and indicated wrench lengths for standard bolts shall be those set forth in ANSI/AWWA C600.

Pipe Size *(inches)*	Bolt Size *(inches)*	Range of Torque *(ft-lbs)*	Length of Wrench *(inches)*
3	5/8	45 - 60	8
4 - 24	3/4	75 - 90	10
30 - 36	1	100 - 120	14
42 - 48	1-1/4	120 - 150	16

11. Embedment and Backfill
After the trench has been excavated as set forth herein, the ductile iron gravity sewer pipe shall be placed in general accordance with the Type 5 Standard Laying Condition, as set forth in ASTM

A746 (Ductile Iron Gravity Sewer Pipe), unless structural or foundation requirements indicate that more stringent bedding conditions shall be necessary. Embedment material shall be placed from a point at least four (4) inches below the bottom of the pipe to four (4) inches above the top of the pipe, by the full width of the excavated ditch. The intent shall be to cradle the pipe so the full length of each joint is uniformly supported on firm bedding with the weight of the pipe and fill borne uniformly by the pipe barrel. Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Coarse Aggregate Standard Size No. 67 as set forth in ASTM D448 (Sizes of Aggregate for Road and Bridge Construction).

After the embedment material has been placed to the required depth and compaction, 12 inches of pipe protection cover, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, shall be hand-placed and hand-tamped for a total depth of 16 inches of cover above the pipe. If the material excavated from the trench is completely free of rock larger than 1-1/2 inch, the trench may be machine-backfilled. After placement of the pipe protection cover, the excavation shall be backfilled to grade with final backfill material free from rocks larger than eight (8) inches.

Embedment and backfill of all sanitary sewage force mains shall be as set forth in the Ductile Iron Pipe and Fittings for Water Lines Section of these Specifications.

12. Compaction

After the minimum required pipe protection cover is placed over the top of the pipe, all subsequent final backfill material shall be placed in eight (8) inch lifts and compacted using a mechanical, hydraulically-powered, vibratory trench compactor or other equivalent equipment. Heavy compaction equipment shall not be used within 36 inches of the top of the pipe.

All trench backfill not located under paved areas or other special areas as noted on the Plans shall be compacted to a minimum of 90% of the adjacent undisturbed soil as determined in accordance with ASTM D2922 (Standard Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)).

If trenches are under existing or proposed pavement, driveways, parking areas, sidewalks, or public streets of the City of Springdale, the entire trench shall be backfilled up to the subgrade with Class 7 aggregate base course in eight (8) inch lifts and compacted by approved mechanical methods to 95% Modified Proctor Density as determined by AASHTO T180, unless otherwise directed by the Department or required by other governing authorities.

Field density shall be determined as set forth in the Density Testing Section of these Specifications. All backfill not meeting the compaction requirements set forth herein shall be replaced and/or recompacted until the compaction requirements are met.

13. Disposal of Excavated Material

Excavated material shall be piled adjacent to the Work to be used for backfilling, if suitable. All unsuitable excavated material and any excess material shall be disposed of in a manner in accordance with applicable local, state, and federal regulations and as approved by the Department Engineer. Excess material shall not impede construction, endanger workers, nor obstruct sidewalks, roads, and other structures.

14. Connection to Existing Lines

Unless otherwise approved by the Department, no connection to existing sewer lines shall be made until the newly constructed facilities meet with all required construction standards, pass all required tests, and are approved by the Department for connection.

15. Concrete Reaction Backing for Force Mains

All fittings shall have concrete reaction backing even if restrained joints are shown on the Plans. Reaction backing shall be placed between undisturbed earth and the fitting to be anchored. The area of bearing on the pipe shall be taken as that shown on the Detail Sheet of the Plans or as

directed by the Department Engineer. The backing shall, unless otherwise indicated, be placed so the pipe and fitting joints shall be accessible for repair. All DI fittings and appurtenances shall be wrapped in accordance with the Polyethylene Encasement Section of these Specifications prior to the placement of reaction backing.

16. Concrete Encasement
    If shown on the Plans or otherwise directed by the Department Engineer, the pipe shall be encased in concrete to the dimensions indicated. Where additional concrete encasement is required by the Department Engineer, the additional material shall be provided and installed by the Contractor. All pipes to be encased shall be suitably supported, blocked in proper position, and anchored against flotation.

17. Replacement and Repair of Driving Surfaces
    Replacement and repair of driving surfaces shall be made in accordance with the Pavement Repair Section of these Specifications.

18. Explosives
    The utilization of explosives for excavation shall be as specified in the Use of Explosives Section in the General Requirements Chapter of these Specifications.

19. Cleanup
    Cleanup shall be as specified in the Cleanup, Seeding, and Sod Section of these Specifications.

D. TESTING

The interior of all lines shall be free of mud, muck, dirt, gravel, and debris prior to testing and acceptance. The Department reserves the right to visually inspect all pipeline construction by means of televised camera equipment prior to acceptance. The Contractor shall be required, at own expense, to clean or repair any defects found through inspection.

Ductile iron gravity sewer pipes shall be tested in accordance with the Low Pressure Air Testing of Gravity Sewer Lines Section of these Specifications. Ductile iron force mains shall be tested in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

If pipe repair is necessary due to leakage or test failures, replacement of pipe utilizing solid sleeves shall be required. The use of bell clamps or other bell repair devices shall be strictly prohibited. Complete replacement of the line will be required of any section 400 feet in length or greater which has three (3) or more point failures.

END OF SECTION

SECTION T24

HIGH DENSITY POLYETHYLENE (HDPE) PIPE FOR FORCE MAINS

A. DESCRIPTION

This Section sets forth acceptable materials and procedures for the installation of HDPE pipe for force mains.

B. MATERIALS

Only pipe materials listed herein and in the Ductile Iron Pipe and Fittings for Gravity Sewer Lines and Force Mains Section of these Specifications shall be used for force mains unless specifically authorized by the Department Engineer. All pipe installed shall be of the type, size, class, and thickness indicated in these Specifications and on the Plans.

Sewers at a depth of 14 feet or greater, measured from flowline to finished grade, shall be DIP. DIP shall also be used for all sewer or force main pipe where the grade is 15% or greater. All DI pipe, fittings, and appurtenances shall have a protective interior coating suitable for sanitary sewage as specified in the Ductile Iron Pipe and Fittings for Gravity Sewer Lines and Force Mains Section of these Specifications.

1. Polyethylene (PE) Pipe (Force Main)
   All PE shall conform to the requirements of ANSI/AWWA C906 (Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 63 in., for Water Distribution and Transmission), as applicable. PE pipe shall be DR 9 or 11, as required by the design characteristics of the project and as prior approved by he Department.

   PE pipe shall be rated for a minimum working pressure of 200 psi and a minimum hydrostatic design basis of 1,600 psi with water at 73°F as set forth by ASTM D2837 (Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products). The manufacturer shall certify the materials used to manufacture PE pipe and fittings shall meet these requirements.

   Polyethylene shall be manufactured from extra-high molecular weight (EHMW), high density polyethylene (HDPE) conforming to the dimensional and performance characteristics set forth in ASTM D3350 (Polyethylene (PE) Plastic Tubing) and ANSI/AWWA C901 or 906, as applicable. PE pipe shall have a standard thermoplastic material designation code of PE 3408/3608, and a minimum cell classification of 345464C, as described in ASTM D3350 (Polyethylene Plastics Pipe and Fitting Materials). Material used to manufacture PE pipe shall meet all the requirements for listing as a PE 3408/3608 product by the Plastics Pipe Institute (PPI), listed under the manufacturer's name in PPI TR-4 (PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe). Material shall be homogeneous; free from visible cracks, holes, inclusions, kinks, and other defects; and as uniform in color, opacity, and density as practicable.

   Each PE force main length shall be cleared marked with the manufacturer's name, nominal pipe size, material code designation, AWWA/ASTM designation, DR, and pressure class.

Permanent identification of piping shall be provided by co-extruding four (4) equally spaced colored stripes into the pipe outside surface. The striping material shall be the same material as the pipe material, and the color shall be green for sewer force mains. Stripes printed on the pipe outside surface shall not be acceptable.

2. Accessory Items for Force Mains

Items used in connection with the construction of force mains shall conform to the following:

a. Fittings

All plugs, caps, tees, and bends deflecting 22-1/2˚ or more shall be provided with reaction backing. In addition to reaction backing, restrained joint pipe may also be required as set forth in these Specifications.

Special fittings shall be in accordance with the pipe manufacturer's recommendations and as approved by SWU. All fittings and appurtenances placed in sewer lines shall be installed in accordance with the manufacturer's recommendations and as approved by the Department.

Connections between different kinds of pipe shall be detailed on the Plans and provide self-cleansing sanitary flow and watertight joints and connections. The Contractor shall furnish all required transition devices necessary to adapt fittings of differing materials to PE pipe.

1). Ductile Iron Fittings

Ductile iron fittings for PE force mains shall be epoxy lined and as set forth in the Ductile Iron Pipe and Fittings for Gravity Sewer Lines and Force Mains Section of these Specifications, unless otherwise specified. All casting and mating surfaces shall be smooth and of a workmanlike quality, free from cracks, holes, scale, shrinkage, distortion, grooves, scratches, and other defects. Fittings and other castings may be rejected if found to be unacceptable by the Department in accordance with these Specifications.

2). PE Fittings

Fittings shall be cleared marked with the manufacturer's name, nominal pipe size, material code designation, AWWA/ASTM designation, DR, and pressure class.

a.) Fittings

Molded PE fittings shall be manufactured and tested in accordance with ASTM D3261 (Butt Head Fusion PE Plastic Fittings for PE Plastic Pipe and Tubing), D2683 (Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing), or F1055 (Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing), as applicable. Molded PE fittings shall meet the requirements set forth in ANSI/AWWA 901 or 906, as applicable. Molded fittings are generally available up through the 12 inch pipe size.

Fabricated PE fittings shall be made by heat fusion joining specially machined shapes cut from pipe, PE sheet stock, or molded fittings. Fabricated fittings shall not be allowed where molded fittings are available.

All fittings shall be fully rated for the same design pressure as the piping system of which they are a part and meet the material requirements of the pipe to which the fitting is joined.

b. PE Pipe Joints

All pipe joints shall be made in strict accordance with the manufacturer's recommendations and as approved. All joints shall be made watertight in accordance with the latest applicable AWWA and ASTM standards. Joints shall have a pressure rating equal or greater than the piping system of which they are a part. SWU reserves the right to require the removal of fused connections for destructive testing to verify the integrity of fused joints.

PE pipe shall not be joined by solvent cements, adhesives, or threaded-type connections.

When joining and laying pipe, thermal expansion and contraction shall be taken into account and pipe shall be restrained as necessary.

1). Heat Fusion Joining

Prior to fusion, the pipe shall be clean and the ends shall be cut square. Joints between HDPE plain end pipes and fittings shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made using saddle fusion procedures as recommended by the manufacturer. Electrofusion may be an acceptable form of joining if prior approved by the Department. The fusion bead shall be left intact on the line.

2). Mechanical Joining

PE pipe and fittings may be joined together or to other materials by means of MJ adapters. The manufacturer of the joining device shall be consulted for proper installation procedures. All adapters shall be fully pressure rated and fully restrained such that when installed, a longitudinal load will cause the pipe to yield before the mechanical adapter disjoins. Bolts and nuts shall be high strength, low-alloy structural steel conforming to ASTM A242.

a.) MJ Adapters

MJ adapters shall be provided with metal glands, extended bolts, and gaskets. Stainless steel stiffeners shall be required, as specified herein, unless otherwise specified by the Department. The gland shall be slipped over the pipe, and the MJ adapter butt fused onto the plain end pipe. The gasket shall be lubricated and installed, and bolts shall be installed and tightened as per the manufacturer's recommendations.

b.) Stiffeners

Pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be Type 304 greater stainless steel, formed to the manufacturer's published average inside diameter for the specific size and DR. The stiffener manufacturer's recommendations shall be followed when installing stiffeners and mechanical joints. Stiffeners shall as manufactured by Cascade Waterworks, JCM Industries, or approved equal.

c. Restrained Joints

Joints shall be restrained where shown on the Plans or as otherwise directed by the Department. The restrainer shall have a pressure rating equal to or greater than the pipe on which it is used. Pipe stiffeners shall be used in conjunction with all restrainers unless otherwise specified. Approved restrainers up through the 12 inch size shall be as follows. Restrain for pipe and fittings larger than 12 inches in diameter shall be individually designed and approved by the Department on a case-by-case basis.

1.) Mechanical Joint

Restrained joints of the MJ type incorporated into the design of the follower gland shall consist of individually actuated wedges that increase resistance to pull-out as pressure or external forces increase. The device shall be capable of full MJ deflection during assembly, and the flexibility of the joint shall be maintained after burial. The joint restraint ring and wedging components shall conform to ASTM A536 (Ductile Iron Castings). The ductile iron gripping wedges shall be heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be compatible with the standardized MJ bell conforming to ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings) and ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings for Water Service) or ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids) as applicable. Torque limiting twist-off nuts shall be used to ensure proper actuation of the restraining wedges. Gaskets without torque limiting twist-off nuts shall require 90 ft-lb of bolt torque through the 8 inch size and 120 ft-lb through the 12 inch size.

The MJ restraint shall be available in the 3-12 inch sizes, with a rated working pressure of 350 psi for sizes 12 inch and smaller. The restraint devices shall be UL listed and approved by FM through the 12 inch size. The restraint shall be the Megalug Series 2000 PV as produced by EBAA Iron, Inc., or approved equal.

2.) Restrained Coupling

Joint restraint to prevent axial separation shall be incorporated into the design of the sleeve or coupling used to connect two plain ends of HDPE or HDPE to a dissimilar material. The restraint mechanism shall incorporate a plurality of individually actuating gripping surfaces to maximize restraint capability and have torque limiting twist off nuts to insure proper actuating of the restraint devices, such as the Megalug Series 2000 PV specified above. The restrained joining system shall meet the applicable requirements of ANSI/AWWA C219 (Bolted, Sleeve-Type Couplings for Plain-End Pipe), ASTM C111, and D2000 (Classification System for Rubber Products in Automotive Applications). The restrained coupling system shall be Mega-Coupling Series 3800, as manufactured by EBAA Iron, Inc., or approved equal.

3. Embedment Material

Pipe embedment material is defined as that material placed beneath and around the pipe up to depth required specified herein. All embedment material shall be free from cinders, ashes, refuse, vegetable or other organic material, boulders and other large rock, frozen soil, or other inorganics and materials that in the opinion of the Engineer or SWU is unsuitable.

Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Coarse Aggregate Standard Size No. 67 as specified by ASTM D448 (Sizes of Aggregate for Road and Bridge Construction).

4. Initial Backfill

Initial backfill shall be the same as the embedment material set forth in this Section.

5. Pipe Protection Cover

Pipe protection cover shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

6. Final Backfill

Final backfill shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications

7. Concrete
   Concrete used for reaction backing, pipe cover, or pipe encasement shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications.

8. Tracer Wire and Ports
   Tracer wire and ports shall be used on all PE piping and shall be 14 gauge coated copper for underground burial. Tracer wire and ports shall be installed as set forth herein and as shown in Standard Details M-1, “Tracing Wire Connection Port” and S-19, “PE/PVC Pressure Sewer Pipe Trench”.

9. Affidavits of Compliance and Independent Laboratory Inspection
   All pipe and fittings shall be inspected and tested by the manufacturer. The manufacturer shall furnish to the Department Engineer, prior to delivery, certificates stating that all pipe and fittings shall be manufactured in compliance with these Specifications and other applicable standards. The manufacturer’s certificate shall also fully describe the pipes and fittings proposed to be furnished.

C. EXECUTION

1. Handling and Storage
   Handling and storage shall be as specified in the Storage and Handling of Materials Section in the General Requirements Chapter of these Specifications.

2. Alignment and Grade
   The sewer line shall be laid and maintained to the required lines and grades with fittings, valves, and other appurtenances at the required locations; and all valves shall be plumb.

3. Temporary Plugs or Caps
   All dirt, debris, and other foreign matter shall be removed from the inside of pipe and fittings before being lowered into the trench. Pipes and fittings shall be kept clean during and after placement and care shall be taken to keep dirt out of the jointing space. At the end of each day’s work and also if pipe installation is discontinued for an appreciable period, the open ends of the pipe shall be closed with a watertight cap firmly secured in place. The use of plywood forms or similar means of closure shall not be acceptable. Plugs shall be of the mechanical friction type. Pressurized air plugs shall not be permitted.

4. Requirements Preparatory to Trench Excavation
   In all areas where sewer lines, valves, or other appurtenances shall be constructed, the existing surface shall be removed prior to excavating the trench as set forth in the Surface Removal Section of these Specifications.

5. Dewatering
   Under no conditions shall pipe be laid in a trench that has not been properly dewatered. Dewatering and stabilization shall be as specified in the Site Preparation, Excavation, and Fill Section of these Specifications.

6. Excavation Support and Protection
   Excavation support requirements shall be as specified in the Excavation Support and Protection article under the Excavation paragraph in the Site Preparation, Excavation, and Fill Section of these Specifications.

7. Trench Excavation
   The trench shall be excavated to the alignment, depth, and width required and only so far in advance of the pipe laying as set forth in the paragraph on Trench Length in this Section. The bottom of the trench shall be excavated to provide a uniform and continuous bearing and support for the pipe.

The Contractor shall proceed with caution in the trench preparation and excavation so the exact location of underground structures and conflicts, known and unknown, may be accurately determined. The Contractor shall be held responsible for the repair of such facilities when broken or otherwise damaged from carelessness. Excavation shall be as set forth in the Excavation paragraph of the Site Preparation, Excavation, and Fill Section of these Specifications and also as set forth herein.

Excavation work shall include the necessary removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; placement of all necessary sheeting, shoring, and trench protection; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; construction of fills and embankments; and other pertinent activities.

Excavation should be performed in accordance and compliance with all applicable local, state, and federal safety regulations, including but not limited to 29 CFR 17, Part 1926, Subpart P – OSHA - Excavations.

a. Trench Depth
The trench shall be excavated to at least four (4) inches below the grade required to provide proper pipe embedment and a minimum earth cover of 24 inches.

However, ledge rock, boulders, large stones, or gravel formations with loose cobbles greater than eight (8) inches in diameter shall be removed to provide a clearance of at least six (6) inches below and on all sides of all pipe, valves, and fittings for pipes 24 inches in diameter or less, and a clearance of at least nine (9) inches for pipes larger than 24 inches in diameter. A layer of embedment material shall then be placed on the bottom of the trench, tamped, and leveled to the appropriate depth.

Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workers. All pipe bedding material shall be shaped and graded to provide a uniform and continuous bearing support for the entire length of pipe.

b. Trench Width
The trench width shall be ample enough to permit proper installation and jointing of the pipe, backfill, and compaction. Trench widths set forth in ANSI/AWWA C600 and as shown on the Standard Detail Sheet shall serve as a general guide. Larger trench widths may be necessary for the placement of a trench support system or as otherwise required.

c. Trench Length
The Department shall have the right to limit the amount of trench excavated in advance of laying the pipe. In general, such excavation shall not exceed 300 feet, and the length of trench excavated to grade shall not exceed 100 feet or that length of installation which may reasonably be completed during a workday.

