

CITY OF JUNCTION CITY
Public Works Construction Standards

Division 2-2

Underground, Pavement & Sitework

**SECTION 02100
CLEARING AND GRUBBING**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes grubbing, stripping and otherwise clearing of the construction site in accordance with the drawings and as specified herein or ordered.
- b. This work includes the removing and disposal of all trees, roots, stumps, vegetation and debris as necessary to accommodate new construction or to grade the site and the preservation of all vegetation and other objects designated to remain.

1.2 SUBMITTALS

- a. **Spoil Site Permit:** When the material and debris resulting from the clearing and grubbing operations are disposed of at locations off the project, the Contractor shall obtain and submit written permission from the Owner of the property upon which the material and debris is to be placed. Contractor shall provide executed copy of permit to dispose of waste materials from appropriate jurisdictions.

1.3 PROTECTION

- a. The Contractor shall provide the necessary protection to prevent damage, injury or loss of property at the site or adjacent thereto, including wetland areas, trees, shrubs, lawns, walks, pavements, roadways, monuments, structures and utilities not designated for removal, relocation or replacement in the course of construction.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Paint required for cut or scarred surfaces of trees or shrubs designated to remain shall be a suitable product designed for the specific application.

PART 3: EXECUTION

3.1 GENERAL

- a. Information on the drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered. All such items not shown on the drawings or specified to remain shall be removed as a part of this contract at the expense of the Contractor.
- b. Verify actual field conditions. Inspect related work and adjacent surfaces. Report all conditions which prevent proper execution of this work to the City.
- c. All materials and work shall conform to the requirements of the Building Code and other agencies of the governing body having jurisdiction over the work.
- d. Contractor shall obtain permits and inspections and pay all fees required for this work.
- e. All companies or authorities owning conduits, wires or pipes running over or under property shall be notified so that arrangements can be made for the removal of any utilities and the capping of any pipes that are to be abandoned. Record location of caps.
- f. Existing trees to remain, as noted on plans. Do not disturb or dig into root system.

3.2 CLEARING AND GRUBBING

- a. Only those trees and shrubs shall be removed that are in actual interference with excavation or grading work and such removal shall be subject to approval by the City. The City reserves the right to order additional trees or shrubs removed at no additional cost to the City if, in his opinion, they cannot be maintained or have been damaged by the Contractor's operations.
- b. All trees, stumps, vegetation and debris not designated to remain shall be cleared and/or grubbed, except for special treatment in non-engineered fills as follows:
 - 1) In locations to be seeded, stumps, roots and other protruding obstructions shall be removed to a minimum of 6-inches below the final ground surface.
 - 2) Undisturbed stumps, roots and non-biodegradable solid objects which will be at least 3 feet below the subgrade or embankment surfaces will not

require removing, providing they do not extend more than 6-inches above the existing ground surface.

- c. Clear area within work limits of all surface vegetation, including trees, stumps, down timber, brush, roots, weeds, grasses and deleterious matter.
- d. Clear and remove all internal fences from the site. Perimeter property line fences to remain in place unless otherwise shown or directed.
- e. All timber shall become the property of the Contractor unless otherwise specified.
- f. Tree branches which extend into the work areas within 8 feet vertically from finish grade shall be clean-cut off next to the trunk and the cuts shall be treated with an approved tree sealant.
- g. Remove no trees, shrubbery or other vegetation outside of designated clearing limits. Trees and shrubs not designated for removal to be protected from damage during clearing and grubbing operations. Roots shall be neatly cut where removal is required.
- h. Protect existing facilities, adjacent properties and survey monuments from damage.
- i. Comply with safety requirements per Federal, State and local codes.
- j. Cleanup adjacent work areas of all litter and debris resulting from the Contractor's operations under this section.
- k. The clearing and grubbing shall extend 5 feet beyond the top of the backslope and/or toe of embankment, unless otherwise shown or directed.
- l. At all times, the Contractor shall remain within the property lines and/or easement areas.
- m. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with applicable sections contained herein.

3.3 STRIPPING

- a. Areas of excavation or embankment shall be stripped a minimum of six-inches of roots, sod, grass, crop residue, decayed vegetable matters and other organic materials, unless otherwise shown or directed.

3.4 DISPOSAL OF DEBRIS

- a. Debris resulting from the clearing and grubbing operations shall be disposed of at spoil sites in a legal manner, in full compliance with applicable codes and ordinances. Stumps, branches, roots, etc. shall not be disposed of within the project limits.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02201
EARTHWORK AND SUBGRADE PREPARATION**

PART 1: GENERAL

1.1 SCOPE

- a. Work shall include, but not be limited to, the following:
- 1) Stripping of sod and organic matter.
 - 2) Rough grading and fine grading.
 - 3) Excavations.
 - 4) Fill construction.
 - 5) Moisture control and compaction.
 - 6) Finishing subgrade and slopes.
 - 7) Disposal of materials.
 - 8) Overexcavation
 - 9) Protection of facilities.
 - 10) Obtaining all required inspections.
 - 11) Clean up.

1.2 RELATED SECTIONS

- a. Section 02055 - Site Demolition
- b. Section 02100 - Clearing and Grubbing
- c. Section 02231 - Aggregate Base
- d. Section 02226 - Trench Excavation and Backfill

1.3 PROTECTION

- a. The Contractor shall provide the necessary protection to prevent damage, injury or loss of property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, monuments, structures and utilities not designated for removal, relocation or replacement in the course of construction.

PART 2: PRODUCTS

2.1 STRIPPINGS

- a. Stripping defined as organic matter such as peat, sod, vegetative matter which cannot be compacted to specified density into a stable mass.

- b. Limits of stripping subject to the City's approval.
- c. Stripping materials to be disposed of off-site unless otherwise noted or directed by the City.