Trenches located in rock shall be fully opened at least 50 feet in advance of the place where pipe is being installed or concrete or masonry work is in progress.

d. Over-Excavation
All over-excavation less than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with adequate pipe bedding material or compacted Class 7 aggregate base course. The additional material required shall be placed in three (3) inch lifts and thoroughly compacted. This procedure shall be repeated until the established grade has been reached. All pipe bedding shall be compacted so as to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel.

All over-excavation greater than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with compacted Class 7 aggregate base course as described in the Undercutting paragraph in this Section.

If over-excavation of the trench width occurs, additional pipe bedding gravel or concrete shall be provided as necessary to prevent crushing of the pipe due to excessive earth loads. Additional pipe embedment material shall be provided to completely fill the over-excavated width beyond the defined width of the trench.

8. Undercutting

Where the soil at the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic materials, unstable Class IV or V soil, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, and/or large fragments of inorganic material which in the judgment of SWU should be removed, the Contractor shall excavate and remove the unsuitable material to the width and depth required by the Department. Before the pipe is placed, the subgrade shall be backfilled with Class 7 aggregate base course in 6-8 inch uncompacted layers. The layers shall be machine tamped, as required by the Department, to 95% Modified Proctor, to provide a uniform and continuous bearing and support for the pipe at all points along the pipe length.

9. Installing PE Pipe

PE pipe shall be installed in conformance with the recommendations of ASTM D2321, (Standard Practice for Installing Flexible Thermoplastic Sewer Pipe Lines) and these Specifications. Ductile iron fittings for PE pipe shall be installed as set out in ANSI/AWWA C600 (Installation of Ductile-Iron Water Mains and Their Appurtenances).

Subject to the approval of the Department, other fittings may be added to or substituted for those shown on the Plans, should the need arise during construction. This shall in no way relieve the Contractor of the responsibility for furnishing and installing all fittings required for a complete and proper installation of pipeline as detailed on the Plans.

Pipes, fittings, and other appurtenances shall be inspected carefully before being placed in the trench. Any joint, pipe, fitting, or other appurtenance found to be cracked or otherwise damaged to the point of impaired usefulness shall be plainly marked so the marking shall not rub or wash off. Damaged materials shall be removed from the site as soon as feasible. All pipe, fittings, and other appurtenances shall be lowered carefully into the trench in such a manner to prevent damage to or contamination of the pipe, fittings, and linings. Pipe, fittings, and other appurtenances shall not be dropped or dumped into the trench.

If needed, the pipe shall be cut in a neat, safe, and professional manner, without causing damage to the pipe or pipe lining. Cut ends and rough edges shall be ground smooth.

As the Work progresses, pipe shall be cleaned of all foreign material and maintained clean until accepted or put into service.

If required by the Department, the pipe manufacturer shall provide a qualified installation representative at the start of construction to demonstrate proper installation techniques for each size and type of pipe to be installed. The Contractor shall be responsible to ensuring that personnel have received proper training per the manufacturer's recommended procedure. Records of training shall be maintained by the Contractor and shall not exceed 12 months from the date of construction.

Connections shall be made in strict accordance with the recommendations of the pipe manufacturer. Flange faces shall be centered and aligned to each other before assembling and tightening bolts. In no case shall the flange bolts be used to draw the flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be fitted under the flange nuts. Bolts shall be

evenly tightened according to the tightening pattern and torque step recommendations of the manufacturer. Approximately four (4) hours after initial assembly, flange connections shall be retightened following the manufacturer's instructions and PPI's TN 38 (Bolt Torque for Polyethylene Flanged Joints).

Tracer wire shall be securely attached to the pipe with cable ties or other similar means at approximately 10-foot intervals. Tracer ports shall be constructed at intervals of 400 feet or less and at any change in direction.

10. Embedment and Backfill

After the trench has been excavated as set forth herein, the PE force main shall be placed in general accordance with the Type 5 Standard Laying Condition, as set forth in ASTM D2321 (Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe), unless structural or foundation requirements indicate more stringent bedding conditions shall be necessary. Embedment material shall be placed from a point at least four (4) inches below the bottom of the pipe to four (4) inches above the top of the pipe, by the full width of the excavated ditch. The intent shall be to cradle the pipe so the full length of each joint is uniformly supported on firm bedding with the weight of the pipe and fill borne uniformly by the pipe barrel. Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Coarse Aggregate Standard Size No. 67 as set forth in ASTM D448 (Sizes of Aggregate for Road and Bridge Construction).

After the embedment material has been placed to the required depth and compaction, 12 inches of pipe protection cover, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, shall be hand-placed and hand-tamped, for a total depth of 16 inches cover above the pipe. If the material excavated from the trench is completely free of rock larger than 1-1/2 inch, the trench may be machine-backfilled. After placement of the pipe protection cover, the excavation shall be backfilled to grade with final backfill material free from rocks larger than six (6) inches in any dimension within three (3) feet of the top of the pipe and free from rock larger than eight (8) inches thereafter.

11. Compaction

After the minimum required pipe protection cover is placed over the top of the pipe, all subsequent final backfill material shall be placed in eight (8) inch lifts and compacted using a mechanical, hydraulically-powered, vibratory trench compactor or other equivalent equipment. Heavy compaction equipment shall not be used within 36 inches of the top of the pipe.

All trench backfill not located under paved areas or other special areas as noted on the Plans shall be compacted to a minimum of 90% of the adjacent undisturbed soil as determined in accordance with ASTM D2922 (Standard Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)).

If trenches are under existing or proposed pavement, driveways, parking areas, sidewalks, or public streets of the City of Springdale, the entire trench shall be backfilled up to the subgrade with Class 7 Aggregate Base Course in eight (8) inch lifts and compacted by approved mechanical methods to 95% Modified Proctor Density as determined by AASHTO T180, unless otherwise directed by the Department or required by other governing authorities.

Field density shall be determined as set forth in the Density Testing Section of these Specifications. All backfill not meeting the compaction requirements set forth herein shall be replaced and/or recompacted until the compaction requirements are met.

12. Disposal of Excavated Material

Excavated material shall be piled adjacent to the Work to be used for backfilling, if suitable. All unsuitable excavated material and any excess material shall be disposed of in a manner in accordance with applicable local, state, and federal regulations and as approved by the

Department Engineer. Excess material shall not impede construction, endanger workers, nor obstruct sidewalks, roads, and other structures.

13. Connection to Existing Lines
    Unless otherwise approved by the Department, no connection to existing sewer lines shall be made until the newly constructed facilities meet with all required construction standards, pass all required tests, and are approved by the Department for connection.

14. Concrete Reaction Backing for Force Mains
    All fittings shall have concrete reaction backing even if restrained joints are shown on the Plans. Reaction backing shall be placed between undisturbed earth and the fitting to be anchored. The area of bearing on the pipe shall be taken as that shown on the Detail Sheet of the Plans or as directed by the Department Engineer. The backing shall, unless otherwise indicated, be placed so the pipe and fitting joints shall be accessible for repair. All DI fittings and appurtenances shall be wrapped in accordance with the Polyethylene Encasement Section of these Specifications prior to the placement of reaction backing.

15. Concrete Encasement
    If shown on the Plans or otherwise directed by the Department Engineer, the pipe shall be encased in concrete to the dimensions indicated. Where additional concrete encasement is required by the Department Engineer, the additional material shall be provided and installed by the Contractor. All pipes to be encased shall be suitably supported, blocked in proper position, and anchored against flotation.

16. Replacement and Repair of Driving Surfaces
    Replacement and repair of driving surfaces shall be made in accordance with the Pavement Repair Section of these Specifications, as applicable.

17. Explosives
    The utilization of explosives for excavation shall be as specified in the Use of Explosives Section in the General Requirements Chapter of these Specifications.

18. Cleanup
    Cleanup shall be as specified in the Cleanup, Seeding, and Sod Section of these Specifications.

D. TESTING

The interior of all lines shall be free of mud, muck, dirt, gravel, and debris prior to testing and acceptance. The Department reserves the right to visually inspect all pipeline construction by means of televised camera equipment prior to acceptance. The Contractor shall be required, at own expense, to clean or repair any defects found through inspection.

PE force mains shall be tested in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

If pipe repair is necessary due to leakage or test failures, replacement of pipe utilizing solid sleeves shall be required. The use of bell clamps or other bell repair devices shall be strictly prohibited. Complete replacement of the line will be required of any section 400 feet in length or greater which has three (3) or more point failures.

END OF SECTION

SECTION T25

POLYVINYL CHLORIDE (PVC) PIPE FOR GRAVITY SEWER LINES AND FORCE MAINS

A. DESCRIPTION

This Section sets forth acceptable materials and procedures for the installation of PVC pipe for gravity sewer lines and force mains.

B. MATERIALS

Only pipe materials listed herein and in the Ductile Iron Pipe and Fittings for Gravity Sewer Lines and Force Mains Section of these Specifications shall be used for gravity sewer lines and force mains unless specifically authorized by the Department Engineer. All pipe installed shall be of the type, size, class, and thickness indicated in these Specifications and on the Plans.

Sewers at a depth of 14 feet or greater, measured from flowline to finished grade, shall be DIP. DIP shall also be used for all sewer or force main pipe where the grade is 15% or greater. All DI pipe, fittings, and appurtenances shall have a protective interior coating suitable for sanitary sewage as specified in the Ductile Iron Pipe and Fittings for Gravity Sewer Lines and Force Mains Section of these Specifications.

1. Polyvinyl Chloride (PVC) Pipe (Force Main)
   All sanitary sewer force mains shall be of equal design, material, and construction as potable water pipe, as set forth in the Ductile Iron Pipe and Fitting for Water Lines Section of these Specifications, and shall comply with ANSI/AWWA C900 (PVC Pressure Pipe and Fabricated Fittings, 4 Inch Through 12 Inch, for Water Distribution) or ANSI/AWWA C905 (PVC Pressure Pipe and Fabricated Fittings, 14 Inch Through 48 Inch for Water Transmission and Distribution), as applicable. PVC pipe for force mains shall have a minimum DR of 18 (Pressure Class or Rating, as applicable for C900 or C905 respectively, of 235 psi).

   The plastic material used in making the pipe shall be clean, virgin, Cell Classification 12454 PVC compound conforming to ASTM D1784 (Rigid PVC and Chlorinated PVC Compound).

   Each PVC force main length shall be cleared marked with the manufacturer's name, nominal pipe size, cell classification, AWWA/ASTM designation, DR, and pressure class or pressure rating as applicable.

2. Polyvinyl Chloride (PVC) Pipe (Gravity Sewer)
   All PVC gravity sewer pipe, 8 inch through 15 inch, shall conform to ASTM D3034 (Type PSM Polyvinyl Chloride (PVC) for Sewer Pipe and Fittings) and have a minimum SDR of 26. PVC sewer pipe 18 inch and larger shall be manufactured in accordance with ASTM F679 (PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings). All PVC pipe shall have a minimum pipe stiffness of 115 psi at 5% deflection, as defined in ASTM D2412 (Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading). The minimum acceptable size of all gravity sewer mains shall be eight (8) inches.

   The plastic material used in making the pipe shall be clean, virgin, Cell Classification 12454 or 12364 PVC compound as specified in ASTM D3034 and ASTM F679, conforming to ASTM

D1784 (Rigid PVC and Chlorinated PVC Compound). Standard laying lengths shall be 20 feet ± 1 inch, unless otherwise specified. All pipe shall be tested in accordance with ASTM D2412, D2152 (Adequacy of Fusion of Extruded PVC Pipe and Molded Fittings by Acetone Immersion), and D2444 (Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)).

Each PVC sewer pipe length shall be clearly marked with the manufacturer's name, nominal pipe size, cell classification, AWWA/ASTM designation, and SDR.

a. Service Lines

Service lines shall be defined as that portion of the sanitary drainage system which extends from the City sewer main to the right-of-way or the property line, or wherever City maintenance terminates. All service lines shall meet with the material and performance requirements for pipe, fittings, and joints set forth in this Section.

The minimum size of any service line shall be four (4) inch nominal diameter. Sizes of service lines for multi-family or commercial applications shall be at a minimum, as required by the Arkansas State Plumbing Code, unless otherwise directed by SWU. Service lines may be constructed PVC with an SDR of 26 or DIP Special Class 50, as set forth herein.

3. Accessory Items for Sewer Lines and Force Mains

Items used in connection with the construction of gravity sewer lines and force mains shall conform to the following:

a. Fittings

All plugs, caps, tees, and bends deflecting 22-1/2˚ or more shall be provided with reaction backing or shall be restrained joint pipe as described herein.

A wye shall be installed for each anticipated future connection of sewer service.

Special fittings shall be in accordance with the pipe manufacturer's recommendations and as approved by SWU. All fittings and appurtenances placed in sewer lines shall be installed in accordance with the manufacturer's recommendations and as approved by the Department.

Connections between different kinds of pipe shall be detailed on the Plans and provide self-cleansing sanitary flow and watertight joints and connections. The Contractor shall furnish all required transition devices necessary to adapt fittings of differing materials to PVC pipe. Transition couplings for gravity sewers from shall be made of an elastomeric plastic material as manufactured by Fernco, Inc., or approved equal.

1.) Ductile Iron Fittings (Force Main)

All fittings on PVC force mains shall be ductile iron, as set forth in the Ductile Iron Pipe and Fittings for Gravity Sewer Lines and Force Mains Section of these Specifications, unless otherwise specified.

2.) PVC Fittings (Gravity Sewer)

PVC fittings for gravity sewer pipe shall be of one-piece injection-molded construction, with self-cleansing sanitary flow of design meeting ASTM D3034 or F679, as applicable. Fitting types and larger sizes not manufactured as injection-molded pieces may be fabricated. Fittings shall have a wall thickness equal to or greater than the wall thickness of the pipe to which the fitting is joined, meeting or exceeding the adjacent pipe quality requirements and have an SDR of 26.

Each PVC fitting shall be clearly marked with the manufacturer's name, nominal pipe size, cell classification, AWWA/ASTM designation, and deflection angle if applicable.

b. PVC Pipe Joints

Joints shall be of the push-on, elastomeric gasket type, conforming to ASTM D3212 (Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals) or ASTM D3139 (Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals) as applicable, and/or Uni-Bell UNI-B-1 (Recommended Specification for Thermoplastic Pipe Joints, Pressure and Non-Pressure Applications). All bells shall be formed integrally with the pipe and shall contain a positively retained, factory installed elastomeric gasket and have a raceway or groove specially formed to accept and retain the gasket. Wall thickness of the bell at any point shall not be less than the required minimum for the pipe barrel. Pipe spigots shall be beveled and have insertion stop marks.

The use of solvent cement or chemically welded joints shall not be permitted in field construction, except as specifically authorized by the Department Engineer. All pipe joints other than those specified herein shall be made in strict accordance with the manufacturer's recommendations and as approved by the Department. All joints shall be made watertight in accordance with the latest applicable AWWA and ASTM standards.

c. Gaskets for PVC Joints and Fittings

Gaskets shall be molded or extruded from a high grade, vulcanized, elastomeric compound consisting of either a basic natural or synthetic rubber. Gaskets shall be marked for nominal pipe size, manufacturer, and year of manufacture. Gaskets shall comply with the requirements of ASTM F477 and ASTM D3212 or ASTM D3139, as applicable.

d. Restrained Joints

1.) Mechanical Joint

Restrained joints of the MJ type incorporated into the design of the follower gland shall consist of individually actuated wedges that increase resistance to pull-out as pressure or external forces increase. The device shall be capable of full MJ deflection during assembly, and the flexibility of the joint shall be maintained after burial. The joint restraint ring and wedging components shall conform to ASTM A536 (Ductile Iron Castings). The ductile iron gripping wedges shall be heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be compatible with the standardized MJ bell conforming to ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings) and ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings for Water Service) or ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids) as applicable. Torque limiting twist-off nuts shall be used to ensure proper actuation of the restraining wedges. Gaskets without torque limiting twist-off nuts shall require 90 ft-lb of bolt torque through the 8 inch size and 120 ft-lb through the 24 inch size.

The MJ restraint shall be available in the 3-48 inch sizes, with a rated working pressure of 350 psi for sizes 16 inch and smaller, and 250 psi for sizes 18-48 inch. The restraint devices shall be UL listed through the 24 inch size and approved by FM through the 12 inch size. For applications requiring restraint of pipe 30 inches and greater, an alternate grade of iron meeting the material requirements of ASTM

A536 shall be acceptable, providing the device shall meet all end product performance requirements. The restraint shall be the Megalug Series 2000 PV as produced by EBAA Iron, Inc., MJ Field-Lok Gaskets Series PV as produced by U.S. Pipe, or approved equal.

2.) Push-On Joint

Restrained joints of the push-on joint type incorporated into the design of the pipe shall provide a locking interface between the bell interior surface and a retainer weldment on the spigot end of the pipe. Restrained joint pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.5 (Ductile Iron Pipe, Centrifugally Cast, for Water and Other Liquids) and ANSI/AWWA C111/A21.11. The device shall be capable of full push-on joint deflection during assembly, and the flexibility of the joint shall be maintained after burial. When restrained joints require factory welded, all welding procedures and welders used to produce the product shall be qualified per the requirements of a documented quality assurance system based on ANSI/AWS D11.2.

4. PVC Joint and Fitting Lubricant

Lubricant shall be provided by the pipe manufacturer and applied as per the manufacturer's recommendations. Lubricant shall be non-toxic, not support the growth of bacteria and have no deteriorating effects on the gasket or pipe material. Lubricant containers shall be appropriately identified and labeled with the manufacturer's name. Each lubricant container shall have printed instructions for usage and joint assembly.

5. Embedment Material

Pipe embedment material is defined as that material placed beneath and around the pipe up to depth required specified herein. All embedment material shall be free from cinders, ashes, refuse, vegetable or other organic material, boulders and other large rock, frozen soil, or other inorganics and materials that in the opinion of the Engineer or SWU is unsuitable.

Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Coarse Aggregate Standard Size No. 67 as specified by ASTM D448 (Sizes of Aggregate for Road and Bridge Construction).

6. Initial Backfill

Initial backfill shall be the same as the embedment material set forth in this Section.

7. Pipe Protection Cover

Pipe protection cover shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

8. Final Backfill

Final backfill shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

9. Concrete

Concrete used for reaction backing, pipe cover, or pipe encasement shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications.

10. Tracer Wire and Ports

Tracer wire and ports shall be used on all PVC force main piping and shall be 14 gauge coated copper for underground burial. Tracer wire shall be installed as set forth herein.

11. Affidavits of Compliance and Independent Laboratory Inspection

All pipe and fittings shall be inspected and tested by the manufacturer. The manufacturer shall furnish to the Department Engineer, prior to delivery, certificates stating that all pipe and fittings shall be manufactured in compliance with these Specifications and other applicable standards.

The manufacturer's certificate shall also fully describe the pipes and fittings proposed to be furnished.

C. EXECUTION

1. Handling and Storage
   Handling and storage shall be as specified in the Storage and Handling of Materials Section in the General Requirements Chapter of these Specifications.

2. Construction Sequence for Gravity Sewers
   Unless otherwise directed by the Department, the construction of sanitary sewers shall begin at the low point of the line and continue in orderly succession throughout the work, with the bell ends facing upstream. Any deviation from this procedure shall be made only with the approval of the Department Engineer.

3. Alignment and Grade
   The sewer line shall be laid and maintained to the required lines and grades with fittings, valves, and other appurtenances at the required locations; spigots shall be centered in bells; and all valves shall be plumb.

4. Temporary Plugs or Caps
   All dirt, debris, and other foreign matter shall be removed from the inside of pipe and fittings before being lowered into the trench. Pipes and fittings shall be kept clean during and after placement and care shall be taken to keep dirt out of the jointing space. At the end of each day's work and also if pipe installation is discontinued for an appreciable period, the open ends of the pipe shall be closed with a watertight cap firmly secured in place. The use of plywood forms or similar means of closure shall not be acceptable. Plugs shall be of the mechanical friction type. Pressurized air plugs shall not be permitted.

5. Requirements Preparatory to Trench Excavation
   In all areas where sewer lines, valves, or other appurtenances shall be constructed, the existing surface shall be removed prior to excavating the trench as set forth in the Surface Removal Section of these Specifications.

6. Dewatering
   Under no conditions shall pipe be laid in a trench that has not been properly dewatered. Dewatering and stabilization shall be as specified in the Site Preparation, Excavation, and Fill Section of these Specifications.

7. Excavation Support and Protection
   Excavation support requirements shall be as specified in the Excavation Support and Protection article under the Excavation paragraph in the Site Preparation, Excavation, and Fill Section of these Specifications.

8. Trench Excavation
   The trench shall be excavated to the alignment, depth, and width required and only so far in advance of the pipe laying as set forth in the paragraph on Trench Length in this Section. The bottom of the trench shall be excavated to provide a uniform and continuous bearing and support for the pipe on solid, undisturbed ground between bell holes. The bell shall not support the weight of the pipe or soil.

   The Contractor shall proceed with caution in the trench preparation and excavation so the exact location of underground structures and conflicts, known and unknown, may be accurately determined. The Contractor shall be held responsible for the repair of such facilities when broken or otherwise damaged from carelessness. Excavation shall be as set forth in the Excavation

paragraph of the Site Preparation, Excavation, and Fill Section of these Specifications and also as set forth herein.

Excavation work shall include the necessary removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; placement of all necessary sheeting, shoring, and trench protection; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; construction of fills and embankments; and other pertinent activities.

Excavation should be performed in accordance and compliance with all applicable local, state, and federal safety regulations, including but not limited to 29 CFR 17, Part 1926, Subpart P - OSHA - Excavations.

a. Trench Depth
The trench shall be excavated to at least four (4) inches below the grade required to provide proper pipe embedment and a minimum earth cover of 24 inches.

However, ledge rock, boulders, large stones, or gravel formations with loose cobbles greater than eight (8) inches in diameter shall be removed to provide a clearance of at least six (6) inches below and on all sides of all pipe, valves, and fittings for pipes 24 inches in diameter or less, and a clearance of at least nine (9) inches for pipes larger than 24 inches in diameter. A layer of embedment material shall then be placed on the bottom of the trench, tamped, and leveled to the appropriate depth.

Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workers. All pipe bedding material shall be shaped and graded to provide a uniform and continuous bearing support for the pipe at each point along the pipe barrel. Bell holes shall be excavated to accommodate the pipe bells so that the bells do not support the weight of the pipe.

b. Trench Width
The trench width shall be ample enough to permit proper installation and jointing of the pipe, backfill, and compaction. Trench widths set forth in ANSI/AWWA C600 and as shown on the Standard Detail Sheet shall serve as a general guide. Larger trench widths may be necessary for the placement of a trench support system or as otherwise required.

c. Trench Length
The Department shall have the right to limit the amount of trench excavated in advance of laying the pipe. In general, such excavation shall not exceed 300 feet, and the length of trench excavated to grade shall not exceed 100 feet or that length of installation which may reasonably be completed during a workday.

Trenches located in rock shall be fully opened at least 50 feet in advance of the place where pipe is being installed or concrete or masonry work is in progress.

d. Over-Excavation
All over-excavation less than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor’s expense, with adequate pipe bedding material or compacted Class 7 aggregate base course. The additional material required shall be placed in three (3) inch lifts and thoroughly compacted. This procedure shall be repeated until the established grade has been reached. All pipe bedding shall be compacted so as to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel.

All over-excavation greater than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with compacted Class 7 aggregate base course as described in the Undercutting paragraph in this Section.

If over-excavation of the trench width occurs, additional pipe bedding gravel or concrete shall be provided as necessary to prevent crushing of the pipe due to excessive earth loads. Additional pipe embedment material shall be provided to completely fill the over-excavated width beyond the defined width of the trench.

9. Undercutting

Where the soil at the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic materials, unstable Class IV or V soil, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, and/or large fragments of inorganic material which in the judgment of SWU should be removed, the Contractor shall excavate and remove the unsuitable material to the width and depth required by the Department. Before the pipe is placed, the subgrade shall be backfilled with Class 7 aggregate base course in 6-8 inch uncompacted layers. The layers shall be machine tamped, as required by the Department, to 95% Modified Proctor, to provide a uniform and continuous bearing and support for the pipe at all points along the pipe length.

10. Installing PVC Pipe

PVC pipe shall be installed in conformance with the recommendations of ASTM D2321, (Standard Practice for Installing Flexible Thermoplastic Sewer Pipe Lines) and the Specifications set forth herein. Ductile iron fittings for PVC pipe shall be installed as set out in ANSI/AWWA C600 (Installation of Ductile-Iron Water Mains and Their Appurtenances).

Subject to the approval of the Department, other fittings may be added to or substituted for those shown on the Plans, should the need arise during construction. This shall in no way relieve the Contractor of the responsibility for furnishing and installing all fittings required for a complete and proper installation of pipeline as detailed on the Plans.

Pipes, fittings, and other appurtenances shall be inspected carefully before being placed in the trench. Any joint, pipe, fitting, or other appurtenance found to be cracked or otherwise damaged to the point of impaired usefulness shall be plainly marked so the marking shall not rub or wash off. Damaged materials shall be removed from the site as soon as feasible. All pipe, fittings, and other appurtenances shall be lowered carefully into the trench in such a manner to prevent damage to or contamination of the pipe, fittings, and linings. Pipe, fittings, and other appurtenances shall not be dropped or dumped into the trench.

If needed, the pipe shall be cut in a neat, safe, and professional manner, without causing damage to the pipe or pipe lining. Cut ends and rough edges shall be ground smooth.

Whenever necessary to deflect pipe from true alignment in either the vertical or horizontal plane, the degree of deflection at any joint shall be not greater than that which will provide adequate gasket space entirely around the spigot end of pipe. Joint deflections for force mains shall not exceed the maximum recommended by the pipe manufacturer or as set forth in ANSI/AWWA C605, as applicable, whichever is less. Deflection of pipe joints in gravity sewer pipe shall not be allowed.

As the Work progresses, pipe shall be cleaned of all foreign material and maintained clean until accepted or put into service.

If required by the Department, the pipe manufacturer shall provide a qualified installation representative at the start of construction to demonstrate proper installation techniques for each size and type of pipe to be installed.

Joints shall be installed as set forth in ANSI/AWWA C605 and as follows:

a. Slip-Type or Push-On Joints

Joints shall be made in strict accordance with the recommendations of the pipe manufacturer and under conditions that allow for clean mating and sealing of joining surfaces. The elastomeric gasket is typically factory installed in most bell joints and should not be removed. If the gasket is not pre-installed, the gasket shall be cleaned and positioned in the annular groove of the bell.

Prior to jointing, the bell and spigot end of the pipe shall be cleaned thoroughly to remove all foreign matter. The spigot and bell shall be checked for cleanliness immediately before insertion of the spigot into the bell. Lubricant shall be applied in accordance with the manufacturer's recommendations. The spigot end of the pipe shall be inserted in the bell of the pipe to which connection is being made and forced to a firm contact with the bell shoulder.

Pipe spigot ends are pre-marked with an insertion line to reference how far the spigot should be inserted into the bell. Field-cut pipe spigots shall be marked and beveled to match the manufacturer's insertion line. After assembly, the insertion line shall remain visible and be nearly flush with the lip of the adjoining pipe bell. Joints assembled beyond the insertion line may result in damaging stresses or leakage and shall not be acceptable. PVC pipe-to-DI fitting connections generally have insertion depths less than PVC pipe and fittings. In such cases, the factory bevel shall be removed or shortened to ensure the gasket will be in full contact with the non-beveled portion of the pipe outside diameter. After initial insertion is made, the pipe may then be deflected.

Tracer wire shall be securely attached to all force main pipe with cable ties or other similar means at approximately 10-foot intervals. Tracer ports shall be constructed at intervals of 400 feet or less and at any change in direction.

11. Embedment and Backfill

After the trench has been excavated as set forth herein, the PVC sewer pipe shall be placed in general accordance with the Type 5 Standard Laying Condition, as set forth in ASTM D2321 (Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe) and ANSI/AWWA C605, unless structural or foundation requirements indicate more stringent bedding conditions shall be necessary. Embedment material shall be placed from a point at least four (4) inches below the bottom of the pipe to four (4) inches above the top of the pipe, by the full width of the excavated ditch. The intent shall be to cradle the pipe so the full length of each joint is uniformly supported on firm bedding with the weight of the pipe and fill borne uniformly by the pipe barrel. Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Coarse Aggregate Standard Size No. 67 as set forth in ASTM D448 (Sizes of Aggregate for Road and Bridge Construction).

After the embedment material has been placed to the required depth and compaction, 12 inches of pipe protection cover, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, shall be hand-placed and hand-tamped, for a total depth of 16 inches cover above the pipe. If the material excavated from the trench is completely free of rock larger than 1-1/2 inch, the trench may be machine-backfilled. After placement of the pipe protection cover, the excavation shall be backfilled to grade with final backfill material free from rocks larger than six (6) inches in any dimension within three (3) feet of the top of the pipe and free from rock larger than eight (8) inches thereafter.

12. Compaction

After the minimum required pipe protection cover is placed over the top of the pipe, all subsequent final backfill material shall be placed in eight (8) inch lifts and compacted using a mechanical, hydraulically-powered, vibratory trench compactor or other equivalent equipment. Heavy compaction equipment shall not be used within 36 inches of the top of the pipe.

All trench backfill not located under paved areas or other special areas as noted on the Plans shall be compacted to a minimum of 90% of the adjacent undisturbed soil as determined in accordance with ASTM D2922 (Standard Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)).

If trenches are under existing or proposed pavement, driveways, parking areas, sidewalks, or public streets of the City of Springdale, the entire trench shall be backfilled up to the subgrade with Class 7 Aggregate Base Course in eight (8) inch lifts and compacted by approved mechanical methods to 95% Modified Proctor Density as determined by AASHTO T180, unless otherwise directed by the Department or required by other governing authorities.

Field density shall be determined as set forth in the Density Testing Section of these Specifications. All backfill not meeting the compaction requirements set forth herein shall be replaced and/or recompacted until the compaction requirements are met.

13. Disposal of Excavated Material
Excavated material shall be piled adjacent to the Work to be used for backfilling, if suitable. All unsuitable excavated material and any excess material shall be disposed of in a manner in accordance with applicable local, state, and federal regulations and as approved by the Department Engineer. Excess material shall not impede construction, endanger workers, nor obstruct sidewalks, roads, and other structures.

14. Connection to Existing Lines
Unless otherwise approved by the Department, no connection to existing sewer lines shall be made until the newly constructed facilities meet with all required construction standards, pass all required tests, and are approved by the Department for connection.

15. Concrete Reaction Backing for Force Mains
All fittings shall have concrete reaction backing even if restrained joints are shown on the Plans. Reaction backing shall be placed between undisturbed earth and the fitting to be anchored. The area of bearing on the pipe shall be taken as that shown on the Detail Sheet of the Plans or as directed by the Department Engineer. The backing shall, unless otherwise indicated, be placed so the pipe and fitting joints shall be accessible for repair. All DI fittings and appurtenances shall be wrapped in accordance with the Polyethylene Encasement Section of these Specifications prior to the placement of reaction backing.

16. Concrete Encasement
If shown on the Plans or otherwise directed by the Department Engineer, the pipe shall be encased in concrete to the dimensions indicated. Where additional concrete encasement is required by the Department Engineer, the additional material shall be provided and installed by the Contractor. All pipes to be encased shall be suitably supported, blocked in proper position, and anchored against flotation.

17. Replacement and Repair of Driving Surfaces
Replacement and repair of driving surfaces shall be made in accordance with the Pavement Repair Section of these Specifications, as applicable.

18. Explosives
The utilization of explosives for excavation shall be as specified in the Use of Explosives Section in the General Requirements Chapter of these Specifications.

19. Cleanup
Cleanup shall be as specified in the Cleanup, Seeding, and Sod Section of these Specifications.

D. TESTING

The interior of all lines shall be free of mud, muck, dirt, gravel, and debris prior to testing and acceptance. The Department reserves the right to visually inspect all pipeline construction by means of televised camera equipment prior to acceptance. The Contractor shall be required, at own expense, to clean or repair any defects found through inspection.

PVC gravity sewer pipes shall be tested in accordance with the Low Pressure Air Testing of Gravity Sewer Lines Section of these Specifications. PVC force mains shall be tested in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

If pipe repair is necessary due to leakage or test failures, replacement of pipe utilizing solid sleeves shall be required. The use of bell clamps or other bell repair devices shall be strictly prohibited. Complete replacement of the line will be required of any section 400 feet in length or greater which has three (3) or more point failures.

END OF SECTION

SECTION T26

BUTTERFLY VALVES

A. DESCRIPTION

This Section sets forth acceptable materials and procedures for the installation of butterfly valves. Only SWU personnel shall be permitted to operate existing system valves. Valves shall be provided with an extension stem, position indicator, alignment ring, and cast iron valve box and cover as required and specified below.

B. MATERIALS

Valves specified in this Section shall be intended for buried use on water distribution lines and within structure walls. Butterfly valves shall be used on lines 12 inches and larger, unless otherwise specified.

1. Butterfly Valves

   a. Design

   Butterfly valves shall be in complete conformance with the requirements set forth in ANSI/AWWA C504 (Rubber Seated Butterfly Valves) for Class 150B or 250B, as required by the maximum working pressure. Valves shall be tight closing, with seats that are securely fastened to the valve body. Valves shall be designed for a maximum differential pressure of 150 or 250 psi, as applicable.

   Acceptable buried butterfly valve shall be the Pratt Groundhog, as furnished by the Henry Pratt Company. Inside vault butterfly valves shall be Model 2F11, HP250II, or Triton XR-70 as manufactured by Pratt, or Lineseal as manufactured by Mueller.

   b. Construction

   1.) Closure

   Bubble-tight at working pressure differential.

   2.) Valve Body

   The valve body shall be in accordance with ASTM A126 (Gray Iron Castings for Valves, Flanges, and Pipe Fittings), Class B cast iron or ASTM A536 (Ductile Iron Castings) ductile iron, minimum grade 65-45-12. Body thickness shall be in strict accordance with ANSI/AWWA C504.

   3.) Valve Ends

   All valves utilized for buried service shall have integrally cast MJ ends as per ANSI/AWWA C111/A21.11, and all aboveground valves or valves in vaults shall have flange end bodies, unless otherwise specified. Flanges and drilling shall conform to ANSI B16.1, Class 125.

4.) Valve Disc

Discs shall be furnished with 316 stainless steel seating edge to mate with the rubber seat on the body.

- 4 Inch through 24 Inch
  Class B cast iron with 316 stainless steel edge as per ASTM A126, or Class 40 cast iron as per ASTM A48 (Gray Iron Casting)
- 30 Inch through 48 Inch
  Ductile iron in conformance with ASTM A536 (Ductile Iron Casting). Valves 30 inches and larger shall be of flow-through design, with no hollow chambers or ribs transverse to the flow.

5.) Valve Seat

The valve seat shall be Buna-N rubber located on the valve body. The seat shall be retained in the valve body without the use of retaining rings, segments, or screws of any kind in the flow stream. Valves 20 inches and smaller shall have a bonded seat design, simultaneously molded, vulcanized, and bonded to the body. Seats must withstand a 75 pound pull as per ASTM D429, test Method B. Valves 24 inches and greater shall be retained by mechanical means.

Seats for valves 24 inches and greater shall be a full 360° without interruption and have a plurality of grooves mating with a spherical disc edge seating surface. Valve seats shall be field adjustable around the full 360° circumference and replaceable without dismantling the operator, disc, or shaft and without removing the valve from the line. Manufacturer shall certify that the rubber seat is field-replaceable.

6.) Valve Shaft and Bearings

Type 304 stainless steel shaft as per ASTM A276 (Stainless Steel Bars and Shapes) with corrosion resistant, self-lubricating bearings.

7.) Valve Actuators

Lever or handwheel rotation, where required, shall be counterclockwise (left) to open the valve. The valve shall have an arrow cast on the operating nut or handwheel indicating the opening direction.

a. Aboveground Service or Within Vault
   Valves for aboveground service shall be motor operated or handwheel operated, at the discretion of the Department.

b. Buried Service
   Traveling nut operator with a two (2) inch standard square AWWA operating nut, for use with a standard “T” wrench, suitable for direct burial. Operator components shall withstand the torque at the extreme operator position specified in ANSI/AWWA C504. Operator shall be totally enclosed, fully gasketed, and grease packed.

8.) Alignment Ring

A valve box self-centering alignment ring shall be as manufactured by American Flow Control or approved equal.

2. Interior Coating

The interior of the valve shall have a polyamide cured epoxy protective interior coating in compliance with ANSI/AWWA C550 (Protective Interior Coatings for Valves and Hydrants) and C504, Tnemec Series N140 Pota-Pox Plus, PPG Amercoat 370, or approved equal.

3. Exterior Coating

All valves shall have either an exterior coating as set forth below:

a. Factory Primed Valves

Unless otherwise shown on the Plans, all exposed valves within the limits of structure walls or any valves exposed aboveground shall be delivered to the job site factory-blasted in accordance with SSPC-SP-6, hand or power-tool cleaned with oil and grease removed, and primed with one (1) coat of polyamide cured epoxy coating Tnemec Series N140 Pota-Pox Plus, PPG Amerlock 370, or approved equal.

All aboveground or vaulted valves shall be painted in accordance with ANSI/AWWA C504 and as set forth below.

		Dry Film Thickness *(mils)*
Field Spot-Primer	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0
Top Coat 1	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0
Top Coat 2	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0

SWU reserves the right to select paint colors. Where no colors are selected by the Department or otherwise shown on the Plans, all aboveground valves for potable water shall be color-coded dark blue (Tnemec Color ID: SC06 Safety Blue).

b. Bituminous Coating

All valves indicated for buried service shall have a bituminous coating in accordance with all ANSI/AWWA C504, or an epoxy coating as set forth in the Factory Primed Valves paragraph above.

4. Affidavit of Compliance

Prior to equipment delivery, the manufacturer shall furnish to the Department Engineer an affidavit stating that the valve and all materials used in its construction conform to the requirements of ANSI/AWWA C504, that all tests specified therein have been performed, and all test requirements have been met.

5. Valve Boxes

All buried valves shall be equipped with suitable valve boxes, compatible with the valves for which they are provided. The valve boxes, including all appurtenances, shall be cast iron. The valve box and appurtenances shall consist of a base, extensions as required, and a top section with a drop lid. The lid shall be marked with the word “WATER”. The manufacturer shall submit three (3) sets of drawings prior to delivery for approval by the Department Engineer, showing the principal dimensions, construction details, and materials used in construction of the valve box.