2.2 EXCAVATIONS

- a. Common excavation defined as all material not classified as rock excavation.
- b. Rock excavation shall be defined as follows:
 - 1) "Rock excavation shall consist only of that solid bedrock or ledge rock and boulders over two (2) cubic yards in volume which cannot be removed by a D8K (or approved equal) with four barrel hydraulics and dual rippers or 90,000 pound class Excavator (P.C 400 Komatsu or 235 Caterpillar or approved equal) with single shank ripper on back of bucket, which shall not be more than thirty-six inches (36") in width, but which requires systematic drilling and blasting or the use of rock splitters, pneumatic hammers and wedges. All D8K's and 90,000 pound class Excavators shall be in excellent operating condition and operated by personnel competent to operate like machinery."
 - 2) "Removal of existing concrete and asphaltic surfaces does not qualify as rock excavation."

2.3 ENGINEERED FILLS AND EMBANKMENTS

- a. Select native materials available from excavations and borrow areas after stripping.
- b. All materials shall be free of organic matter, sod, soft or spongy earth, clods, large rocks, or broken pavement fragments, etc., which would preclude compaction at specified density into a stable mass.
- c. All materials shall be within moisture content range necessary to achieve specified compaction.
- d. Fill materials at all times shall be subject to approval of the City.
- e. Materials judged unsuitable to be disposed of off-site as provided herein.
- f. Subject to approval of the City, materials may also include gravel if wet weather prevents use of excavated materials.

2.4 CURB BACKFILL

- a. Backfill behind curbs and material for dressing up disturbed areas behind curbs to be approved native topsoil.
- b. All materials shall be free of organic matter and fragments which would interfere with smooth finish and landscaping.
- c. Topsoil backfill and grading are the responsibility of the Contractor.

PART 3: EXECUTION

3.1 CONTRACTOR RESPONSIBILITY TO OBTAIN ALL REQUIRED INSPECTIONS

- a. The Contractor shall be responsible to ensure that all inspections and testing required by the drawings, contract documents or agencies having jurisdiction are completed or witnessed by authorized inspectors prior to proceeding with subsequent work which covers or which is dependent on the work to be inspected. Work completed or covered without obtaining required inspections will be considered as unauthorized work as outlined below, and may be ordered removed at the Contractor's expense.

3.2 TOLERANCES AND LINE/GRADE CONTROL

- a. Rough grade per plan requirements to within 0.30 feet vertically and 1.0 feet horizontally of required lines and grades at any point.
- b. Following installation of underground utilities, fine grade per plan requirements to within 0.10 feet vertically and 0.30 feet horizontally of required lines and grades at any point. Place curb backfill and dress up disturbed areas to same tolerances.
- c. All finished grading surfaces to be smooth, uniform and compact.
- d. Contractor to provide sufficient survey instruments, blue tops, etc., as necessary to construct subgrades accurately within the above tolerances. Contractor to set roadway centerline bluetops for fine grading.

3.3 STRIPPING

- a. Areas of excavation or embankment shall be stripped as required of roots, sod, grass, crop residue, decayed vegetable matter and other organic materials.
- b. Stripping limits shall be subject to the City's approval. Contractor shall place no engineered fills until stripping limits have been approved.

3.4 EXCAVATIONS

- a. Sawcut and remove existing AC pavement and PCC as required by the plans.
- b. Excavate to lines and grades required by plans and/or as staked in field.
- c. Excavate for driveways where required by plans and/or as field determined.
- d. Protect existing facilities from damage when excavating.
- e. Protect construction stakes and survey monuments.
- f. Finish cut slopes smooth, uniform and compact.
- g. The Contractor shall notify the City immediately if soft or uncompactable subgrade soils are encountered. When directed by the City, over-excavate to remove poor foundation material as specified herein.
- h. Unauthorized over-excavation shall be backfilled in conformance with these specifications using the City approved materials.
- i. Haul suitable excavated materials for direct placement in fill areas as designated on the plans.
- j. Excess and waste materials shall be hauled to off-site disposal arranged for by the Contractor.
- k. Stockpile or windrow topsoil as required for curb backfill.

3.5 ROCK EXCAVATION

- a. The use of explosives shall be prohibited.

3.6 SUBGRADE PREPARATION

- a. Perform all operations involved in excavating, hauling and/or placing earthwork or baserock in a manner to prevent damage to subgrades or other completed or partially completed work. Loaded trucks shall not be operated on marginal subgrades incapable of supporting the loads.
- b. Immediately following fine grading operations, compact subgrade areas to achieve 95% of maximum dry density for a 6-inch depth per AASHTO T-180 test method.
- c. Subgrade which is wet of optimum shall be ripped and aerated as necessary to achieve optimum moisture content for compaction to specified densities.
- d. Scarify and sprinkle water on dry subgrade as necessary to achieve the specified compaction.
- e. Finish subgrade smooth and uniform to required lines and grades within job tolerances.
- f. Overexcavation
 - 1) Soft or spongy subgrade which exhibits deflection under proof rolling shall be over excavated and backfilled as directed by the City. It shall remain the Contractor's responsibility to notify the City immediately if such subgrade is encountered.
 - 2) Overexcavation of the subgrade shall be accomplished using a large trackhoe with a smooth-edged bucket. Soils which are soft as evidenced by excessive tearing upon excavation by the trackhoe or which evidences excessive pumping under foot pressure may be considered too soft to support and compact the baserock, and additional overexcavation may be required. Excavation work shall not be conducted during nor subgrade left exposed to heavy rains.
 - 3) Following overexcavation, geotextile fabric as specified shall be placed on the subgrade prior to placement of the baserock. Fabric shall be Amoco 4553 non-woven fabric, Amocco 2002 woven fabric or approved equivalent.
 - 4) No equipment shall be allowed to run directly on the excavated subgrade until the full rock section is in place. Rock shall be end dumped into the excavated street in a manner to provide at least the full rock section to distribute truck loads and prevent damage to the subgrade. Crushed rock

to be spread in lifts using a small dozer to the full rock section indicated prior to operating loaded trucks on the section.

- 5) Grade and compact crushed rock base to the specified compaction.
- 6) Any soft spots identified by either compaction testing or which exhibit deflection under proof rolling shall be corrected and retested prior to paving or curb placement. By definition, "soft" spots are defined as any area(s) for which the required compaction specification cannot be met, or which deflect, pump or rut under loads.
- 7) Should inclement weather (i.e. significant rain) occur between the time the proof roll is performed and either curb placement or paving, another proof roll may be required prior to paving.