A valve box, as specified herein, shall be provided for each valve used in a buried service application. All castings shall be in conformance with AASHTO M306 (Drainage, Sewer, Utility, and Related Castings) and shall be free from cracks, holes, scale, shrinkage, distortion, and other defects; have a quality finish; and conform to the Plans. Weights shall be within ± 5% tolerance of the specified weights, as set forth by AAHSTO M306.

a. Standard Depth

Standard depth valve boxes shall be two (2) piece, screw-type, 5-1/4 inch shaft, 27-37 inch extension, with a combined weight of at least 80 pounds. Standard depth valve boxes shall be 6850 Series Model No. 562-S as manufactured by Tyler Pipe, 8550 Series Model 562-S as manufactured by East Jordan Iron Works, or approved equal.

b. Extra Depth

Extra depth valve boxes shall be two (2) piece, screw-type, 5-1/4 inch shaft, with extension length appropriate for depth of bury, as manufactured by Tyler Pipe or East Jordan Iron Works. No more than two (2) box extensions shall be allowed. In no case shall PVC risers be used to adjust alignment with grade. DIP risers shall not be permitted

to adjust alignment to grade unless under special conditions as approved by the Department. If the depth of bury exceeds three (3) feet, as measured from top of nut to finished grade, an operator extension shall be provided with the box to enable the operation of the valve with a standard six (6) foot "T" wrench. All valves with greater than a six (6) foot bury shall be equipped with a permanent extension stem, extending to three (2) below finished grade.

6. Concrete
   All concrete used for the placement of valve box collars shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications.

7. Operator Extensions (Valve Hub)
   Valve key extensions of ample size shall be provided where required and shall be one-piece or welded together. Valve key extensions shall be Schedule 40 steel pipe, painted with Tnemec Series N140 Pota-Pox Plus. Only one (1) extension shall be permissible. The operating nut shall be three (3) feet below the top of the valve box. Operator extensions shall be as manufactured by Mueller, American Flow Control, or approved equal.

8. Valve Marker Posts
   If required by the Department, valve marker posts shall be 3-Rail as manufactured by Rhino, with a blue coating and the applicable warning decal.

C. EXECUTION

All valves shall be installed at the locations shown on the Plans or at the direction of the Department Engineer.

1. Valve Installation
   Valves shall be installed in accordance with ANSI/AWWA C504, the relevant sections of ANSI/AWWA C600, the manufacturer's recommendations, and these Specifications. Valves shall be installed in the closed position to prevent debris from entering the valve.

2. Visual Inspection
   Prior to installation, all valves shall be visually inspected for defects, and any foreign material in the valve interior shall be removed. The valve shall be tested for operation through its full range of motion and compared to the manufacturer's published information.

3. Valve Boxes
   The valve box shall be installed with an alignment ring to not transmit shock or stress to the valve. The valve box shall be centered and plumb over the operating nut of the valve, with the box cover flush with the surface of the finished pavement, final grade, or other level as directed by the Department Engineer. The valve box shall be backfilled evenly around the perimeter with select material. The material shall be hand tamped so the ground will not settle after placement of the concrete collar.

4. Valve Box Collar
   All valve box lids shall have an 18 inch square cast-in-place concrete collar, as designated by the Department. Generally, valve box collars shall be constructed around valve boxes when located in pastures, fields, open area, roadsides, gravels drives, parking areas, and embankments. Six (6) inches of compacted gravel base shall be installed under all valve box collars. The collar shall be centered on the valve box lid and shall be six (6) inches thick with #4 concentric rebar centered around the valve box. The top of the pad shall be flush with the top of the box and the surrounding ground or roadway surface. Valve box collars shall not be installed until the soil has been compacted and every item of cleanup has been completed.

5. Valve Marker Posts
   If required by the Department, valve marker posts shall be 3-Rail as manufactured by Rhino, with a blue coating and the applicable warning decal.

6. Dead Ends
   Valves located at the end of pipelines shall have DI plugs or caps, with or without blowoff cocks, as indicated. All dead end valves shall be restrained as shown on the Plans or at the direction of the Department Engineer.

D. TESTING

Valves shall be hydrostatically tested for leakage in accordance with ANSI/AWWA C504, prior to leaving the factory. Valves shall also be field hydrostatically tested in conjunction with main line testing in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

END OF SECTION

SECTION T27

GATE VALVES

A. DESCRIPTION

This Section sets forth acceptable materials and procedures for the installation of gate valves. Only SWU personnel shall be permitted to operate existing system valves. Valves shall be provided with an extension stem, position indicator, alignment ring, and cast iron valve box and cover as required and specified below.

B. MATERIALS

Valves specified in this Section shall be intended for buried use on water distribution lines, as auxiliary valves for fire hydrants, and within structure walls. Gate valves shall be used on lines smaller than 12 inches, unless otherwise specified.

1. Gate Valves

   a. Design

   All gate valves, 2 inch through 12 inch, shall be cast iron or ductile iron bodied, non-rising stem (NRS), bronze mounted, resilient seat gate valves, in conformance with the requirements of ANSI/AWWA C509 (Resilient Seated Gate Valves for Water Supply Service) or ANSI/AWWA C515 (Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service), unless otherwise specified. All gate valves shall be designed for at least a 200 psi maximum working pressure.

   Valves conforming to these Specifications shall be accepted from the following manufacturers:

   1. Mueller Company
   2. Clow Corporation
   3. American Flow Control
   4. Kennedy Valve

   b. Construction

   3.) Valve Body, Bonnet, Stuffing Box, and Disc

   The valve body, bonnet, stuffing box, and disc shall be cast iron or ductile iron. Body and bonnet shall strictly adhere to the minimum wall thicknesses set forth in ANSI/AWWA C509 or C515, as applicable. Valve disc shall be fully encapsulated in EPDM, unless otherwise specified.

   4.) Valve Ends

   All valves utilized for buried service shall have MJ end bodies as per ANSI/AWWA C111/A21.11, and all aboveground valves or valves in vaults shall have flange end bodies, unless otherwise specified on the Plans. Tapping valves shall be flanged joint on the inlet side and MJ on the outlet side, or as otherwise specified. Flanges and drilling shall comply with ANSI B16.1, Class 125.

5.) Valve Stem

The valve shall be bronze conforming to ASTM B132. Two-piece stem collars shall not be acceptable.

6.) Stem Seal

All gate valves shall have O-ring stem seals. The O-ring stem seal shall be designed such that the seal above the stem collar is replaceable with the valve under pressure in the fully open position.

7.) Bolts and Nuts

Bolts and nuts for the stuffing box and bonnet shall be 316 stainless steel.

8.) Valve Actuators

Lever or handwheel rotation, where required, shall be counterclockwise (left) to open the valve. The valve shall have an arrow cast on the operating nut or handwheel indicating the opening direction.

a. Aboveground Service or Within Vault

Valves for aboveground service shall be motor operated or handwheel operated, at the discretion of the Department.

b. Buried Service

Traveling nut operator with a two (2) inch standard square AWWA operating nut, for use with a standard "T" wrench, suitable for direct burial. Operator components shall withstand the torque at the extreme operator position specified in ANSI/AWWA C509 or C515 as applicable. Operator shall be totally enclosed, fully gasketed, and grease packed.

Right angle, side actuated worm gears shall be required in locations where the top nut is less than 18 inches from finished grade.

9.) Alignment Ring

A valve box self-centering alignment ring shall be as manufactured by American Flow Control or approved equal.

2. Interior Coating

The interior of the valve shall have a polyamide cured epoxy protective interior coating in compliance with ANSI/AWWA C550 (Protective Interior Coatings for Valves and Hydrants) and C504, Tnemec Series N140 Pota-Pox Plus for potable water application or a factory-applied fusion bonded powder epoxy.

3. Exterior Coating

All valves shall have either an exterior coating as set forth below:

a. Factory Primed Valves

Unless otherwise shown on the Plans, all exposed valves within the limits of structure walls or any valves exposed aboveground shall be delivered to the job site factory-blasted in accordance with SSPC-SP-6, hand or power-tool cleaned with oil and grease removed, and primed with one (1) coat of polyamide cured epoxy coating Tnemec Series N140 Pota-Pox Plus or an approved factory-applied fusion bonded powder epoxy in compliance with ANSI/AWWA C550.

All aboveground or vaulted valves shall be painted in accordance with ANSI/AWWA C504 and as set forth below.

		Dry Film Thickness *(mils)*
Field Spot-Primer	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0
Top Coat 1	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0
Top Coat 2	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0

SWU reserves the right to select paint colors. Where no colors are selected by the Department or otherwise shown on the Plans, all aboveground valves for potable water shall be color-coded dark blue (Tnemec Color ID: SC06 Safety Blue).

b. Bituminous Coating
All valves indicated for buried service shall have a bituminous coating in accordance with all ANSI/AWWA C504, or an epoxy coating as set forth in the Factory Primed Valves paragraph above.

4. Affidavit of Compliance
Prior to equipment delivery, the manufacturer shall furnish to the Department Engineer an affidavit stating that the valve and all materials used in its construction conform to the requirements of ANSI/AWWA C509 or C515 as applicable, that all tests specified therein have been performed, and all test requirements have been met.

5. Valve Boxes
All buried valves shall be equipped with suitable valve boxes, compatible with the valves for which they are provided. The valve boxes, including all appurtenances, shall be cast iron. The valve box and appurtenances shall consist of a base, extensions as required, and a top section with a drop lid. The lid shall be marked with the word “WATER”. The manufacturer shall submit three (3) sets of drawings prior to delivery for approval by the Department Engineer, showing the principal dimensions, construction details, and materials used in construction of the valve box.

A valve box, as specified herein, shall be provided for each valve used in a buried service application. All castings shall be in conformance with AASHTO M306 (Drainage, Sewer, Utility, and Related Castings) and shall be free from cracks, holes, scale, shrinkage, distortion, and other defects; have a quality finish; and conform to the Plans. Weights shall be within ± 5% tolerance of the specified weights, as set forth by AAHSTO M306.

a. Standard Depth
Standard depth valve boxes shall be two (2) piece, screw-type, 5-1/4 inch shaft, 27-37 inch extension, with a combined weight of at least 80 pounds. Standard depth valve boxes shall be 6850 Series Model No. 562-S as manufactured by Tyler Pipe, 8550 Series Model 562-S as manufactured by East Jordan Iron Works, or approved equal

b. Extra Depth
Extra depth valves shall be two (2) piece, screw-type, 5-1/4 inch shaft, with extension length appropriate for depth of bury, as manufactured by Tyler Pipe or East Jordan Iron Works. No more than two (2) box extensions shall be allowed. In no case shall PVC risers be used to adjust alignment with grade. DIP risers shall not be permitted to adjust alignment with grade unless under special conditions as approved by the Department. If the depth of bury exceeds three (3) feet, as measured from top of nut to finished grade, an operator extension shall be provided with the box to enable the operation of the valve with a standard six (6) foot “T” wrench. All valves with greater than a six (6) foot bury shall be equipped with a permanent extension stem, extending to three (3) below finished grade.

6. Concrete
All concrete used for the placement of valve box collars shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications.

7. Operator Extensions (Valve Hub)
   Valve key extensions of ample size shall be provided where required and shall be one-piece or welded together. Valve key extensions shall be Schedule 40 steel pipe, painted with Tnemec Series N140 Pota-Pox Plus. Only one (1) extension shall be permissible. The operating nut shall be three (3) feet below the top of the valve box. Operator extensions shall be as manufactured by Mueller, American Flow Control, or approved equal.

8. Valve Marker Posts
   If required by the Department, valve marker posts shall be 3-Rail as manufactured by Rhino, with a blue coating and the applicable warning decal.

C. EXECUTION

All valves shall be installed at the locations shown on the Plans or at the direction of the Department Engineer.

1. Valve Installation
   Valves shall be installed in accordance with ANSI/AWWA C509 or C515 as applicable, relevant sections of ANSI/AWWA C600, the manufacturer's recommendations, and these Specifications. Valves shall be installed in the closed position to prevent debris from entering the valve.

2. Visual Inspection
   Prior to installation, all valves shall be visually inspected for defects, and any foreign material in the valve interior shall be removed. The valve shall be tested for operation through its full range of motion and compared to the manufacturer's published information.

3. Valve Boxes
   The valve box shall be installed with an alignment ring to not transmit shock or stress to the valve. The valve box shall be centered and plumb over the operating nut of the valve, with the box cover flush with the surface of the finished pavement, final grade, or other level as directed by the Department Engineer. The valve box shall be backfilled evenly around the perimeter with select material. The material shall be hand tamped so the ground will not settle after placement of the concrete collar.

4. Valve Box Collar
   All valve box lids shall have an 18 inch square cast-in-place concrete collar, as designated by the Department. Generally, valve box collars shall be constructed around valve boxes when located in pastures, fields, open area, roadsides, gravels drives, parking areas, and embankments. Six (6) inches of compacted gravel base shall be installed under all valve box collars. The collar shall be centered on the valve box lid and shall be six (6) inches thick with #4 concentric rebar centered around the valve box. The top of the pad shall be flush with the top of the box and the surrounding ground or roadway surface. Valve box collars shall not be installed until soil has been compacted and every item of cleanup has been completed.

5. Valve Marker Posts
   If required by the Department, valve marker posts shall be 3-Rail as manufactured by Rhino, with a blue coating and the applicable warning decal.

6. Dead Ends
   Valves located at the end of pipelines shall have DI plugs or caps, with or without blowoff cocks, as indicated. All dead end valves shall be restrained as shown on the Plans or at the direction of the Department Engineer.

D. TESTING

Valves shall be hydrostatically tested for leakage in accordance with ANSI/AWWA C509 or C515 as applicable, prior to leaving the factory. Valves shall also be field hydrostatically tested in conjunction with main line testing in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

END OF SECTION

SECTION T28

PLUG VALVES

A. DESCRIPTION

This Section sets forth acceptable materials and procedures for the installation of plug valves. Only SWU personnel shall be permitted to operate existing system valves. Valves shall be provided with an extension stem, position indicator, alignment ring, and cast iron valve box and cover as required and specified below.

B. MATERIALS

1. Plug Valves
   a. Design

   All plug valves shall be of the corrosion resistant, resilient-faced, tight-closing type as manufactured by DeZurik or Pratt. Plug valves shall be in general accordance with ANSI/AWWA C517 (Resilient-Seated Cast-Iron Eccentric Plug Valves), with the exception that longer laying lengths may be permissible to account for rounded ports. Valves shall be bi-directional with eccentric seating such that the opening movement of the closing plug members results in the closing member rising off the body seat contact.

   Valves 3-12 inches shall be designed for a minimum working pressure of at least 175 psi, and valves 14-72 inches shall be designed for a minimum working pressure of at least 150 psi.

   Valves shall be satisfactory for applications involving throttling service and/or frequent operation and for applications involving open/close valve operation. Valves shall have port areas of at least 80% of the cross section of the connecting piping. Valves shall have stainless steel, permanently lubricated upper and lower plug stem bushings.

   b. Construction

      1.) Valve Body and Ends

      Valve bodies shall be constructed of ASTM A126 (Gray Iron Castings for Valves, Flanges, and Pipe Fittings), Class B cast iron.

      2.) Valve Ends

      All valves utilized for buried service shall have MJ end bodies, as per ANSI/AWWA C111/A21.11, and all aboveground valves or valves in vaults shall have flange end bodies, unless otherwise specified. Flanges ends and drilling shall comply with ANSI B16.1, Class 125.

      3.) Valve Plug

      The valve plug shall be constructed of ductile or cast iron with a rubber facing. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and the body seat, with the plug in the closed position, shall be externally adjustable in the field

with the valve under pressure. The plug shall be coated with a Hycar, or an approved equal compound suitable for use with raw sewage.

4.) Nuts, Bolts, and Washers
316 stainless steel.

5.) Bearings
Permanently lubricated sleeve type 316 stainless steel.

6.) Packing Seal
Buna-N, U-ring type. Seals shall be self-adjusting and repackable without moving the bonnet from the valve under pressure.

7.) Grit Seal
Buna-N.

8.) Valve Actuators
Lever or handwheel rotation, where required, shall be counterclockwise (left) to open the valve. The valve shall have an arrow cast on the operating nut or handwheel indicating the opening direction.

a.) Aboveground Service
Aboveground plug valves shall be equipped with a totally-enclosed worm gear type manual actuator and handwheel. Gears shall be sized for the maximum rated pressure and flow of the valve.

All aboveground valves shall have dial indicators.

b.) Buried Service
Buried valves shall be equipped with a totally-enclosed worm gear type manual actuator and a two (2) inch operating nut in compliance with the requirements of ANSI/AWWA C517. Gears shall be sized for the maximum rated pressure and flow of the valve.

9.) Alignment Ring
A valve box self-centering alignment ring shall be as manufactured by American Flow Control or approved equal.

2. Interior Coating
The interior of the valve shall have a polyamide cured epoxy protective interior coating in compliance with ANSI/AWWA C550 (Protective Interior Coatings for Valves and Hydrants) and C517, Tnemec Series N69 Hi-Build Epoxoline II, PPG Amerlock 400, or approved equal.

3. Exterior Coating
All valves shall have either an exterior coating as set forth below:

a. Factory Primed Valves
Unless otherwise shown on the Plans, all exposed valves within the limits of structure walls or any valves exposed aboveground shall be delivered to the job site factory-blasted in accordance with SSPC-SP-6, hand or power-tool cleaned with oil and grease removed, and primed with one (1) coat of polyamide cured epoxy coating Tnemec Series N140 Pota-Pox Plus, PPG Amerlock 400, or approved equal.

All aboveground or vaulted valves shall be painted in accordance with ANSI/AWWA C504 and as set forth below.

		Dry Film Thickness *(mils)*
Field Spot-Primer	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0
Top Coat 1	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0
Top Coat 2	Tnemec Series N69 H. B. Epoxoline II	4.0 - 6.0

SWU reserves the right to select paint colors. Where no colors are selected by the Department or otherwise shown on the Plans, all aboveground valves for sewage application shall be color-coded dark gray (Tnemec Color ID: GR08 Fossil).

b. Bituminous Coating
All valves indicated for buried service shall have a bituminous coating in accordance with ANSI/AWWA C517, or an epoxy coating as set forth in the Factory Primed Valves paragraph above.

4. Affidavit of Compliance
Prior to equipment delivery, the manufacturer shall furnish to the Department Engineer an affidavit stating that the valve and all materials used in its construction conform to the requirements of ANSI/AWWA C517, that all tests specified therein have been performed, and all test requirements have been met.

5. Valve Boxes
All buried valves shall be equipped with suitable valve boxes, compatible with the valves for which they are provided. The valve boxes, including all appurtenances, shall be cast iron. The valve box and appurtenances shall consist of a base, extensions as required, and a top section with a drop lid. The lid shall be marked with the word “SEWER”. The manufacturer shall submit three (3) sets of drawings prior to delivery for approval by the Department Engineer, showing the principal dimensions, construction details, and materials used in construction of the valve box.