3.7 ENGINEERED FILLS AND EMBANKMENTS

- a. Construct fills and embankment sections to lines and grades required by plans with tolerances as specified herein.
- b. Strip away sod and organic matter to a minimum depth of six (6) inches unless otherwise shown or directed between toes of fill or embankment prior to placing fill to depths required by drawings, or as the City directs.
- c. Fills to be constructed in lifts, each lift not to exceed 6-inches in compacted thickness.
- d. Each lift to be compacted to specified density prior to placement of succeeding lift.
- e. Condition fill material from excavations and borrow areas for proper moisture content before placing in embankment.
- f. Place no material that is frozen or excessively wet. Do not place material in final position in fills or embankments until excess moisture has been removed to within -4% to +2% of optimum moisture.
- g. Scarify and sprinkle dry lift surfaces where necessary to ensure bond with succeeding lift.
- h. Shape subgrades and finished surfaces until smooth and uniform.

- i. Place top soil backfill and dress up disturbed areas to the City's satisfaction, top soil areas to be finished smooth, free draining, uniform and free from fragments and debris.

3.8 COMPACTION REQUIREMENTS

- a. Compact earthwork areas to be at least the following densities, relative to the maximum dry density per AASHTO T-180 test method.
 - 1) Subgrade - 95 percent.
 - 2) Fill and embankment lifts - 95 percent.
 - 3) Backfill of over excavation - 95 percent.
 - 4) Curb backfill - 85%, 90% under sidewalk.
- b. Materials not placed in accordance with these specifications shall be reconsolidated or removed and replaced, as the City directs and at the expense of the Contractor.
- c. Each lift shall be tested and accepted prior to proceeding with the next lift.
- d. Contractor shall coordinate with the City in the performance any in-place density tests.
- e. In addition to moisture-density testing, each compacted layer may be proof rolled to check for deflection or reaction and to verify that no soft or pumping areas remain in any layer or foundation soil.

3.9 MAINTAIN LOCAL TRAFFIC

- a. Excavate in manner to allow local traffic flow with a minimum of inconvenience during construction.
- b. Ramp cuts up to existing driveways for vehicular access to abutting properties and maintain driveway accesses.
- c. Store materials and equipment to allow traffic flow.

3.10 CLEAN UP

- a. Contractor to clean up site of work of all litter and construction debris caused by him following each of his rough and fine grading operations.
- b. Materials judged unsuitable for placement in any fill area to be removed from site by the Contractor.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02226
TRENCH EXCAVATION AND BACKFILL**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes all trench excavation, backfill and related work for the construction of the designated pipelines and other incidental work.

- b. **Trench Excavation and Backfill Includes:**
 - 1) Work of making all necessary trench excavations for the construction of all work.
 - 2) Furnishing, placing and use of sheeting, shoring and sheet piling necessary in excavating for and protecting the work and workmen.
 - 3) Performing all pumping and fluming necessary to keep the trenches free from water.
 - 4) Providing for uninterrupted flow of existing rivers, treatment plant processes, drains and sewers and the temporary disposal of water from other sources during the progress of the work.
 - 5) Damming and cofferdamming where necessary. To be the Contractor's design.
 - 6) Supporting and protecting all structures, pipes, conduits, culverts, railroad tracks, posts, poles, wires, fences, buildings and other public and private property adjacent to the work.
 - 7) Removing and replacing existing sewers, culverts, pipelines and bulkheads where necessary.
 - 8) Removing after completion of the work all sheeting and shoring not necessary to support the sides of excavations.
 - 9) Removing all surplus excavated material.
 - 10) Performing all backfilling, rough grading and compaction to the limits specified or ordered by the City.

- 11) Restoring all property damaged as a result of the work included under this section.
- c. The Work includes obtaining and transporting suitable fill material from off-site when on-site material is not available.
- d. The Work includes transporting surplus excavated material not needed for backfill at the location where the excavation is made, to other parts of the work where filling is required, or disposal of all surplus on other sites provided by the Contractor as directed by the City.

1.2 LABORATORY SERVICES

- a. Unless otherwise specified or shown on the drawings, the Contractor shall perform laboratory services as described below. The Contractor shall be responsible for providing all samples requested by the City.
 - 1) Sieve Analysis (ASTM C-136): One test for each material source and type:
 - a) Selected backfill.
 - b) Granular backfill.
 - 2) Backfill Compaction:
 - a) One moisture density curve (AASHTO T-180) for each size and type of material used for backfill. The maximum dry weight and optimum moisture content shall be indicated. The cost of all retests required due to any unauthorized change in backfill material shall be the responsibility of the Contractor.
 - b) Test consolidated backfill material in trenches around pipes for conformance with specified "Compaction Requirements," contained herein:
 - (1) Where tests indicate insufficient values, perform additional tests as required by the City. Testing shall continue until specified values have been attained by additional compaction effort.
 - (2) Retests shall be referenced to the corresponding failing test. The cost of all retests shall be the responsibility of the Contractor.

1.3 CONSTRUCTION WITHIN ROADWAY AND RAILROAD RIGHT-OF-WAYS

- a. Permits: The Contractor shall procure and pay for permits required for construction.
- b. Contractor shall provide bonds and insurance as required by affected agency prior to proceeding with any work.
- c. Notification: The Contractor shall give written notice to appropriate officials of the affected Federal, State Highway Department, City, County or railroad at least five days, not including weekends and holidays, before starting construction within highway or railroad right-of-ways and as required under other roadways.

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards and shall include:
 - 1) When excess excavated material is disposed of at locations off the project site, the Contractor shall obtain and submit written permission from the Owner of the property upon which the material is to be placed.
 - 2) Executed copy of permit(s) to dispose of material specified under this section.