A valve box, as specified herein, shall be provided for each valve used in a buried service application. All castings shall be in conformance with AASHTO M306 (Drainage, Sewer, Utility, and Related Castings) and shall be free from cracks, holes, scale, shrinkage, distortion, and other defects; have a quality finish; and conform to the Plans. Weights shall be within ± 5% tolerance of the specified weights, as set forth by AAHSTO M306.

a. Standard Depth
Standard depth valve boxes shall be two (2) piece, screw-type, 5-1/4 inch shaft, 27-37 inch extension, with a combined weight of at least 80 pounds. Standard depth valve boxes shall be 6850 Series Model No. 562-S as manufactured by Tyler Pipe, 8550 Series Model 562-S as manufactured by East Jordan Iron Works, or approved equal.

b. Extra Depth
Extra depth valves shall be two (2) piece, screw-type, 5-1/4 inch shaft, with extension length appropriate for depth of bury, as manufactured by Tyler Pipe or East Jordan Iron Works. No more than two (2) box extensions shall be allowed. In no case shall PVC risers be used to adjust alignment with grade. DIP risers shall not be permitted to adjust alignment with grade unless under special conditions as approved by the Department. If the depth of bury exceeds three (3) feet, as measured from top of nut to finished grade, an operator extension shall be provided with the box to enable the operation of the valve with a standard six (6) foot “T” wrench. All valves with greater than a six (6) foot bury shall be equipped with a permanent extension stem, extending to three (3) below finished grade.

Valves shall be located as shown on the Plans, and valve boxes shall be set to finished grade.

6. Concrete
All concrete used for the placement of valve box collars shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications.

7. Operator Extensions (Valve Hub)
   Valve key extensions of ample size shall be provided where required and shall be one-piece or welded together. Valve key extensions shall be Schedule 40 steel pipe, painted with Tnemec Series N140 Pota-Pox Plus. Only one (1) extension shall be permissible. The operating nut shall be three (3) feet below the top of the valve box. Operator extensions shall be as manufactured by Mueller, American Flow Control, or approved equal.

8. Valve Marker Posts
   If required by the Department, valve marker posts shall be 3-Rail as manufactured by Rhino, with a blue coating and the applicable warning decal.

C. EXECUTION

All valves shall be installed at the locations shown on the Plans or at the direction of the Department Engineer.

1. Valve Installation
   Valves shall be installed in accordance with ANSI/AWWA C517, relevant sections of ANSI/AWWA C600, the manufacturer's recommendations, and these Specifications. Valves shall be installed in the closed position to prevent debris from entering the valve.

2. Visual Inspection
   Prior to installation, all valves shall be visually inspected for defects, and any foreign material in the valve interior shall be removed. The valve shall be tested for operation through full range of motion and compared to the manufacturer's published information.

3. Valve Boxes
   The valve box shall be installed with an alignment ring to not transmit shock or stress to the valve. The valve box shall be centered and plumb over the operating nut of the valve, with the box cover flush with the surface of the finished pavement, final grade, or other level as directed by the Department Engineer. The valve box shall be backfilled evenly around the perimeter with select material. The material shall be hand tamped so the ground will not settle after placement of the concrete collar.

4. Valve Box Collar
   All valve box lids shall have an 18 inch square cast-in-place concrete collar, as designated by the Department. Generally, valve box collars shall be constructed around valve boxes when located in pastures, fields, open area, roadsides, gravels drives, parking areas, and embankments. Six (6) inches of compacted gravel base shall be installed under all valve box collars. The collar shall be centered on the valve box lid and shall be six (6) inches thick with #4 concentric rebar centered around the valve box. The top of the pad shall be flush with the top of the box and the surrounding ground or roadway surface. Valve box collars shall not be installed until soil has been compacted and every item of cleanup has been completed.

5. Valve Marker Posts
   If required by the Department, valve marker posts shall be 3-Rail as manufactured by Rhino, with a blue coating and the applicable warning decal.

6. Dead Ends
   Valves located at the end of pipelines shall have DI plugs or caps, with or without blowoff cocks, as indicated. All dead end valves shall be restrained as shown on the Plans or at the direction of the Department Engineer.

D. TESTING

Valves shall be hydrostatically tested for leakage in accordance with ANSI/AWWA C517, prior to leaving the factory. Valves shall also be field hydrostatically tested in conjunction with main line testing in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

END OF SECTION

SECTION T29

AIR RELEASE AND VACUUM VALVE ASSEMBLIES, BLOWOFF VALVES, PRESSURE REDUCERS, BACKFLOW PREVENTERS, AND CHECK VALVES

A. DESCRIPTION

This Section sets forth acceptable materials and procedures for the installation of air release and vacuum valve assembly, blowoff valves, pressure reducers, and backflow preventers. Only SWU personnel shall be permitted to operate existing system valves.

B. MATERIALS

1. Combination Air Release and Vacuum Valve for Sewage

a. Design

Combination air and vacuum release valve assemblies shall conform to ANSI/AWWA C512 (Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service) performance specifications. Combination sewage air and vacuum release valve assemblies shall be ARI Model D-020 and shall be rated for a minimum working pressure of at least 250 psi.

Sewage air release valves shall be of the type that automatically exhausts large quantities of air during the filling of a system and allows air to re-enter during draining or when a vacuum occurs. The valve shall also be capable of exhausting small quantities of air during normal system operation.

Sewage air release valves shall be furnished with back-flushing attachments. The connection on all pipelines shall be sized as indicated on the Plans with a full port isolation ball valve of the same size. Valves with two (2) inch connections shall be threaded, and larger connections shall be flanged.

b. Construction

The valve shall be constructed of the following materials:

1.) Body and Cover

The body and cover shall be 316 stainless steel. The body shall be conically shaped to maintain adequate clearance between the lower float and the body of the valve.

2.) Seal

The rolling resilient seal shall provide smooth, leak-free opening and closing over the fluctuation of pressure differentials. Seal assembly hinge shall be EPDM or Buna-N.

3.) Nuts and Bolts

316 stainless steel

4.) Float and Float Stem

Float shall be spring-loaded, consisting of 316 stainless steel. Float system and seal plug connection shall combine to ensure that no contact occurs between the sewage and the seal.

5.) Ball Valve

Ball valve shall be ASTM B124 (Copper and Copper Alloy Forging Rod, Bar, and Shapes) chrome plated brass or 316 stainless steel.

2. Air Release Valve

a. Design

Air release valve assemblies shall conform to ANSI/AWWA C512 (Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service) performance specifications. Air release valve assemblies shall be ARI Model D-020-V and shall be rated for a minimum working pressure of at least 250 psi.

Sewage air release valves shall be of the type that automatically exhausts air as it accumulates at the high points of a pressurized system. These systems are not recommended for vacuum protection or for venting large quantities of air, although some air will be admitted into the system under vacuum conditions.

Sewage air release valves shall be furnished with back-flushing attachments. The connection on all pipelines shall be sized as indicated on the Plans with a full port isolation ball valve of the same size.

b. Construction

Valve construction and materials shall be as specified in the Combination Air Release and Vacuum Valve for Sewage paragraph set forth in this Section.

3. Pressure Reducing Valves

Pressure reducing valves (PRVs) for residential applications shall be as set forth herein. Large PRVs shall be subject to individual design and approval by the Department.

PRVs shall be designed to provide tight shutoff under conditions of no flow and shall not “hunt” under ordinary flow conditions. Valves shall be capable of handling a minimum inlet pressure of at least 300 psi.

Direct-acting valves shall be globe type with threaded connections and union assembly. The valves shall be provided with a bronze or ductile iron body and cover, stainless steel trim, reinforced neoprene diaphragm, Buna-N disc, and stainless steel strainer. Direct-acting pressure reducing valves shall be Watts Model LF25AUB-Z3, or approved equal.

A strainer shall be installed in the piping immediately upstream from each two (2) inch or smaller pressure reducing valve. Strainers shall be Y-pattern units with a bronze, brass, or cast iron body and monel and stainless steel, 40 mesh screens. Strainers installed in copper piping shall be of bronze or brass. The blowoff from each strainer shall be equipped with a shutoff valve.

4. Backflow Preventer

Backflow preventers shall comply with ANSI/AWWA C511 (Reduced-Pressure Principle Backflow-Prevention Assembly), and shall be of the reduced pressure principle type, consisting of a dual check valve assembly with a reduced pressure zone between check valves. A tight-closing shutoff valve shall be provided on each end of the device. Valves shall open and close quietly and shall not “hunt” under normal flow conditions. The design shall not cause undue pressure surges from occurring during the normal cycle of operation, nor shall the valve be impaired by surges that are normally encountered in a system.

Backflow preventers, two (2) inch and smaller, shall have a bronze body with threaded end connections. Backflow preventers in larger sizes shall have a cast iron body with flat faced, flanged connections. Flange diameter and drilling shall conform to ANSI/ASME B16.1, Class 125.

Backflow preventers 1/2 inch through two (2) inch in size shall be Wilkins Model 975XL2. Assemblies 2-1/2 inch through 10 inch shall be Wilkins Model 375. Larger system shall be subject to individual design and approval by the Department. Backflow preventers shall be designed for a working pressure of at least 175 psi, and shall have an epoxy coated interior and exterior, stainless steel internals, and conform to the requirements as indicated on the Plans.

5. Flushing Hydrants
   Flushing hydrants shall not be used, unless otherwise approved by the Department. When prior approved, flushing hydrants shall be as manufactured by Kupferle Foundry Co.

6. Check Valves
   Check valves shall permit flow in one direction only and close tightly without slamming when the discharge pressure exceeds the inlet pressure. The valve in the full open position shall permit full flow through the valve equal to the nominal pipe diameter. Check valves shall have a lever arm with the dampening devices as specified by the Department. The Department reserves the right to determine the type of check valve depending on the specific application and location of the valve as well as the valve model and manufacturer.

C. EXECUTION

Construction and installation of the combination assembly, air release valve, PRVs, and backflow preventers shall be in accordance and at the locations indicated on the Plans and as otherwise directed by the Department Engineer. Configuration of air release valves in vaults shall be as depicted on the Standard Detail Sheet.

1. Valve Installation
   Valves shall be installed in accordance with the applicable AWWA standards, the manufacturer's recommendations, and these Specifications. Valves shall be installed in the closed position to prevent debris from entering.

2. Visual Inspection
   Prior to installation, all valves shall be visually inspected for defects, and any foreign material in the valve interior shall be removed. The valve shall be tested for operation through the full range of its motion and compared to the manufacturer's published information.

D. TESTING

Air release and combination air release and vacuum valve assemblies shall be subjected to hydrostatic testing for leakage in accordance with ANSI/AWWA C512, prior to leaving the factory. Backflow preventers shall also be subjected to hydrostatic testing for leakage as set forth in ANSI/AWWA C511, prior to leaving the factory. Valves shall also be field hydrostatically tested in conjunction with main line testing in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

END OF SECTION

SECTION T30

CLEANUP, SEEDING, AND SOD

A. GENERAL

This Section sets forth requirements for completing proper cleanup of all areas utilized in construction of the Work. This Section also sets forth the materials and procedures required for the seeding, sodding, fertilizing, and mulching of all required areas. Cleanup is an important part of the project, and adequate equipment and qualified personnel shall be applied to this portion of the construction procedures from the beginning of the project. The general classifications of cleanup shall be as set forth below.

1. Class I Cleanup
   Areas of construction within lawns, gardens, and other well-kept areas, including street right-of-ways.

2. Class II Cleanup
   Areas of construction within fields, meadows, and other graded areas not included under Class I.

3. Class III Cleanup
   Areas of construction that are heavily brushed or wooded, steep rocky slopes, and other areas where it is not practical for the area to be cultivated.

4. Special Cleanup
   Areas of construction which require special cleanup procedures.

Final cleanup shall be performed immediately after pipe construction and other facility installations. Cleanup shall be completed on each pipeline segment or other installation, including all necessary seeding and sodding. Sod, where required, shall match the adjacent turf conditions and horticultural species.

B. MATERIALS

1. Topsoil
   Topsoil shall be stripped as specified in the Topsoil Removal paragraph in the Site Preparation, Excavation, and Fill Section of these Specifications and shall be used for the establishment and repair of vegetative cover. All disturbed areas shall receive a minimum of four (4) inches of topsoil, regardless of Cleanup Class. In the event there is insufficient topsoil stored along the ditch line to accomplish the topsoiling requirement, the Contractor shall haul in additional topsoil at own expense to meet this requirement.

   Topsoil shall be a loam or silty loam, free of clay lumps, rocks, and excessive amount of roots. Topsoil shall have an organic content of at least 1%.

2. Seed
   Seed shall be labeled in accordance with the rules and regulations of the Arkansas State Plant Board and shall have a minimum of 98% pure seed and 85% germination by weight, as well as

contain no noxious weed seeds. Seed that has become wet, moldy, or otherwise damaged in transit or storage shall not be accepted. Seeding shall be at the rates and mixtures as set forth herein, depending on type of seeding and season, unless otherwise specified. Seed shall be uniformly applied using a spreader. Seeds shall be watered as required to obtain an adequate stand of grass cover.

a. Temporary Seeding
Areas denuded of vegetation by grading operations, stockpiles of topsoil, or other areas disturbed by the Contractor which are subject to erosion shall be temporarily seeded with annual rye grass and covered with mulch. Temporary seeding shall be at a rate of 0.25 pounds per 100 square feet.

b. Permanent Seeding
Permanent seeding shall be composed of the varieties and amounts by weight as listed for the specific class of cleanup set forth herein.

3. Fertilizer
Fertilizer shall be a commercial grade, uniform in composition, free flowing, and suitable for application with mechanical equipment. Fertilizer shall be delivered to the site in labeled containers conforming to all local, state, or federal fertilizer laws and bearing the analyses of the nutrients. Nutrients shall be proportioned 10-20-10 (nitrogen-phosphorus-potash). Fertilizer shall be applied to all seeded and sodded areas at the rates specified herein.

4. Sod
Sod shall consist of cuttings procured from areas where the soil is fertile, as indicated by vigorous growth. The grass shall have a healthy root system of dense, thickly matted roots throughout the sod for a minimum thickness of three (3) inches. The sod shall be substantially free from noxious weeds or otherwise undesirable grasses and shall not contain any chemicals or other matter injurious to its growth or hardiness when transplanted, including staples. All sources of sod shall be approved by the Department Engineer. Palletted and rolled sod shall be acceptable.

5. Mulching Straw
Straw for mulching shall be from threshed rice, oats, wheat, barley, or rye; hay obtained from various legumes or grasses such as lespedeza, clover, vetch, soybeans, Bermuda, carpet sedge, Bahia, and fescue; or a combination thereof. Mulch shall be dry and reasonably free from Johnson grass or other noxious weeds, chemicals, or other injurious matter and shall not be excessively brittle or in a state of decomposition. All material shall be approved by the Department Engineer prior to use.

6. Tackifiers
Tackifiers shall be used to adhere the mulch mat together, keeping it intact under normal climatic conditions, and shall meet all AHTD requirements for approved materials.

7. Hydro-Seeder Applications
Application of seed and fertilizer incorporated into one operation by “Hydro-Seeder” equipment shall be acceptable when prior approved by the Department and as specified herein.

8. Water
Water shall be of irrigation quality, free of impurities that would be detrimental to plant growth.

C. EXECUTION

The method of cleanup for each of the classes defined above shall be as set forth below.

1. All Areas
During construction, the Contractor shall keep the construction area clean and neat at all times. For all classes of cleanup, the Contractor shall clean the entire area after construction has been

completed. Tops of structures, sidewalks, exterior and interior building walls, floors, equipment, and all painted and glass surfaces shall be cleaned of clay, mortar, and other materials by washing down with soap or other cleaning materials as required. Such touch-up work as required shall then be performed to leave the area in a clean and neat condition.

Excess materials, excavation, brush, trash, debris, and other construction materials shall be removed and disposed of as the Work progresses. In built-up areas, such as lawns, the jobsite shall be cleaned up immediately behind construction. Streets and driveways blocked by excess materials after construction is completed shall not be tolerated. All construction areas shall be cleaned to the satisfaction of SWU.

If any trench should settle while the Contractor is still on the job or within one (1) year of the project completion date, the Contractor shall make the required repairs in accordance with these Specifications.

2. Class I Cleanup

The trench shall be backfilled in accordance with the applicable Section for water or sewer lines in these Specifications. Areas which have been disturbed, including those areas damaged by the tracks of heavy equipment, shall be carefully backfilled and repaired as though part of the actual trench excavation. A minimum of four (4) inches of topsoil shall be placed on all disturbed areas. After the topsoil has been spread over the damaged areas, the Contractor shall immediately hand-rake the entire construction area to remove all rock. Debris of every type shall be removed and all damaged tree limbs shall be pruned in accordance with ANSI A300 (Tree, Shrub, and Other Woody Plant Maintenance – Pruning (Part I)) by a qualified horticulturist, unless otherwise directed by the Department.

Establishment of vegetation shall be by either seeding or sodding as shown on the Plans or as otherwise directed by the Department.

a. Seeding

The area to be seeded shall be brought to a reasonably smooth and uniform surface to conform to the finished grade indicated on the Plans. The area shall be thoroughly pulverized by means of disk harrows or another approved means, unless otherwise specified, to a depth of at least four (4) inches below the finished grade. The area shall be lightly firmed with a cultipacker or otherwise rolled before seeding. Water may be required before, during, and after site preparation to maintain an adequate soil moisture content, as directed by the Department.

Fertilizer shall be applied to all seeded areas at a rate of 800 lb/acre. Fertilizer shall be thoroughly incorporated into the soil. Application of seed and fertilizer integrated into one operation by an approved “Hydro-Seeder” method shall be acceptable. A maximum of 800 pounds of fertilizer shall be permitted per 1,500 gallons of water.

After the area has been adequately raked and accepted by the Department, the area shall be seeded at the rate of 0.15 pounds per 100 square feet, using the following seed mixture with percent expressed in terms of weight, unless sod shall be otherwise applied.

Lawn Fescue	30%
Blue Grass	30%
Rye Grass (Annual)	30%
White Clover (Common)	10%

Straw for mulch shall be uniformly placed over seeded areas to provide a cover thickness of approximately two (2) inches. Mulch shall be anchored using a tracking or roller method by pressing the mulch into the soil or by applying a tackifier at a rate of approximately 0.05 gallons/square yard. The Contractor may use an approved mulching

machine to combine the operations of applying mulch cover and tackifier into one procedure.

b. Sodding

If the existing ground cover does not contain any of the grasses as set out in the seed mixture above, the Contractor shall be responsible for cutting, removing, and stockpiling the existing sod on the job site. After backfilling, the sod shall be replaced to a condition equal to or better than that prior to construction. In the event that an insufficient amount of sod has been stored or if sod has been lost or destroyed, the Contractor shall be responsible for providing and installing new ground cover of the existing type.

The area to be sodded shall be brought to a reasonably smooth and uniform surface to conform to the finished grade indicated on the Plans. The area shall be firm but compacted, with the top one (1) inch below the finished grade loosened, unless otherwise specified. Water may be required before, during, and after site preparation to maintain an adequate soil moisture content, as directed by the Department. Fertilizer shall be applied to the areas receiving sod at a rate of 250 lbs/acre and incorporated into the top inch of soil.

Areas producing sod mulch shall be mowed and raked to remove weeds and undesirable matter. Sod shall be excavated with an approved device, such as a sod cutter, and care shall be taken to retain the native soil intact. Cut sod shall be hauled and placed immediately. Sod shall be kept moist from the time it is cut until hand placement on a moist earth bed. Sod shall be placed at the base of slopes, working upward. At the top of slopes, sod shall be turned slightly into the embankment and a layer of earth placed over it and compacted, so as to direct surface water over and onto the sod.

After the sod has been spread and shaped uniformly, the area shall be firmed with the use of a lawn roller or other approved equipment, with care taken to avoid tearing the end strips. When sodding is completed, the area shall be cleared of loose sod, excess soil, and other foreign material.