1.5 PROTECTION

- a. Test Pits: The Contractor shall dig such exploratory test pits as may be necessary in advance of excavation to determine the exact location and elevation of subsurface structures, pipelines and conduits which are likely to be encountered and shall make acceptable provision for their protection, support, and maintenance in operation.
- b. Sheeting, Shoring and Bracing:
 - 1) The Contractor shall furnish and install adequate sheeting, shoring, and bracing to maintain safe working conditions, and to protect newly built work and all adjacent and neighboring structures from damage by settlement.
 - 2) Bracing shall be arranged so as not to place a strain on portions of completed work until the construction has proceeded far enough to provide ample strength. Sheeting and bracing may be withdrawn and removed at the time of backfilling, but the Contractor shall be responsible for all damage to newly built work and adjacent and neighboring structures.

- 3) All sheeting, shoring and bracing shall be of Contractor's design and shall be in accordance with all Federal, State and Local codes and requirements.

c. Construction Sheeting Left in Place:

- 1) The Contractor shall furnish, install, and leave in place, construction sheeting and bracing when specified or when indicated or shown on the drawings.
- 2) Construction sheeting and bracing, placed by the Contractor to protect adjacent and neighboring structures, may be left in place if desired by the Contractor and approved by the City. All such sheeting and bracing left in place shall be included in the cost for excavation.

d. Removal of Water:

- 1) The Contractor shall at all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the work and shall keep said excavations dry until the pipelines to be placed therein are completed. In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.
- 2) The Contractor shall dispose of water from the work in a suitable manner without damage to adjacent property or structures.
- 3) Contractor shall provide silt fences, straw bales, and/or sedimentation basins as required to clarify waters prior to discharge in accordance with Federal, State and Local requirements.

1.6 DEFINITIONS

a. Classification of Excavated Materials

- 1) Common Excavation (Unclassified) shall be defined as all material not classified as rock excavation.
- 2) Rock Excavation shall be defined as follows:
 - a) "Rock excavation shall consist only of that solid bedrock or ledge rock and boulders over two (2) cubic yards in volume which cannot be removed by a D8K (or approved equal) with four barrel hydraulics and dual rippers or 90,000 pound class Excavator (P.C. 400 Komatsu or 235 Caterpillar or approved equal) with single

shank ripper on back of bucket, which shall not be more than thirty-six inches (36") in width, but which requires systematic drilling, blasting or the use of rock splitters pneumatic hammers and wedges. All D8K's and 90,000 pound class Excavators shall be in excellent operating condition and operated by personnel competent to operate like machinery."

- b) "Removal of existing concrete and asphaltic surfaces does not qualify as rock excavation."

b. Trench Backfill Zones

- 1) Pipe Embedment Zone - The area from 6-inches under the pipe to 1/6 the outside pipe diameter distance above the bottom of pipe for the width of the trench.
- 2) Pipe Zone - The area from the top of the pipe embedment zone to 12-inches above the pipe for the width of the trench.
- 3) Backfill Zone - The area from 12-inches above the pipe to bottom line of surface restoration for the width of the trench.

c. Trench Classifications

- 1) Class I Trench - Class I trench shall have granular material in all three zones for backfill material. For use under paved roadways, gravel and paved driveways, or as directed by the City.
- 2) Class II Trench - Class II trench shall have granular material in the pipe embedment and pipe zones and selected backfill in the backfill zone for backfill material. For use under unimproved roads or future paved areas, or as directed by the City.
- 3) Class III Trench - Class III trench shall have granular material in the pipe embedment and pipe zones and native excavated material in the backfill zone for backfill material. For use under unimproved areas or as directed by the City.
- 4) Class IV Trench - Class IV trench shall have unclassified native material in the pipe embedment and pipe zones and native excavated material in the backfill zone for backfill material. For use under unimproved open rural area or as directed by the City.

PART 2: PRODUCTS

2.1 GRANULAR BACKFILL

- a. Unless otherwise shown on the drawings, granular material shall consist of crushed rock, including fines, meeting the requirements of OSHD 02630, Base Aggregate, Grading Requirements of 3/4"-0" in accordance with AASHTO T-27.

2.2 CONTROL DENSITY BACKFILL

- a. Controlled Density Fill (CDF) shall be a mixture of Portland Cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self consolidating, free-flowing and excavatable material that will result in a hardened, dense, non-settling fill.
- b. CDF may be approved as an alternative to "Granular Backfill" for use at locations requested by the Contractor and approved by the City. CDF may also be used at the option of the Contractor for foundation stabilization material and pavement base material.

- c. Materials used in CDF mixture shall conform with the following:

Portland Cement: ASTM C-150 or AASHTO M-85 or ODOT 02010.10

Fly Ash: ASTM C-618 Class F or Class C or ODOT 02010.10

Aggregates: ASTM C-33 or ODOT 02690

Water: ODOT 02020

Admixtures: ODOT 0240

- d. CDF shall attain unconfined compressive 28 day strengths from 50 psi to a maximum of 100 psi.
- e. The Contractor shall prepare test cylinders for laboratory testing by a certified independent laboratory.
 - 1) Test cylinders shall be prepared in conformance with ASTM D-4832. Unless otherwise directed by the City, a set of test cylinders shall be prepared for each day CDF is placed on the project. A set shall consist of four (4) cylinders, two for testing at 7 days and two for testing in 28 days.
 - 2) Other testing methods more suitable for low strength concrete may be permitted by the City.

2.3 SELECTED BACKFILL

- a. Selected backfill material shall consist of well graded pit run, sand or crushed screenings, meeting the following minimum requirements:
 - 1) One hundred percent (100%) passing #6 sieve (U.S.) and 5 to 15 percent (5-15%) passing #200 mesh (U.S.).
 - 2) Material shall be free of clay, organic material, debris and other deleterious matter.

2.4 NATIVE EXCAVATED MATERIAL

- a. Excavated material free of vegetable matter and debris.
- b. Excavated material approved by the City for use as backfill in designated locations.
- c. Individual particles less than one third (1/3) trench width in greater dimension but no more than 8-inches in diameter.

2.5 UNCLASSIFIED NATIVE MATERIAL

- a. Excavated material free of vegetable matter, large rocks and debris.
- b. Excavated material approved by the City for use as backfill in designated trench zones.
- c. Individual particles no larger than 4 inches in diameter.

2.6 FOUNDATION STABILIZATION

- a. Gravel or crushed aggregate or City approved clean, well graded granular material.