Watering shall be required immediately after placement of seeding or sod and at a rate and frequency to sufficiently establish adequate vegetation. The Contractor shall maintain growth areas for 3 weeks after the time of placement or until final acceptance of the project, whichever is greater.

3. Class II Cleanup

The trench shall be backfilled in accordance with the applicable Section for water or sewer pipe in these Specifications. Areas which have been disturbed, including those areas damaged by the tracks of heavy equipment, shall be carefully backfilled and repaired as though part of the actual trench excavation. A minimum of four (4) inches of topsoil shall be placed on all disturbed areas. After the topsoil has been spread over the damaged areas, the Contractor shall immediately hand-rake the entire construction area to remove all rock. Debris of every type shall be removed and all damaged tree limbs shall be pruned in accordance with ANSI A300 (Tree, Shrub, and Other Woody Plant Maintenance – Pruning (Part I)) by a qualified horticulturist, unless otherwise directed by the Department.

Establishment of vegetation shall be by either seeding or sodding as shown on the Plans or as otherwise directed by the Department.

a. Seeding

The area to be seeded shall be brought to a reasonably smooth and uniform surface to conform to the finished grade indicated on the Plans. The area shall be thoroughly pulverized by means of disk harrows or another approved means, unless otherwise specified, to a depth of at least four (4) inches below the finished grade. The area shall be lightly firmed with a cultipacker or otherwise rolled before seeding. Water may be

required before, during, and after site preparation to maintain an adequate soil moisture content, as directed by the Department.

Fertilizer shall be applied to all seeded areas at a rate of 800 lb/acre. Fertilizer shall be thoroughly incorporated into the soil. Application of seed and fertilizer integrated into one operation by an approved "Hydro-Seeder" method shall be acceptable. A maximum of 800 pounds of fertilizer shall be permitted per 1,500 gallons of water.

After the area has been adequately raked and accepted by the Department, the area shall be seeded at the rate of 0.15 pounds per 100 square feet, using the following seed mixture with percent expressed in terms of weight, unless sod shall be otherwise applied.

Field Fescue	40%
Rye Grass (Annual)	40%
White Clover (Common)	20%

Straw for mulch shall be uniformly placed over seeded areas to provide a cover thickness of approximately two (2) inches. Mulch shall be anchored using a tracking or roller method by pressing the mulch into the soil or by applying a tackifier at a rate of approximately 0.05 gallons/square yard. The Contractor may use an approved mulching machine to combine the operations of applying mulch cover and tackifier into one procedure.

b. Sodding

If the existing ground cover does not contain any of the grasses as set out in the seed mixture above, the Contractor shall be responsible for cutting, removing, and stockpiling the existing sod on the job site. After backfilling, the sod shall be replaced to a condition equal to or better than that prior to construction. In the event that an insufficient amount of sod has been stored or if sod has been lost or destroyed, the Contractor shall be responsible for providing and installing new ground cover of the existing type.

The area to be sodded shall be brought to a reasonably smooth and uniform surface to conform to the finished grade indicated on the Plans. The area shall be firm but compacted, with the top one (1) inch below the finished grade loosened, unless otherwise specified. Water may be required before, during, and after site preparation to maintain an adequate soil moisture content, as directed by the Department. Fertilizer shall be applied to the areas receiving sod at a rate of 250 lbs/acre and incorporated into the top inch of soil.

Areas producing sod mulch shall be mowed and raked to remove weeds and undesirable matter. Sod shall be excavated with an approved device, such as a sod cutter, and care shall be taken to retain the native soil intact. Cut sod shall be hauled and placed immediately. Sod shall be kept moist from the time it is cut until hand placement on a moist earth bed. Sod shall be placed at the base of slopes, working upward. At the top of slopes, sod shall be turned slightly into the embankment and a layer of earth placed over it and compacted, so as to direct surface water over and onto the sod.

After the sod has been spread and shaped uniformly, the area shall be firmed with the use of a lawn roller or other approved equipment, with care taken to avoid tearing the end strips. When sodding is completed, the area shall be cleared of loose sod, excess soil, and other foreign material.

Watering shall be required immediately after placement of seeding or sod and at a rate and frequency to sufficiently establish adequate vegetation. The Contractor shall maintain growth areas for 3 weeks after the time of placement or until final acceptance of the project, whichever is greater.

4. Class III Cleanup

The trench shall be backfilled in accordance with the applicable Section for water or sewer pipe in these Specifications. After backfill is complete, all damaged brush shall be cut just below ground surface, and all damaged limbs shall be trimmed in accordance with ANSI A300. A minimum of four (4) inches of topsoil shall be placed on all disturbed areas at the discretion of the Department. All debris shall be disposed of by the Contractor, and the entire area shall be machine-raked to bring the area of construction to a condition equal or better than pre-construction conditions.

The area to be seeded shall be brought to a reasonably smooth and uniform surface to conform to the finished grade indicated on the Plans. The area shall be thoroughly pulverized by means of disk harrows or another approved means, unless otherwise specified, to a depth of at least four (4) inches below the finished grade. The area shall be lightly firmed with a cultipacker or otherwise rolled before seeding. Water may be required before, during, and after site preparation to maintain an adequate soil moisture content, as directed by the Department.

Fertilizer shall be applied to all seeded areas at a rate of 800 lb/acre. Fertilizer shall be thoroughly incorporated into the soil. Application of seed and fertilizer integrated into one operation by an approved “Hydro-Seeder” method shall be acceptable. A maximum of 800 pounds of fertilizer shall be permitted per 1,500 gallons of water.

After the area has been adequately raked and accepted by the Department, the area shall be seeded at the rate of 0.15 pounds per 100 square feet, using the following seed mixture with percent expressed in terms of weight, unless sod shall be otherwise applied.

Tall Fescue (Kentucky 31)	40%
Rye Grass (Annual)	40%
White Clover (Common)	20%

Straw for mulch shall be uniformly placed over seeded areas to provide a cover thickness of approximately two (2) inches. Mulch shall be anchored using a tracking or roller method by pressing the mulch into the soil or by applying a tackifier at a rate of approximately 0.05 gallons/square yard. The Contractor may use an approved mulching machine to combine the operations of applying mulch cover and tackifier into one procedure.

Watering shall be required immediately after placement of seeding or sod and at a rate and frequency to sufficiently establish adequate vegetation. The Contractor shall maintain growth areas for 3 weeks after the time of placement or until final acceptance of the project, whichever is greater.

5. Special Cleanup

Areas or conditions requiring special attention, cleanup, and/or seeding or sodding procedures shall be as directed and approved by SWU.

6. Restoration of Damaged Surfaces and Property

If any pavement, vegetation, or other property is damaged, removed, or otherwise disturbed by the Contractor, through intentional or non-intentional failure to carry out the requirements of the contract documents, state laws, municipal ordinances, and/or the specific direction of the Department or through failure to employ typical and reasonable safeguards, such property shall be replaced and repaired at the expense of the Contractor.

7. Access after Construction

Unless otherwise directed by the Department, all areas shall be graded after construction to be accessible by a four-wheel-drive vehicle at a minimum.

8. Erosion Control
   Erosion control measures and procedures shall comply with all permit requirements and as set forth in the Erosion Control paragraph in the General Project Considerations Section as well as the Environmental Permits Section found in the General Requirements Chapter of these Specifications.

9. Final Acceptance
   Before final acceptance, the Contractor shall repair or replace any seeding or sodding that is defective or has been damaged.

END OF SECTION

SECTION T31

DENSITY TESTING

A. DESCRIPTION

This Section sets forth proper materials, procedures, and acceptable results for density testing. Testing shall be required for backfill around newly constructed manholes, water and sewer lines, service lines, and other structures to ensure proper fill and compaction. The cost of all density testing shall be borne by the Contractor. Asphaltic density testing shall be in conformance with all state, local, and federal regulations and any governing agencies as required.

B. MATERIALS

1. Densometer and Accessories
   An nuclear electronic counting instrument capable of being seated on the surface of the materials to be tested and containing a sealed, high energy, gamma source and a gamma detector. A block of dense material to be used as a reference standard for calibration and to establish reproducible conditions shall be required, as well as a site preparation device to level the test site. The steel drive pin shall be slightly larger than the densometer rod to prepare a hole in the test materials for inserting the rod.

C. EXECUTION

1. Maximum Laboratory Density
   Laboratory soil tests shall be performed by an independent, qualified soils laboratory with equipment and methods acceptable to SWU.

   a. Backfill and Base Course
      Maximum soil density shall be determined in accordance with the Standard Proctor as set forth in AASHTO T99 (The Moisture-Density Relations of Soils Using a 5.5 lb Rammer and a 12-Inch Drop) or the Modified Proctor as set forth in AASHTO T180 (The Moisture-Density Relations of Soils Using a 10 lb Rammer and a 18-Inch Drop), as applicable.

2. In-Place Field Density
   Field density shall be the minimum percentage set forth elsewhere in these Specifications based on the maximum laboratory density value as determined above.

   a. Backfill and Base Course
      In-place direct transmission field density shall be determined in accordance with ASTM D2922 (Standard Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)) or AASHTO T310 (In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)).

The density of backfill material, including crushed stone trench backfill, shall be determined at locations in the field as directed by the Department but at no less than one (1) per 500 linear foot intervals for trench backfill, one (1) per 200 linear feet of trench bottom where over-excavation

required trench filling, one (1) per driveway location, and one (1) per 2,500 square feet in parking lot locations, unless otherwise directed by the Department.

Density testing shall be conducted at a depth of 12-18 inches below the finished grade prior to the placement of topsoil. All surfaces to be paved shall be tested at three (3) depths below finished grade, as selected by the Department Engineer. Unpaved roadway surfaces shall be tested at 12 inches below finished grade.

Moisture content of backfill shall be taken concurrently with the density test, controlled to a range of -2% to +3% of the optimum moisture content as determined by AASHTO T310 or ASTM D2922.

Two (2) additional tests shall be made for each test failure, approximately 100 feet on either side of the failing test.

The cost for performing all density and moisture content tests shall be borne by the Contractor. Any retest or tests performed at the option of the Contractor shall be at the expense of the Contractor and shall not be included in the test frequency specified previously.

END OF SECTION

SECTION T32

MANDREL TESTING OF PVC SEWER LINES

A. DESCRIPTION

This Section sets forth proper materials, procedures, and acceptable results required for mandrel testing of PVC sewer lines.

B. MATERIALS

The mandrel (go/no-go) device shall be cylindrical in shape and constructed with either 9 or 16 evenly spaced arms or prongs. Mandrels with a lesser amount of arms (in odd or even numbers, respectively) shall be rejected for insufficient accuracy. The contact length of the mandrel's arms shall equal or exceed the nominal diameter of the PVC sewer pipe to be inspected. Critical mandrel dimensions shall carry a tolerance of ± 0.01 inch. Drawings of the mandrel with complete dimensioning shall be submitted by the Contractor to the Department Engineer for approval of each diameter and specification of pipe. All necessary equipment to perform the mandrel test in accordance with the Specifications shall be provided by the Contractor.

C. EXECUTION

Flexible sewer pipe shall be mandrel tested with a rigid device sized to pass 5% or less deflection (deformation) of the pipe. The maximum allowable pipe deflection shall not exceed 5% of the base inside diameter. Base inside diameters, as set forth in Table X1.1 of ASTM D3034 (Type PSM Polyvinyl Chloride (PVC) for Sewer Pipe and Fittings) or Table X2.1 of ASTM F679 (PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings) as applicable, shall be used to compute the Mandrel dimensions. Allowances for ovality (from shipment, heat, shipping loads, poor production, etc.) shall not be deducted from the base ASTM data but shall be counted as a part of the 5% or less deflection allowance.

The mandrel shall be hand-pulled by the Contractor through all PVC sewer lines. Any sections of sewer not passing the mandrel shall be uncovered, and the Contractor shall rebed, reround, or replace the sewer to the satisfaction of the Department. Any repaired section shall be retested.

The mandrel inspection shall be conducted no earlier than 30 days after reaching final trench backfill grade provided, in the opinion of the Department Engineer, that sufficient water densification or rainfall has occurred to thoroughly settle the soil throughout the entire trench depth. If the mandrel test cannot be achieved in the 30 days after installation and prior to the project completion date, then the mandrel size shall be increased to measure one-third less of a deflection allowance.

SWU reserves the right to mandrel test any PVC sewer pipe before acceptance and prior to expiration of the warranty period. If a previously accepted line fails a mandrel test during the first year of operation, the defects must be corrected at the Contractor's expense.

END OF SECTION

SECTION T33

LOW PRESSURE AIR TESTING OF GRAVITY SEWER LINES

A. DESCRIPTION

This Section sets forth requirements for the materials, procedures, and acceptable results required for low pressure air testing of gravity sewer lines to determine watertightness. On all gravity flow sewers, the Contractor shall conduct low pressure air tests on the various sections of pipe by use of equipment manufactured for this purpose. Low pressure air testing is used to indicate damaged piping or improper jointing by measuring the rate at which air escapes under pressure. This method shall not be intended to show water leakage limits and shall not be used as a quantitative measure of leakage under service conditions.

B. MATERIALS

All necessary equipment to perform the air test in accordance with these Specifications shall be provided by the Contractor.

1. Air Compressor, Regulator, and Gauge

   The air compressor shall be a portable air source with a main shut-off valve and a regulator to avoid over-pressurizing and possibly damaging an otherwise acceptable line. The compressor shall also have a 9.0 psi pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge. The equipment test gauge shall have a range of at least 0-10 psi with minimum increments of 0.10 psi and an accuracy of at least $\pm$ 0.04 psi. The equipment used shall be Air-Loc system as manufactured by Cherne Industrial, Inc. or as approved by the Department.

C. EXECUTION

After the sewer line has been installed and after manholes have been constructed, the Contractor shall proceed to air test all gravity sewer lines in accordance with ASTM F1417 (Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air) time-pressure drop method to determine if the sewers are free of breaks and other defects which may permit excessive infiltration or leakage.

1. Procedure

   Prior to testing, the line shall be flushed to eliminate debris. The low pressure air test shall be conducted by plugging each opening in the reach of pipe to be tested, including all branches, laterals, wyes, tees, and stubs. Plugs shall be braced securely, and one (1) of the plugs provided shall have an inlet tap or other provision for connecting an air hose. After connecting the air control equipment to the air hose, the air pressure shall be monitored so the internal pressure is approximately 4.0 psi but not exceeding 5.0 psi. The starting test pressure shall be increased by 0.433 psi per foot of groundwater level above the pipe invert if groundwater is present. If the groundwater level is two (2) feet of more above the top of the pipe or if the calculated air pressure required for the test is greater than 9.0 psi, the air test method shall not be used or the groundwater level must be lowered by dewatering. In no case shall the test pressure exceed 9.0 psi. After reaching 4.0 psi, the air supply shall be throttled to maintain pressure between 4.0 and 3.5 psi for at least two (2) minutes to allow equilibrium to occur between the air temperature and the pipe walls. If

any plugs leak during the test period, the Contractor shall bleed off the air, tighten the plugs, and retest. After stabilization is reached, the pressure shall be allowed to be decrease to 3.5 psi. At 3.5 psi, the Contractor shall begin timing with a stopwatch to determine the test time required for the pressure to drop to 3.0 psi. The observed time shall be compared with the minimum allowable times in the chart set forth in ASTM F1417 and herein for pass/fail determination. The pipe shall be presumed free of defects if the time in seconds for the air pressure to decrease from 3.5 psi to 3.0 psi is equal to or greater than that shown in the table below. For pipes 30 inches and larger, the Contractor shall consult with the pipe and appurtenance manufacturers for maximum test pressures.

2. Safety Precautions

The low pressure air test may be dangerous to personnel if, through lack of understanding or carelessness, a line is over-pressurized or plugs are installed improperly. The proper installation of all plugs is vital to prevent the sudden expulsion of a poorly inflated plug. All plugs shall be braced against slippage from internal pressure, and no person shall be allowed in the manhole during the testing procedure or when a plugged pipe in under pressure. Gauges, air piping, manifolds, and valves shall be located on the top of the ground. The line(s) shall not be over-pressurized by exceeding 9.0 psi. The bleeder valve shall be opened after test completion to allow all air to escape. Plugs shall not be removed until pressure in the system has been released.

SPECIFICATION TIME REQUIRED FOR 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PVC PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	46:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

Any test section less than 100 feet in length shall be tested against the times set forth for 100 feet in the chart.

If any defective section of line is found, the line segment shall be tested at 20 foot intervals to determine the exact location(s) of the defect(s). Repairs shall be made in the defective section(s), and the entire line segment shall then be retested. Bell repair clamps shall be strictly prohibited in the repair of defective pipe.

3. Acceptance

All gravity sewer lines shall pass the low pressure air test before accepted by SWU. No air test shall be accepted unless a Department representative is present during the test. Complete replacement of the line will be required of any section 400 feet in length or greater which has three (3) or more point failures. Upon successful low pressure air testing, the line shall then be considered acceptable

for service with other conditions necessary for final acceptance as set forth in the Final Inspection and Acceptance Section in the General Requirements Chapter of these Specifications. The Contractor shall furnish personnel as necessary to assist the Department in the initial start-up of the system.

END OF SECTION

SECTION T34

HYDROSTATIC TESTING OF WATER LINES, SEWER FORCE MAINS, AND APPURTENANCES

A. GENERAL

This Section sets forth the materials and procedures for the hydrostatic testing of pipe, joints, and other materials incorporated into the construction of water lines and sewer force mains to determine watertightness and leakage. All flushing of lines shall be in strict accordance with all local, state, and federal permit requirements.

B. MATERIALS

1. Water for Water Mains
   The Contractor shall schedule and coordinate testing so as to not be carried out during periods of high water usage. A reasonable amount of water shall be furnished to the Contractor by the Department, free of cost to the Contractor for the testing of new water mains. Should the Contractor require additional amounts of water due to water line breaks or neglect on the part of the Contractor, water shall be purchased from the Department at standard water rates. Quantities of water to be paid for by the Contractor shall be determined by the Department. All water for testing shall be potable.

2. Water for Force Mains
   The Contractor shall schedule and coordinate testing so as to not be carried out during periods of high water usage. All water for the testing of force mains shall be provided by the Contractor. No direct connection shall be allowed between any water main and force main. All water for testing shall be potable.

3. Pump, Regulator, and Gauge
   All necessary equipment to perform the test in accordance with these Specifications shall be provided by the Contractor. The equipment test gauge shall have a range of at least 0-300 psi with minimum increments of two (2) psi and shall be oil or glycerin filled.

C. EXECUTION

After completion of construction of water lines or lines conveying pumped wastewater, biosolids, or chemical solutions, the Contractor shall flush and test the new line as set forth below.

1. Initial Flushing of Water Mains
   Prior to hydrostatic testing, the pipe shall be flushed as set forth in the Disinfecting Water Lines Section of these Specifications.