PART 3: EXECUTION

3.1 PREPARATION

- a. The site of an open cut excavation shall be first cleared of all obstructions preparatory to excavation. Wherever paved or surfaced streets are cut, saw wheel or approved cutting devices shall be used. Width of pavement cut shall not be less than 6-inches greater than trench width. All cut or broken pavement shall be removed from site during excavation.

- b. The Contractor shall maintain street traffic at all times and erect and maintain barricades, warning signs, traffic cones, and other safety devices during construction in accordance with Manual of Uniform Traffic Control Devices (MUTCD), Part VI, to protect the traveling public. Provide flagmen as required during active work in roadway areas.
- c. Intent of specifications is that all streets, structures, and utilities be left in condition equal to or better than original condition. Where damage occurs and cannot be repaired or replaced, Contractor shall purchase and install new material which is satisfactory to City. Plans and/or specifications cover and govern replacement and restoration of foreseeable damage.
- d. The operations shall be confined to the work limits provided. Avoid encroachment on, or damage to, private property or existing utilities unless prior arrangements have been made with copy of said arrangement submitted to City.

3.2 TRENCHING

- a. Excavation for trenches in which pipelines and sewers are to be installed shall provide adequate space for workmen to place and joint the pipe properly, but in every case the trench shall be kept to a minimum width. The width of trench at the top of the pipe shall not exceed the limits specified or as shown on the drawings without notification and concurrence in writing by the City. Use of trenches wider than the minimum width will not entitle the Contractor to additional compensation.
- b. Excavation shall be to the depth necessary for placing of granular bedding material under the pipe as shown on the drawings. If overdigging occurs, the trench bottom shall be filled to grade with compacted granular bedding material.
- c. Unless otherwise permitted by the City, trenching operations shall not be performed beyond the distance which will be backfilled and compacted the same day.
- d. In general, backfilling shall begin as soon as the conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.
- e. Where the excavation activities require the removal of portions of an abandoned pipeline, 3,300 psi concrete plugs shall be installed in the open ends of the pipe. Concrete plugs to be a minimum one and one-half (1-1/2) times the diameter of the pipe.

- f. Line for vertical and horizontal alignment to be provided by the City with stakes at not more the 50 foot intervals.

3.3 EXCAVATION OF UNSUITABLE MATERIALS

- a. Unsuitable materials existing below the Contract bottom limits for excavation shall be removed as directed by the City. Unless otherwise authorized by the City, such excavation shall be conducted at a time when the City is present and shall not exceed the vertical and lateral limits as prescribed by the City.
- b. Where soft subgrade is encountered in which satisfactory stability cannot be obtained by moisture control and compaction, the Contractor shall notify the City and the unstable material shall be excavated to the depth required by the City.
- c. Backfill with foundation stabilization material compacted in layers not exceeding 12-inches depth to required density and compaction.

3.4 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

- a. All excavated materials which are unsuitable for use in backfilling trenches or around structures, and materials excavated that are in excess of that required for backfilling and for constructing fills and embankments as shown on the drawings, shall be disposed of by the Contractor at own expense and at disposal sites provided by him as may be required.
- b. Surplus excavated material shall be disposed of at designated spoil sites in a legal manner, in full compliance with applicable codes and ordinances.

3.5 ROCK EXCAVATION

- a. Where the bottom of the trench encounters ledge rock and/or boulders and large stones which meet the definition of "rock" as described herein, said rock shall be removed to provide 6-inches of clearance to each side and below all pipe and accessories.
- b. Excavations below subgrade in rock shall be backfilled to subgrade with approved bedding material and thoroughly compacted.
- c. Contractor to excavate and remove the overburden exposing the rock surface, allowing the City to profile the excavated trench for rock measurement. The profiling of the exposed rock surface shall be done prior to commencement of rock removal activities.
- d. The use of explosives shall be prohibited.

3.6 REMOVAL OF PCC CURBS & SIDEWALKS

- a. Where trench excavation requires removal of PCC curbs and/or sidewalks, the curbs and/or sidewalks shall be sawcut as required and removed at a tooled joint unless otherwise authorized by the City.
- b. The intention of this requirement is to facilitate the replacement of curbs and sidewalks to the joint pattern of the existing and surrounding curbs and/or sidewalks. The sawcut lines for PCC sidewalk and curb cuts shown on the drawings are schematic and not intended to show the exact alignment of such cuts.

3.7 BACKFILL AND COMPACTION

- a. Backfill Immediately: All trenches and excavations shall be backfilled immediately after pipe is laid therein, unless otherwise directed by the City. Under no circumstances shall water be permitted to rise in unbackfilled trenches after pipe has been placed.
 - 1) Backfilling With Excavated Material: Where specified or directed, material excavated in connection with the work shall be used for backfilling, in accordance with the type of trench classification shown on the contract drawings. No material shall be used for backfilling that contains stones, rock or pieces of masonry greater than 8-inches, frozen earth, debris, earth with an exceptionally high void content, organic material, or marl. Large pieces of rock or masonry shall not be deposited closer than 12-inches from the completed outside surface of any structure or pipe.
 - 2) In no case shall backfill material deposited by machinery be allowed to fall directly on the pipe and in all cases the bucket shall be lowered so that the shock of the falling backfill material will not cause damage.
- b. Embedment Zone
 - 1) Pipe embedment material shall be placed in the trench, compacted and shaped to provide continuous support for the pipe between joints or fittings.
 - 2) Holes shall be provided for all joints or fittings as required to permit assembly.
 - 3) Pipe shall be laid directly on the embedment materials.
- c. Pipe Zone

- 1) Backfill shall be placed in uniform layers on both sides of the pipe. Each layer shall be placed, then carefully and uniformly tamped to the specified density so as to eliminate the possibility of lateral displacement of the pipe.
- 2) Care shall be taken to ensure that the material under the haunches of the pipe is sufficiently compacted.

d. Backfill Zone

- 1) After the backfill has been placed and compacted around the structures and conduits to a height of 12-inches over the top as specified above, the remainder of the trench may be backfilled by machine.
- 2) The backfill material shall be deposited in horizontal layers not exceeding 12-inches thick, and each layer shall be thoroughly compacted to the specified density by approved methods before the succeeding layer is placed.

e. Backfilling Under Existing Conduits

- 1) Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with granular bedding material tamped in place in 6-inch layers to the required density. The granular bedding shall extend outward from the spring line of the conduit a distance of 2 feet on either side and thence downward at its natural slope.

f. Backfilling Under Pavement and Walks

- 1) Where any pavement, driveway, parking lot, curb and gutter, or walk is to be placed over a backfill area, granular material shall be used. The material shall be placed and compacted to the required density in accordance with the specification contained herein.

3.8 COMPACTION REQUIREMENTS

- a. In Class I, II and III trench classification, compaction in the pipe zone shall be achieved by mechanical compaction in horizontal lifts or other approved method to ninety percent (90%) of the maximum dry density per AASHTO T-180 test method.
- b. In Class I and II trench classification, compaction in the backfill zone shall be achieved by mechanical compaction in horizontal lifts or other approved method to ninety-two percent (92%) of the maximum dry density per AASHTO T-180 test method.

- c. In Class III and IV trench classification, compaction in the backfill zone shall be achieved by ramming, vibration or a combination thereof to at least eighty-five percent (85%) of the maximum dry density per AASHTO T-180 test method.

3.9 COMPACTION TESTS

- a. Trenches shall be backfilled and consolidated in layers, as specified, to the existing ground surface. Compaction tests shall be performed on each layer immediately after compaction.
- b. The initial test series for each type of backfill material shall be continued until the method of consolidation employed has proven to attain the required compaction. Any change in the proven method of consolidation will not be permitted unless approved by the City.
- c. Subsequent tests or series of tests shall be in locations and at depths ordered by the City.
- d. The cost of all retests shall be the responsibility of the Contractor.

3.10 SURFACE RESTORATION AND CLEAN UP

- a. Surface restoration shall conform to these Contract Documents where applicable. Restore ground surfaces to original conditions and elevations unless otherwise specified or directed.
- b. Maintenance of such surfaces shall be for 12 months following acceptance of work.
- c. Clean up and remove all excess materials, construction materials, debris from construction, etc. Replace or repair any fences, mailboxes, signs, landscaping, or other facilities removed or damaged during construction. Replace all lawns, topsoil, shrubbery, flowers, etc., damaged or removed during construction. Contractor to be responsible for seeing that lawns, shrubs, etc. remain alive. Leave premises in condition equal to or better than original condition before construction.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02231
AGGREGATE BASE**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing all material, equipment, labor and supervision required to install aggregate base as specified or as shown on the drawings.
- b. All preparatory work and incidental work required to properly complete the work shall also be included under this section.

1.2 LABORATORY SERVICES

- a. Unless otherwise specified or shown on the drawings, the Contractor shall perform laboratory services as described below. The Contractor shall be responsible for providing all samples requested by the City.
- b. The laboratory shall sample each source of aggregate in accordance with ASTM D-75 and shall perform the following tests in accordance with the ASTM Standards:
 - 1) D-4318 test for plasticity index.
 - 2) C-535 test for abrasion.
 - 3) C-136 test for sieve or screen analysis of fine and coarse aggregate.
 - 4) D-2419 test for sand equivalent.
- c. The sample shall meet limits established in ASTM C-330. If the sample fails to meet set limits, a new source shall be found. The City shall approve each source of material(s).
- d. Compaction:
 - 1) One moisture density curve (AASHTO T-180) for each size and type of material used. The maximum dry weight and optimum moisture content shall be indicated. The cost of all retests required due to any unauthorized change in backfill material shall be the responsibility of the Contractor.
 - 2) Test consolidated backfill material in trenches around pipes for conformance with specified "Compaction Requirements," contained herein:

- a) Where tests indicate insufficient values, perform additional tests as required by the City. Testing shall continue until specified values have been attained by additional compaction effort.
 - b) Retests shall be referenced to the corresponding failing test. The cost of all retests shall be the responsibility of the Contractor.
- e. All re-tests shall be the responsibility of the contractor.

1.3 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards and shall include:
 - 1) For the City's review - laboratory test results.
 - 2) For the record - weight tickets for all material delivered.

PART 2: PRODUCTS

2.1 BASE AND LEVELING ROCK

- a. Base rock and leveling rock shall be in conformance with the requirements of OSHD Section 2630, Base Aggregate.
- b. Gradation shall be as follows:
 - 1) Base Rock: 1-1/2"-0
 - 2) Leveling Rock: 3/4"-0
 - 3) Alternate single size 1"-0 aggregate as approved by the City.

PART 3: EXECUTION

3.1 GENERAL

- a. The subgrade shall be checked for grade and compaction and accepted by the City prior to placement of base rock.
- b. Aggregate base rock shall be placed over approved subgrade in accordance with OSHD Section 00642, Plant Mix Aggregate Base and Shoulders, except that plant mixing of aggregate and water shall not be required.

- c. Existing graveled driveways shall be re-rocked to match existing surface(s) where disturbed by construction. Finish with 3/4-inch minus crushed rock a minimum of 6-inches deep.

3.2 COMPACTION

- a. The maximum compacted thickness of each lift of aggregate base rock shall be 6-inches.
- b. The Contractor shall perform tests to determine the maximum dry density and optimum moisture content of the rock.
- c. All aggregate base shall be compacted to 95 percent (95%) of the maximum dry density per AASHTO T-180.
- d. All structures shall be protected from damage when placing and compacting rock.
- e. Contractor shall sprinkle the aggregate with water as necessary to achieve the required compaction.

3.3 TOLERANCES

- a. Aggregate base courses shall be finished accurately to lines and grades shown on the drawings and within the tolerances specified.
- b. The maximum tolerance on finished rock grade is 1/2-inch on a 16 foot straightedge with no bird baths.
- c. All rims shall be adjusted to final grade after leveling rock course is placed and compacted.

3.4 ACCEPTANCE

- a. Final acceptance of the material will be from samples taken on the finished grade in the compacted state.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02260
GEOTEXTILE FABRIC**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing and installing of geotextile fabric and incidentals on the project.