2. Initial State of Force Mains
   Sewer force mains shall be free of debris prior to hydrostatic testing.

3. Hydrostatic Testing
   After initial flushing, pipes conveying water or pumped wastewater, biosolids, or chemical solutions shall be subject to hydrostatic testing as set forth in ANSI/AWWA C600 (Installation of Ductile-Iron

Mains and Their Appurtenances) or ANSI/AWWA C605 (Underground Installation of PVC Pressure Pipe and Fittings for Water) as applicable and with these Specifications. All service lines and ancillary equipment shall be in place and tested with the main. Tests shall be conducted after the line has been backfilled and construction completed, except areas around valves may be left open at the discretion of the Contractor.

a. Test Pressure and Duration

After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the stated working pressure measured at the lowest point along the test section but no less than 150 psi. Under no circumstance shall the test pressure exceed the thrust restraint design pressure limit or the pressure rating for the pipe or joint, whichever is less. For tests exceeding the rated valve working pressure, pressure shall be reduced to the rated valve working pressure on completion of the test. Only then shall the valve be opened to equalize any trapped pressure, such as that which can become trapped between the gates of a double-disc gate valve. The test pressure shall not exceed the rated working pressure of any resilient-seated gate valve, plug valve, or butterfly valve, if such valves are located on the test section. The Contractor shall provide all pumps and other equipment necessary to meter water and maintain the test pressure within $\pm$ 5 psi of the test pressure for a period of at least two (2) hours.

After installing a tapping sleeve and valve but prior to tapping the line, two (2) hydrostatic and leakage tests shall be performed as set forth herein. The initial test shall be conducted by introducing water into a tap or test hole located at the neck of the outlet half of the sleeve, on sleeves furnished with said tap, and with the valve in the closed position and without a test plug. The second test shall be conducted with the valve open and with a plug in place. The sleeve valve shall be capable of maintaining a test pressure of 200 psi for 15 minutes with no visible sign of leakage or drop in test pressure for both tests.

b. Definition of Leakage

Leakage shall be defined as the quantity of water required to maintain pressure within five (5) psi of the specified test pressure for a newly laid pipe, or any valved section thereof, after the air in the pipeline has been expelled and the pipe filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time. The leakage test shall be conducted concurrently with the pressure test.

c. Allowable Leakage

Leakage for water pipe shall be within the limits set forth in the table below in this Section and also in ANSI/AWWA C600 and C605. Allowable leakage for larger pipe diameters may also be found in ANSI/AWWA C600 and C605. If the tested pipe section contains various diameters of pipe, the allowable leakage shall be the sum of the testing allowance for each size. If any pipe exhibits leakage greater than that specified, the Contractor shall, at own expense, locate and repair the defects and retest the line until the leakage is within the specified allowance. Bell repair clamps shall be strictly prohibited for use in repair.

No pipe installation shall be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where:

L = allowable leakage (gph)
S = length of pipe tested (ft)
D = nominal diameter of the pipe (in)
P = average test pressure during the leakage test (psig)

ALLOWABLE LEAKAGE PER 1,000 FT. OF PIPELINE IN GPH

Average Test Pressure *(psi)*	**Nominal Pipe Diameter** (*inches)*														
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
450	0.43	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44	4.30	5.16	6.02	6.88
400	0.41	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24	4.05	4.86	5.68	6.49
350	0.38	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07
300	0.35	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62
275	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63
100	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24

d. Visible Leakage and Damage
All visible leaks shall be repaired regardless of the amount of leakage. Any exposed pipe, fitting, valve, hydrant, tapping sleeve and valve, or joint found to be damaged or defective during the test shall be repaired or replaced. The test shall be repeated until satisfactory results are obtained.

4. Acceptance
After the pipeline has been successfully hydrostatically tested, disinfected as per the Disinfection of Water Lines Section in these Specifications if applicable, and approved by ADH, the line shall then be considered acceptable for service with other conditions necessary for final acceptance as set forth in the Final Inspection and Acceptance Section in the General Requirements Chapter of these Specifications. The Contractor shall furnish personnel as necessary to assist the Department in the initial start-up of the system.

END OF SECTION

SECTION T35

DISINFECTION OF WATER LINES

A. GENERAL

This Section sets forth requirements for the materials, procedures, and acceptable results required for the disinfection of water lines. All flushing of lines shall be in strict accordance with all local, state, and federal permit requirements.

B. MATERIALS

1. Water
   The Contractor shall schedule and coordinate testing so as to not be carried out during periods of high water usage. A reasonable amount of water shall be furnished to the Contractor by the Department, free of cost to the Contractor for the disinfection of new water mains. Should the Contractor require additional amounts of water due to water line breaks or neglect on the part of the Contractor, water shall be purchased from the Department at standard water rates. Quantities of water to be paid for by the Contractor shall be determined by the Department. All water for testing shall be potable.

2. Chlorine
   Chlorine shall be calcium hypochlorite or sodium hypochlorite, conforming to ANSI/AWWA B300 (Hypochlorites) and as specified herein. The material should be stored in a cool, dry, and dark environment to minimize deterioration.

   a. Calcium Hypochlorite
      Calcium hypochlorite is generally available in granular form or in five (5) gram tablets and must contain approximately 65% available chlorine by weight. Tablets dissolve in approximately seven (7) hours and must be given adequate contact time. Calcium hypochlorite intended for swimming pool disinfection shall be prohibited, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the required contact time is achieved.

   b. Sodium Hypochlorite
      Sodium hypochlorite is available in liquid form, containing 5-15% available chlorine. Available chlorine is generally expressed as a percent of weight when the concentration is 5% or less and usually as a percent of volume when the concentration is greater than 5%.

C. EXECUTION

New water mains shall be disinfected before being placed into service. Water mains taken out of service for inspection, repair, or other activities that may lead to contamination shall also be disinfected before being returned to service. The Contractor shall flush and test the water line as set forth herein.

1. Initial Flushing
   Prior to disinfection by chlorination, the pipe shall be filled to eliminate air and flushed to remove any debris. Flushing procedures, including adequate flushing velocity, shall be as set forth in

ANSI/AWWA C651 (Disinfecting Water Mains), unless otherwise specified. Under the direct supervision of the Department, the Contractor may use fire hydrants for flushing water lines. If no fire hydrants exist, the Contactor shall provide the necessary equipment required to flush the lines.

2. Disinfection

Pipes conveying water shall be disinfected as set forth in ANSI/AWWA C651. Disinfection shall be conducted after successful hydrostatic testing has been performed.

a. Test Method

Chlorination shall be performed in accordance with the continuous feed method set forth in ANSI/AWWA C651. The continuous feed method consists of initially placing calcium hypochlorite granules in the main, if required by the Department; completely filling the main to remove air pockets; flushing the main to remove particulates; and filling the main with potable water. At a point not more than 10 feet downstream from the beginning of the main, the water shall receive a dose of chlorine, fed at a constant rate so the water will have no less than 25 mg/L free chlorine, as measured at regular intervals in accordance with the Standard Methods for the Examination of Water and Wastewater, AWWA Manual M12, or appropriate chlorine test kits.

The required solutions of 1% chlorine may be prepared with either sodium hypochlorite or calcium hypochlorite as specified herein to achieve 25 mg/L free chlorine in 100 feet of pipe by diameter, as set forth in ANSI/AWWA C651 Table 4, amended. Chlorine application shall continue until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24 hours, during which time, all valves, hydrants, and other equipment shall be operated to ensure disinfection of all appurtenances. Valves on existing lines shall only be operated by SWU personnel. At the end of the 24 hour period, the treated water in all portions of the main shall have a chlorine residual of not less than 10 mg/L.

Provisions shall be made to prevent contamination of existing mains by cross-connection during flushing or disinfection of newly installed mains.

Disinfection procedures for existing lines, such as when cutting into an existing main, shall be as set forth in the appropriate section of ANSI/AWWA C651 and as directed by the Department.

b. Bacteriological Testing

Bacteriological samples shall be collected after disinfection from each respective section of the new main, as prescribed in ANSI/AWWA C651, on two (2) consecutive days at least 24 hours apart and shall be submitted to the ADH for analysis.

The lines shall not be placed in service until negative results for coliform bacterial (safe) of both samples are received by the Engineer or Contractor and are submitted to SWU.

If bacterial tests produce positive results for coliform, the lines shall be reflushed, disinfected again, and resampled until the two (2) consecutive samples test negative.

3. Final Flushing and Dynamic Testing

After disinfection, the line shall be thoroughly flushed until chlorine residual measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system, the level which is acceptable for domestic use, or less than one (1) mg/L, whichever is more stringent.

4. Acceptance

Upon successful completion of disinfection, final flushing, hydrostatic testing as per the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances as applicable, and the approval of the ADH, the line shall then be considered acceptable for service with other conditions necessary for

final acceptance as set forth in the Final Inspection and Acceptance Section in the General Requirements Chapter of these Specifications. The Contractor shall furnish personnel as necessary to assist the Department in the initial start-up of the system.

END OF SECTION

SECTION T36

VACUUM TESTING OF MANHOLES

A. GENERAL

This Section sets forth requirements for the materials, procedures, and acceptable results required for the vacuum testing of manholes.

B. MATERIALS

1. Vacuum
   The Contractor shall furnish a suitable apparatus to provide a vacuum, such as manufactured by Shamrock Glazier, Inc., made for such a purpose.

C. EXECUTION

1. Watertightness
   All manholes constructed shall be watertight, show no visible evidence of infiltration or leakage, and be tested in accordance with these Specifications. Manhole testing shall be conducted by the Contractor in coordination with the Department.

   a. Vacuum Test
      All incoming and outgoing sewer lines shall be plugged, and the manhole shall be vacuum drawn. A vacuum of 10 inches of mercury (Hg) shall be drawn, and the vacuum pump shut off. With all valves closed, the time shall be measured for the vacuum to drop to nine (9) inches Hg. The minimum allowable test times for manhole acceptance at the specified vacuum drop shall be as per ASTM C1244 (Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill) Table 1 but in no case less than one (1) minute, as set forth in the table below.

Manhole Depth *(ft)*	**Acceptable Specification Time for Manhole Diameter** *(sec)*		
	4'-0"	5'-0"	6'-0"
<4	60	60	60
6	60	60	60
8	60	60	60
10	60	60	60
12	60	60	60
14	60	60	60
16	60	60	67
18	60	60	73
20	60	65	81
22	60	72	89
24	60	78	97
26	64	85	105
28	69	91	113
30	74	98	121

2. Acceptance

   Any manhole that is not watertight shall not be accepted by the Department. All manholes which fail the leakage test shall be repaired, or a new manhole shall be constructed at the expense of the Contractor. Manholes which initially fail testing shall be retested after remedial measures are completed. If a manhole fails the vacuum test three (3) times, the inadequate manhole shall be removed and a new manhole shall be constructed.

END OF SECTION

SECTION T37

PRIVATE FIRE PROTECTION SYSTEM CONNECTIONS

A. DESCRIPTION

This section sets forth additional requirements specific for private fire protection system supply line connections.

The Owner shall be responsible, at their expense, for installing the fire line and appurtenances, tapping and making connection to the public water main designated by SWU.

All Fire System Plans shall be reviewed and approved by SWU prior to any other submittals.

B. MATERIALS

All extensions of public mains and fire system taps shall be in strict conformance with the Springdale Water and Sewer Commission's "Specification Requirements for the Construction of Water and Sewer Facilities," latest addition, and the requirements of the Arkansas Department of Health. The fire system and components shall be in strict conformance with the latest adopted versions of the State Plumbing Code, and Arkansas Fire Prevention Code, and as approved by the local Fire Marshal.

C. EXECUTION

1. Valve Box Lids
All valve box lids located on demarcation valves shall be labeled as "FIRE" and painted red per Fire Hydrants Section, Part K of these Specifications. Valve boxes and valve box collars shall meet all provisions specified in the Gate Valve Section of these Specifications.

2. Design
All pipe shall be sized for sufficient hydraulic capacity as determined by the fire sprinkler design company's Responsible Managing Employee licensed by the Arkansas Fire Protection Licensing Board and as approved by the City Fire Marshal.

All private fire system lines shall have a section of ductile iron pipe that extends five (5) feet past the demarcation valve which shall meet the requirements of the Ductile Iron Pipe and Fittings for Water Lines Section of these specifications.

SWU shall not be liable for any damages to a customer's plumbing or property caused by high pressure, by low pressure, or by fluctuation in pressure in water mains.

The Fire Department Connection (FDC) shall have a minimum of ten (10) feet horizontal separation from any fire hydrant.

3. Leak Detection Meter
Operations and maintenance shall be limited to publicly owned systems with a demarcation valve isolating public water system from private fire systems. All fire protection systems shall incorporate at the point of connection a leak detection meter assembly, detail S-36, between the public and private systems. The leak detection meter shall be located in a non-paved area isolated from vehicular traffic. SWU shall be present

for inspection of all taps on public mains. All lid castings shall be painted red and painted red per Fire Hydrants Section, Part K of these Specifications.

4. Tapping

All tapping requirements shall meet all provisions specified in the Tapping Section of these Specifications.

5. Inspection and Testing

SWU shall inspect and approve the connection of the private water main to the public main. The Owner or owner's contractor shall arrange at least two (2) business days in advance for an inspection by SWU before backfilling the installed fire line and appurtenances. The Owner or Owner's contractor shall not backfill the installation until after approval.

All fire lines from the public water main to the building shall be tested in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

6. Operation

Only SWU may operate valves as part of the public water system. Only SWU may terminate or activate service to private fire protection supply lines. SWU may operate valves and leak detection meters at any time.

The Owner shall not operate fire systems in a way that may result in use of water, except for tests as required by the Arkansas Fire Prevention Code.

END OF SECTION

SECTION T38

POLYVINYL CHLORIDE (PVC) PIPE FOR WATER LINES IN CORROSIVE SOILS

A. GENERAL

This Section sets forth acceptable materials and procedures for the installation of polyvinyl chloride (PVC) pipe and ductile iron (DI) fittings for water lines located in areas with corrosive soils, as depicted on the "Corrosive Soils Map" included in these Specifications.

B. MATERIALS

Only pipe materials listed below shall be used for water lines in corrosive soils, unless specifically authorized by the Department Engineer. All pipe installed shall be of the type, size, class, and thickness indicated in these Specifications and on the Plans.

1. Polyvinyl Chloride Pipe
   Unless otherwise shown on the Plans or specified, all pipe furnished for underground water piping in corrosive soils shall be polyvinyl chloride (PVC) pipe, with push-on joints.

   All PVC water mains shall be of equal design, material, and construction as potable water pipe, as set forth in the Ductile Iron Pipe and Fittings for Water Line Section of these Specifications, and shall comply with ANSI/AWWA C900 (Polyvinyl Chloride (PVC) Pressure Pipe and Fabricating Fittings, 4 Inch Through 60 Inch), as applicable. PVC pipe for water lines in corrosive soils shall have a minimum DR of 18 (Pressure Class or Rating, as applicable for C900, of 235 psi). The pipe manufacturer shall check for depth of bury and furnish pipe of a heavier class if needed, in accordance with ANSI/AWWA C900.

   The plastic material used in making the pipe shall be clean, virgin, Cell Classification 12454 PVC compound conforming to ASTM D1784 (Rigid PVC and Chlorinated PVC Compound).

   Each PVC water line length shall be clearly marked with the manufacturer's name, nominal pipe size, cell classification, AWWA/ASTM designation, DR, and pressure class or pressure rating as applicable.

2. Accessory Items for Water Lines
   Items used in connection with the construction of water lines shall conform to the following:

   a. Ductile Iron Pipe Fittings
      All DIP fittings shall be compact fittings unless otherwise specified. All fittings shall be furnished with gaskets. Restrained fittings of the MJ type shall also be furnished with bolts, nuts, and restraint devices. The restraint shall be the Megalug Series 2000 PV as produced by EBAA Iron, Inc., MJ Field-Lok Gaskets Series PV as produced by U.S. Pipe, or approved equal. All plugs, caps, tees, and bends deflecting 22-1/2° or more shall be provided with reaction backing as described herein. In addition to reaction backing, restrained joint pipe may also be required as set forth in these Specifications.

      All casting and mating surfaces shall be smooth and of a workmanlike quality, free from cracks, holes, scale, shrinkage, distortion, grooves, scratches, and other defects. Fittings and other castings may be rejected if found to be unacceptable by the Department in accordance with these Specifications.

      1.) Ductile Iron Pipe Compact Fittings (3-48")
         All DI compact fittings and associated bolts shall conform to the requirements of ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings for Water

Service). All compact fittings 3-24 inches in diameter shall have a minimum pressure rating of 350 psi, and fittings 30-48 inches in diameter shall have a minimum pressure rating of 250 psi, unless otherwise specified.

2.) Ductile Iron Pipe Fitting (3-48")

All DI fittings and associated bolts shall conform to the requirements of ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids). All fittings 3-24 inches in diameter shall have a minimum pressure rating of 350 psi, and fittings 30-48 inches in diameter shall have a minimum pressure rating of 250 psi, unless otherwise specified.

Special fittings shall be in accordance with the pipe manufacturer's recommendations and as approved by SWU. All fittings and appurtenances placed on water lines shall meet with the requirements of the type of pipe used and shall be installed in accordance with the manufacturer's recommendations and as approved by the Department. Connections between different kinds of pipe shall be detailed on the Plans and provide self-cleansing flow and watertight joints and connections.

b. PVC Pipe Joints

Joints shall be of the push-on, elastomeric gasket type, conforming to ASTM D3139 (Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals) and/or Uni-Bell UNI-B-1 (Recommended Specification for Thermoplastic Pipe Joints, Pressure and Non-Pressure Applications). All bells shall be formed integrally with the pipe and shall contain a positively retained, factory installed elastomeric gasket and have a raceway or groove specially formed to accept and retain the gasket. Wall thickness of the bell at any point shall not be less than the required minimum for the pipe barrel. Pipe spigots shall be beveled and have insertion stop marks.

The use of solvent cement or chemically welded joints shall not be permitted in field construction, except as specifically authorized by the Department Engineer. All pipe joints other than those specified herein shall be made in strict accordance with the manufacturer's recommendations and as approved by the Department. All joints shall be made watertight in accordance with the latest applicable AWWA and ASTM standards.

c. Gaskets for PVC Joints

Gaskets shall be molded or extruded from a high grade, vulcanized, elastomeric compound consisting of either a basic natural or synthetic rubber. Gaskets shall be marked for nominal pipe size, manufacturer, and year of manufacture. Gaskets shall comply with the requirements of ASTM F477 and ASTM D3212 or ASTM D3139, as applicable.

d. Restrained Joints

1.) Mechanical Joint

Restrained joints of the MJ type incorporated into the design of the follower gland shall consist of individually actuated wedges that increase resistance to pull-out as pressure or external forces increase. The device shall be capable of full MJ deflection during assembly, and the flexibility of the joint shall be maintained after burial. The joint restraint ring and wedging components shall conform to ASTM A536 (Ductile Iron Castings). The ductile iron gripping wedges shall be heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be compatible with the standardized MJ bell conforming to ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings) and ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings for Water Service) or ANSI/AWWA C110/A21.10 (Ductile-Iron and Gray-Iron Fittings for Water and Other Liquids) as applicable. Torque limiting

twist-off nuts shall be used to ensure proper actuation of the restraining wedges. Gaskets without torque limiting twist-off nuts shall require 90 ft-lb of bolt torque through the 8 inch size and 120 ft-lb through the 24 inch size.

The MJ restraint shall be available in the 3-48 inch sizes, with a rated working pressure of 350 psi for sizes 16 inch and smaller, and 250 psi for sizes 18-48 inch. The restraint devices shall be UL listed through the 24 inch size and approved by FM through the 12 inch size. For applications requiring restraint of pipe 30 inches and greater, an alternate grade of iron meeting the material requirements of ASTM A536 shall be acceptable, providing the device shall meet all end product performance requirements. The restraint shall be the Megalug Series 2000 PV as produced by EBAA Iron, Inc., MJ Field-Lok Gaskets Series PV as produced by U.S. Pipe, or approved equal.