PART 2: PRODUCTS

2.1 SUBGRADE STABILIZATION

- a. Unless otherwise specified or shown on the drawings, subgrade stabilization geotextile shall be Supac 8NP non-woven fabric as manufactured by Phillips Fibers Corporation, Amoco 4553 non-woven fabric, Amocco 2002 woven fabric or approved equivalent.

2.2 PROTECTION

- a. The geotextile shall be furnished in a protective wrapping which shall protect the fabric from ultraviolet radiation and from abrasion due to shipping and handling.

PART 3: EXECUTION

3.1 SURFACE PREPARATION

- a. The surface to receive the geotextile shall be prepared to a smooth condition free of obstructions, depressions and debris.

3.2 PLACEMENT

- a. The fabric shall be placed loosely, not in a stretched condition.
- b. The fabric shall be covered immediately after placement to limit exposure to ultraviolet radiation.
- c. The crushed rock shall be placed so that the geotextile is not punctured.

- d. The maximum drop height for placing crushed rock on the geotextile shall be 3 feet. This specification shall be strictly adhered to so as to avoid damaging the geotextile fabric.
- e. The geotextile fabric shall be installed per plan details.
- f. Transverse joints between fabric panels shall be overlapped for a length in the direction of baserock placement sufficient to prevent movement of the fabric.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02501
TRENCH SURFACE RESTORATION**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes all surface restoration and related work for the construction of the designated pipelines and other work as required for the completion of the project.
- b. Surface restoration includes, but is not limited to, the following:
 - 1) Restoration of all surfaces disturbed during construction including A.C. pavement, concrete, gravel, lawns, topsoil, trees, shrubbery, flowers, fences, mailboxes, signs, landscaping, etc.
 - 2) Surfaces shall be restored in-kind unless otherwise shown on the drawings or directed by the City.
 - 3) Maintenance of all surfaces until final surface restoration is completed. Temporary AC pavement cold patching shall be required for all street crossings which are not permanently restored within seven (7) days of excavation.
 - 4) Depth, type and compaction of materials shall be equal to original surfaces unless otherwise specified herein or shown on the drawings.

1.2 CLASSIFICATIONS

- a. Class A: Paved street restoration for use on major streets and arterials, or as directed by the City.
- b. Class B: Paved street restoration for use on minor streets and paved driveways, or as directed by the City.
- c. Class C: Gravel shoulder restoration.
- d. Class D: Graveled road or street restoration, including graveled driveways.
- e. Class E: Unimproved or open areas.

- f. Concrete Curbing, Walks and Driveways: Restoration of existing structures.

PART 2: PRODUCTS

2.1 GRANULAR MATERIAL

- a. Unless otherwise specified or shown on the drawings, granular material shall consist of crushed rock, including sand, meeting the requirements of OSHD 02630, Base Aggregate, with grading requirements of 3/4"-0 in accordance with AASHTO T-27.

2.2 TOPSOIL

- a. Native topsoil shall be used for topsoil replacement when possible.
- b. Imported topsoil shall conform to requirements of OSHD Section 01010, Topsoil.
- c. Depth of topsoil shall be determined by actual field conditions or as directed by the City.

2.3 A.C. PAVEMENT

- a. The AC pavement shall meet the requirements of the City of Eugene's Class "C" 35 Blow Marshall asphalt concrete mix design for standard duty A.C. except that the minimum bitumen content shall be 6.5%.
- b. Contractor shall submit the proposed mix design to the City for review and approval.

2.4 PORTLAND CEMENT CONCRETE

- a. All concrete shall conform to the requirements of OSHD Section 00440, Minor Structure Concrete, 3,300 psi.

2.5 GRASS SEED AND MULCH

- a. Grass seed and mulch shall conform to the requirements of OSHD Section 01040, Planting, except as modified herein.
- b. Seed mixtures shall be compatible with the immediately surrounding vegetation.
- c. Seed mix to be approved by the City prior to application.

PART 3: EXECUTION

3.1 GENERAL

- a. The intent of this specification is that cleanup activities and surface restoration work immediately follow the installation of pipe, construction of structures, etc. This is imperative so as to impact activities by the property owner, or other users, as little as possible.
- b. Trench backfill and subgrade shall meet compaction requirements as set forth in the applicable sections contained herein prior to proceeding with surface restoration work.
- c. All workmanship for A.C. pavement surface restoration shall conform to the requirements of OSHD Section 00745, Asphalt Concrete Pavement, for standard duty A.C. pavement or local jurisdiction requirements, whichever are more stringent. Compaction for asphalt concrete pavement shall be a minimum of ninety-one percent (91%) for standard duty mix as determined by the Rice Standard Method (AASHTO T-29).
- d. The Contractor shall notify the City a minimum of 24 hours in advance of performing any A.C. pavement surface restoration work. No A.C. pavement surface restoration work shall be performed when weather conditions, in the City's opinion, are not suitable for placement of A.C. pavement.
- e. All workmanship for PCC restoration shall conform to the requirements of OSHD Section 00440, Minor Structure Concrete or local jurisdiction requirements, whichever are more stringent.
- f. In areas designated for Class E surface restoration, topsoil shall be removed and stored at an approved location prior to excavation.

3.2 PROTECTION

- a. No heavy construction vehicle shall operate on any pavement, curbing or walk.
- b. Concrete Curbing and Walks:
 - 1) No concrete shall be mixed, transported, placed or finished when the temperature of the base, subgrade or air is below 40°F or whenever, in the opinion of the City, the temperature may fall below 40°F within twenty four (24) hours after the concrete has been placed.

- 2) The Contractor shall take such precautions as are necessary to protect newly placed concrete from rain.
- 3) The Contractor shall protect newly placed concrete from freezing for no less than seven (7) days.