2.) Push-On Joint

Restrained joints of the push-on joint type incorporated into the design of the pipe shall provide a locking interface between the bell interior surface and a retainer weldment on the spigot end of the pipe. Restrained joint pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.5 (Ductile Iron Pipe, Centrifugally Cast, for Water and Other Liquids) and ANSI/AWWA C111/A21.11. The device shall be capable of full push-on joint deflection during assembly, and the flexibility of the joint shall be maintained after burial. When restrained joints require factory welded, all welding procedures and welders used to produce the product shall be qualified per the requirements of a documented quality assurance system based on ANSI/AWS D11.2.

3. Interior Lining

All DI Fittings for water service shall receive the following interior lining:

a. Cement-Mortar Lining

All DI fittings for water service shall have a standard thickness, cement-mortar lining, and seal coat in conformance to ANSI/AWWA C104/A21.4 (Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water). Cement linings are not typically provided for caps, plugs, or sleeves.

4. Exterior Coating

All DI fittings shall have an exterior coating as set forth below:

a. Bituminous Coating

All pipe and fittings indicated for buried service shall have a petroleum asphaltic coating approximately one (1) mil thick factory-applied to the outside of all pipe and fittings. The finished coating shall be continuous, smooth, neither brittle when exposed to the cold nor sticky when exposed to the sun, and shall be strongly adherent to the pipe or fitting. The bituminous coating shall not be applied to the first six (6) inches of the exterior of the spigot ends.

5. Tapping Saddles for Meter Services in Corrosive Soils

All service saddles shall be Ford Meter Box Brass Saddles (Model S90) for C900 PVC pipe and designed for a working pressure of 150 psi. A rubber gasket shall be provided between the casting and pipe surface. Saddle straps and bolts shall be high strength, corrosive resistant, alloy steel. All saddles six (6) inches and larger shall be provided with double straps. The outlet threads shall be compatible with AWWA CC type one (1) inch corporation stops. Saddles installed in corrosive soils require polyethylene encasement. No deviation shall be allowed unless approved otherwise by Springdale Water Utilities.

6. Polyethylene Encasement in Corrosive Soils
   Polyethylene encasement shall be provided on all buried ductile iron fittings, valves, tees, service taps, tapping sleeves, and other appurtenances installed in corrosive soils, as indicated on the Plans or otherwise required by the Department. The polyethylene encasement shall be a V-Bio Enhanced Polyethylene Encasement and no deviation shall be allowed. The Contractor shall follow the installation and handling methods put forth by DIPRA (Ductile Iron Pipe Research Association) and the Polyethylene Encasement Section of these Specifications. All buried ductile iron fittings, valves, tees, service taps, tapping sleeves, and other appurtenances are to be double wrapped and approved by the Engineer prior to acceptance.

7. PVC Pipe Joint Lubricant
   Joint lubricant shall be provided by the pipe manufacturer and applied as per the manufacturer's recommendations and in accordance with ASTM D3139 (Standard Specifications for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals). Lubricant shall be non-toxic, not support the growth of bacteria, have no deteriorating effects on the gasket or pipe material, and not impact the taste or odor of the water. Lubricant containers shall be appropriately identified and labeled with the manufacturer's name. Each lubricant container shall have printed instructions for usage and joint assembly.

8. Embedment Material
   Pipe embedment material is defined as that material placed beneath and around the pipe up to required depth specified herein. All embedment material shall be free from cinders, ashes, refuse, vegetable or other organic material, boulders and other large rock, frozen soil, or other inorganics and materials that in the opinion of the Engineer or SWU are unsuitable.

   Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Coarse Aggregate Standard Size No. 67 as specified by ASTM D448 (Sizes of Aggregate for Road and Bridge Construction). The maximum embedment particle size shall not exceed 3/4 inches for angular rock or 1-1/2 inches for rounded rock, as set forth in ANSI/AWWA C605.

9. Initial Backfill
   Initial backfill shall be the same as the embedment material set forth in this Section.

10. Pipe Protection Cover
    Pipe protection cover shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

11. Final Backfill
    Final backfill shall be as set forth in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications.

12. Concrete
    Concrete used for reaction backing, pipe cover, and pipe encasement shall be in conformance with the Concrete and Reinforcing Steel Section of these Specifications. PVC pipe shall not be directly encased in concrete.

13. Tracer Wire and Ports
    Tracer wire and ports shall be used on all PVC water piping in corrosive soils and shall be 12-gauge coated copper for underground burial. The distance between tracer ports shall not exceed 400 feet. Tracer wire and ports shall be installed as set forth herein and as shown in Standard Details M-1, “Tracing Wire Connection Port” and S-18, “D.I. Pressure Water Pipe Trench”.

14. Affidavits of Compliance and Independent Laboratory Inspection
    All pipe and fittings shall be inspected and tested by the manufacturer. The manufacturer shall furnish to the Department Engineer, prior to delivery, certificates stating that all pipe and fittings

shall be manufactured in compliance with these Specifications and all other applicable standards.

The manufacturer's certificate shall also fully describe the pipes and fittings proposed to be furnished.

C. EXECUTION

1. Handling and Storage
   Handling and storage shall be as specified in the Storage and Handling of Materials Section in the General Requirements Chapter of these Specifications.

2. Construction Sequence
   Unless otherwise directed by the Department, water pipe shall be placed with the bell ends facing in the direction of installation. For lines on an appreciable slope, bells shall, at the direction of the Department, face upgrade. Any deviation from this procedure shall be made only with the approval of the Department Engineer.

3. Alignment and Grade
   Water lines shall be laid and maintained to the required lines and grades with fittings, valves, hydrants, and other appurtenances at the required locations; spigots shall be centered in bells; and all valve and hydrant stems shall be plumb.

4. Temporary Plugs or Caps
   All dirt, debris, and other foreign matter shall be removed from the inside of all pipe and fittings before being lowered into the trench. Pipes and fittings shall be kept clean during and after placement, and care shall be taken to keep dirt out of the jointing space. At the end of each day's work and also if pipe installation is discontinued for an appreciable period, the open ends of the pipe shall be closed with a watertight cap firmly secured in place. The use of plywood forms or similar means of closure shall not be acceptable. Plugs shall be of the mechanical friction type. Pressurized air plugs shall not be permitted.

5. Requirements Preparatory to Trench Excavation
   In all areas where water lines, valves, or other appurtenances shall be constructed, the existing surface shall be removed prior to excavating the trench as set forth in the Surface Removal Section of these Specifications.

6. Dewatering
   Under no conditions shall pipe be laid in a trench that has not been properly dewatered. Dewatering and stabilization shall be as specified in the Site Preparation, Excavation, and Fill Section of these Specifications.

7. Excavation Support and Protection
   Excavation support requirements shall be as specified in the Excavation Support and Protection article under the Excavation paragraph in the Site Preparation, Excavation, and Fill Section of these Specifications.

8. Trench Excavation
   The trench shall be excavated to the alignment, depth, and width required and only so far in advance of the pipe laying as set forth in the paragraph on Trench Length in this Section. The bottom of the trench shall be excavated to provide a uniform and continuous bearing and support for the pipe on solid, undisturbed ground between bell holes. The bell shall not support the weight of the pipe or soil.

   The Contractor shall proceed with caution in the trench preparation and excavation so the exact location of underground structures and conflicts, known and unknown, may be accurately

determined. The Contractor shall be held responsible for the repair of such facilities when broken or otherwise damaged from carelessness. Excavation shall be as set forth in the Excavation paragraph in the Site Preparation, Excavation, and Fill Section of these Specifications and also as set forth herein.

Excavation work shall include the necessary removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; placement of all necessary sheeting, shoring, and trench protection; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; construction of fills and embankments; and other pertinent activities.

Excavation should be performed in accordance and compliance with all applicable local, state, and federal safety regulations, including but not limited to 29 CFR 17, Part 1926, Subpart P – OSHA - Excavations.

a. Trench Depth
The trench shall be excavated to at least four (4) inches below the grade required to provide proper pipe embedment and a minimum earth cover as set forth in the General Design Considerations Section in the General Requirements Chapter of these Specifications and listed below:

1). 36 inches of cover for lines 6-8 inch pipe
2). 48 inches of cover for lines 10-16 inch pipe
3). 60 inches of cover for lines greater than 16 inch pipe

However, ledge rock, boulders, large stones, and gravel formations with loose cobbles greater than eight (8) inches in diameter shall be removed to provide a clearance of at least six (6) inches below and on all sides of all pipe, valves, and fittings for pipes 24 inches in diameter or less, and a clearance of at least nine (9) inches for pipes larger than 24 inches in diameter. A layer of embedment material shall then be placed on the bottom of the trench, tamped, and leveled to the appropriate depth.

Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workers. All pipe bedding material shall be shaped and graded to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel. Bell holes shall be excavated to accommodate the pipe bells so that the bells do not support the weight of the pipe.

b. Trench Width
The trench width shall be ample enough to permit proper installation and jointing of the pipe, backfill, and compaction. Trench widths set forth in ANSI/AWWA C600 and as shown on the Standard Detail Sheet shall serve as a general guide. Larger trench widths may be necessary for the placement of a trench support system or as otherwise required.

c. Trench Length
The Department shall have the right to limit the amount of trench excavated in advance of laying the pipe. In general, such excavation shall not exceed 300 feet, and the length of trench excavated to grade shall not exceed 100 feet or that length of installation which may reasonably be completed during a workday.

Trenches located in rock shall be fully opened at least 50 feet in advance of the place where pipe is being installed or concrete or masonry work is in progress.

d. Over-Excavation

All over-excavation less than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with adequate pipe bedding material or compacted Class 7 aggregate base course. The additional material required shall be placed in three (3) inch lifts and thoroughly compacted. This procedure shall be repeated until the established grade has been reached. All pipe bedding shall be compacted so as to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel.

All over-excavation greater than 12 inches below the established pipe grade shall be backfilled to the proper grade, at the Contractor's expense, with compacted Class 7 aggregate base course as described in the Undercutting paragraph in this Section.

If over-excavation of the trench width occurs, additional pipe bedding gravel or concrete shall be provided as necessary to prevent crushing of the pipe due to excessive earth loads. Additional pipe embedment material shall be provided to completely fill the over- excavated width beyond the specified width of the trench.

9. Undercutting

Where the soil at the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic materials, unstable Class IV or V soil, as defined in the Pipe Backfill Material and Aggregate Base Course Section of these Specifications, and/or large fragments of inorganic material, which in the judgment of SWU should be removed, the Contractor shall excavate and remove the unsuitable material to the width and depth required by the Department. Before the pipe is placed, the subgrade shall be backfilled with Class 7 aggregate base course in 6-8-inch uncompacted layers. The layers shall be machine tamped, as directed by the Department, to 95% Modified Proctor, to provide a uniform and continuous bearing and support for the pipe at all points along the pipe length.

10. Installing PVC Pipe

PVC pipe shall be installed in conformance with the recommendations of ANSI/AWWA C605 (Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings) and with the Specifications set forth herein. Ductile iron fittings for PVC pipe shall be installed as set out in ANSI/AWWA C600 (Installation of Ductile-Iron Water Mains and Their Appurtenances).

Subject to the approval of the Department, other fittings may be added to or substituted for those shown on the Plans, should the need arise during construction. This shall in no way relieve the Contractor of the responsibility for furnishing and installing all fittings required for a complete and proper installation of pipeline as detailed on the Plans.

Pipes, fittings, and other appurtenances shall be inspected carefully before being placed in the trench. Any pipe, joint, fitting, or other appurtenance found to be cracked or otherwise damaged to the point of impaired usefulness shall be plainly marked so the marking shall not rub or wash off. Damaged materials shall be removed from the site as soon as feasible. All pipe, fittings, and other appurtenances shall be lowered carefully into the trench in such a manner to prevent damage to or contamination of the pipe, fittings, and linings. Pipe, fittings, and other appurtenances shall not be dropped or dumped into the trench.

If needed, the pipe shall be cut in a neat, safe, and professional manner, without causing damage to the pipe or pipe lining. Cut ends and rough edges shall be ground smooth.

Whenever necessary to deflect pipe from true alignment, in either the vertical or horizontal plane, the degree of deflection at any joint shall not be greater than that which will provide adequate gasket space entirely around the spigot end of pipe. Joint deflections for water mains

shall not exceed the maximum recommended by the pipe manufacturer or as set forth in ANSI/AWWA C605, as applicable, whichever is less.

As the Work progresses, pipe shall be cleaned of all foreign material and maintained clean until accepted or put into service.

If required by the Department, the pipe manufacturer shall provide a qualified installation representative at the start of construction to demonstrate proper installation techniques for each size and type of pipe to be installed.

Joints shall be installed as set forth in ANSI/AWWA C605 and as follows:

a. Slip-Type or Push-On Joints

Joints shall be made in strict accordance with the recommendations of the pipe manufacturer and under conditions that allow for clean mating and sealing of joining surfaces. The elastomeric gasket is typically factory installed in most bell joints and should not be removed. If the gasket is not pre-installed, the gasket shall be cleaned and positioned in the annular groove of the bell.

Prior to jointing, the bell and spigot end of the pipe shall be cleaned thoroughly to remove all foreign matter. The spigot and bell shall be checked for cleanliness immediately before insertion of the spigot into the bell. Lubricant shall be applied in accordance with the manufacturer's recommendations. The spigot end of the pipe shall be inserted in the bell of the pipe to which connection is being made and forced to a firm contact with the bell shoulder.

Pipe spigot ends are pre-marked with an insertion line to reference how far the spigot should be inserted into the bell. Field-cut pipe spigots shall be marked and beveled to match the manufacturer's insertion line. After assembly, the insertion line shall remain visible and be nearly flush with the lip of the adjoining pipe bell. Joints assembled beyond the insertion line may result in damaging stresses or leakage and shall not be acceptable. PVC pipe-to-DI fitting connections generally have insertion depths less than PVC pipe and fittings. In such cases, the factory bevel shall be removed or shortened to ensure the gasket will be in full contact with the non-beveled portion of the pipe outside diameter. After initial insertion is made, the pipe may then be deflected.

Tracer wire shall be securely attached to all PVC water main pipe with cable ties or other similar means at approximately 10-foot intervals. Tracer ports shall be constructed at intervals of 400 feet or less and at any change in direction.

11. Embedment and Backfill

After the trench has been excavated as set forth herein, the PVC water pipe shall be placed in general accordance with the Type 5 Standard Laying Condition, as set forth in ANSI/AWWA C605, unless structural or foundation requirements indicate that more stringent bedding conditions shall be necessary. Embedment material shall be placed from a point at least four (4) inches below the bottom of the pipe to four (4) inches above the top of the pipe, by the full width of the excavated ditch. The intent shall be to cradle the pipe so the full length of each joint is uniformly supported on firm bedding with the weight of the pipe and fill borne uniformly by the pipe barrel. Unless otherwise specified herein or shown on the Plans, embedment materials shall be restricted to Coarse Aggregate Standard Size No. 67 as set forth in ASTM D448 (Sizes of Aggregate for Road and Bridge Construction). The maximum embedment particle size shall not exceed 3/4 inches for angular rock or 1-1/2 inches for rounded rock, as set forth in ANSI/AWWA C605.

After the embedment material has been placed to the required depth and compaction, 12 inches of pipe protection cover, as defined in the Pipe Backfill Material and Aggregate Base

Course Section of these Specifications, shall be hand-placed and hand-tamped, for a total depth of 16 inches cover above the pipe. If the material excavated from the trench is completely free of rock larger than 1-1/2 inch, the trench may be machine-backfilled. After placement of the pipe protection cover, the excavation shall be backfilled to grade with final backfill material free from rocks larger than six (6) inches in any dimension within three (3) feet of the top of the pipe and free from rock larger than eight (8) inches thereafter.

12. Compaction

After the minimum required pipe protection cover is placed over the top of the pipe, all subsequent final backfill material shall be placed in eight (8) inch lifts and compacted using a mechanical, hydraulically-powered, vibratory trench compactor or other equivalent equipment. Heavy compaction equipment shall not be used within 36 inches of the top of the pipe.

All trench backfill not located under paved areas or other special areas as noted on the Plans shall be compacted to a minimum of 90% of the adjacent undisturbed soil as determined in accordance with ASTM D2922 (Standard Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)).

If trenches are under existing or proposed pavement, driveways, parking areas, sidewalks, or public streets of the City of Springdale, the entire trench shall be backfilled up to the subgrade with Class 7 aggregate base course in eight (8) inch lifts and compacted by approved mechanical methods to 95% Modified Proctor Density as determined by AASHTO T180, unless otherwise directed by the Department or required by other governing authorities.

Field density shall be determined as set forth in the Density Testing Section of these Specifications. All backfill not meeting the compaction requirements set forth herein shall be replaced and/or recompacted until the compaction requirements are met.

13. Disposal of Excavated Material

Excavated material shall be piled adjacent to the Work to be used for backfilling, if suitable. All unsuitable excavated material and any excess material shall be disposed of in a manner in accordance with all applicable local, state, and federal regulations and as approved by the Department Engineer. Excess material shall not impede construction, endanger workers, nor obstruct sidewalks, roads, or other structures.

14. Connection to Existing Lines

Unless otherwise approved by the Department, no connection to existing water lines shall be made until the newly constructed facilities meet with all required construction standards, pass all required tests, and are approved by the Department for connection.

15. Concrete Reaction Backing

All fittings shall have concrete reaction backing even if restrained joints are shown on the Plans. Reaction backing shall be placed between undisturbed earth and the fitting to be anchored. The area of bearing on the pipe shall be taken as that shown on the Detail Sheet of the Plans or as directed by the Department Engineer. The backing shall, unless otherwise indicated, be placed so the pipe and fitting joints shall be accessible for repair. All DI fittings and appurtenances shall be wrapped in accordance with the Polyethylene Encasement Section of these Specifications prior to the placement of reaction backing.

16. Concrete Encasement

If shown on the Plans or otherwise directed by the Department Engineer, the pipe shall be encased in concrete to the dimensions indicated. Where additional concrete encasement is required by the Department Engineer, the additional material shall be provided and installed by the Contractor. All pipes to be encased shall be suitably supported, blocked in proper position, and anchored against flotation. PVC pipe shall not be directly encased in concrete.

17. Replacement and Repair of Driving Surfaces
    Replacement and repair of driving surfaces shall be made in accordance with the Pavement Repair Section of these Specifications.

18. Explosives
    The utilization of explosives for excavation shall be as specified in the Use of Explosives Section in the General Requirements Chapter of these Specifications.

19. Cleanup
    Cleanup shall be as specified in the Cleanup, Seeding, and Sod Section of these Specifications.

D. TESTING

The interior of all lines shall be free of mud, muck, dirt, gravel, and debris prior to testing and acceptance. The Department reserves the right to visually inspect all pipeline construction by means of televised camera equipment prior to acceptance. The Contractor shall be required, at own expense, to clean or repair any defects found through inspection.

PVC water pipes shall be tested in accordance with the Hydrostatic Testing of Water Lines, Sewer Force Mains, and Appurtenances Section of these Specifications.

If pipe repair is necessary due to leakage or test failures, replacement of pipe utilizing solid sleeves shall be required. The use of bell clamps or other bell repair devices shall be strictly prohibited. Complete replacement of the line shall be required of any section 400 feet in length or greater which has three (3) or more point failures.

END OF SECTION