3.3 CLASS A SURFACE RESTORATION

- a. Surface restoration shall conform to all standards and requirements of the governing agency.
- b. Surface restoration shall conform to drawing details and specifications contained herein including "T" saw cutting, tack coat and sand seal.
- c. The wearing course shall match the existing pavement in line and grade but in no case shall the pavement thickness be less than four (4) inches placed in two (2) lifts.
- d. Pavement surface shall be a smooth, well sealed, tight mat.
- e. Compaction for asphalt concrete pavement shall be a minimum of ninety-one percent (91%) for standard duty mix as determined by the Rice Standard Method (AASHTO T-29). A roller pattern shall be established by the Contractor to achieve the required compaction at the beginning of the paving process. The roller pattern and compaction tests results from an independent testing lab and may be used to verify compaction.

3.4 CLASS B SURFACE RESTORATION

- a. Surface restoration shall conform to all standards and requirements of governing agency.
- b. Surface restoration shall conform to drawing details and specifications contained herein including "T" sawcutting, tack coat and sand seal.
- c. The wearing course shall match the existing pavement in line and grade, but in no case shall the pavement thickness be less than three (3) inches placed in two (2) lifts.
- d. Pavement surface shall be a smooth, well sealed, tight mat.
- e. Compaction for asphalt concrete pavement shall be a minimum of ninety-one percent (91%) for standard duty mix as determined by the Rice Standard Method

(AASHTO T-29). A roller pattern shall be established by the Contractor to achieve the required compaction at the beginning of the paving process. The roller pattern and compaction tests results from an independent testing lab and may be used to verify compaction.

3.5 CLASS C SURFACE RESTORATION

- a. Surface restoration shall conform to all standards and requirements of the governing agency.
- b. Surface restoration shall conform to drawing details and specifications contained herein.
- c. Where any portion of the trench excavation falls within the shoulder, the shoulder shall be restored to a minimum width of thirty-six (36) inches or original width, whichever is greater.
- d. Gravel shoulders shall be compacted by mechanical means to ninety five percent (95%) of the maximum dry density per AASHTO T-180 unless otherwise directed by the City.

3.6 CLASS D SURFACE RESTORATION

- a. Surface restoration shall conform to all standards or requirements of the governing agency.
- b. Surface restoration shall conform to drawing details and specifications contained herein.
- c. The base and leveling course shall match the existing road surface in depth, line and grade, but in no case shall the finish rock surface be less than nine (9) inches in depth.
- d. All Class D surface restoration shall be compacted by means of mechanical compaction to ninety five percent (95%) of the maximum dry density per AASHTO T-180.

3.7 CLASS E SURFACE RESTORATION

- a. Surface restoration shall conform to all standards and requirements of the governing agency.

- b. Surface restoration shall conform to drawing details and specifications contained herein.
- c. Compact by means of wheel loading unless otherwise directed by the City.
- d. Contractor shall replace trees, shrubbery, flowers, ground cover in kind to match existing as approved by the City.
- e. Reseeding:
 - 1) All areas to be seeded shall be made substantially clear and free of weeds, briars, sticks, loose stones greater than 1-inch, and all other debris detrimental or toxic to the growth of grass.
 - 2) The surface soil in all areas to be seeded shall be in a condition favorable for the germination and growth of grass seed. A minimum of 1/2-inch and maximum of 1-1/2 inches of surface soil shall be in a loose condition.
 - 3) Soil preparation operations shall be directional along the contours of the areas involved.
 - 4) Seed and mulch shall be applied at a time approved by the City when conditions are favorable for germination.

3.8 CONCRETE CURBING, WALKS AND DRIVEWAYS

- a. All soil subgrade under driveways, curbs, curb and gutter and walks shall be compacted in accordance with the requirements of the applicable sections contained herein.
- b. All curbs, sidewalks and driveways shall conform to the lines, grades and thicknesses of existing structures, but in no case shall the thickness be less than sixteen (16) inches for Type "C" curbs, four (4) inches for sidewalks, and six (6) inches for driveways and driveway aprons.
- c. A minimum 2-inch 3/4"-0" granular material leveling course shall be provided under all curbs, sidewalks and driveways.
- d. Unless otherwise authorized by the City, sidewalks and/or curbs shall be constructed to match the joint pattern of the existing and surrounding sidewalks and/or curbs.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02502
CONCRETE CURBS AND SIDEWALKS**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the construction of concrete sidewalks and curbs as shown on the drawings, specified herein or directed by the City.
- b. This section includes the construction of driveway aprons, handicap access ramps, extruded curbs, drop curbs, curb weep holes where required or directed and other work and materials incidental to the construction of curbing and walks.
- c. This section includes the protection of all concrete and curbs from damage.

1.2 SUBMITTALS FOR City'S APPROVAL

- a. Submittals shall be in accordance with the requirements of these standards and shall include the following:
 - 1) Manufacturer's or supplier's certificates stating that the following conform to the specifications contained herein.
 - a) Joint Sealer
 - b) Preformed Filler
 - c) Curing Materials
 - d) Air Entraining Agents

PART 2: PRODUCTS

2.1 GENERAL

- a. Baserock shall conform to the requirements of OSHD 02630, Base Aggregate, for 3/4"-0 crushed rock.
- b. Other materials required for placing concrete shall be as follows:

- 1) Preformed Filler -
 - a) Fiber Filler - ASTM D-1751
 - b) Sponge Filler - ASTM D-1752, Type I
- 2) Curing Materials -
 - a) Burlap Cloth - AASHTO M-182, Class 2.
 - b) Sheet Materials - ASTM C-171
- 3) Plastic sheeting shall be visqueen with a minimum thickness of 5 mils.

2.2 CONCRETE (CAST-IN-PLACE)

- a. All concrete used shall conform to the requirements of OSHD Section 00440, Minor Structure Concrete, 3300 psi.

PART 3: EXECUTION

3.1 GENERAL

- a. All soil subgrade under driveways, curbs, curb and gutter and walks shall be compacted in accordance with the requirements of these standards.
- b. A minimum two (2)-inch crushed rock leveling course shall be provided under all curbs, walks and driveways.
- c. All curbs, sidewalks, driveways and handicapped access ramps shall conform to the lines, grades and details shown on the drawings or modified in the field by the City. Maximum tolerance allowed is 1/2-inch on line and 1/4-inch on grade at any point.
- d. Construction of all curbs, sidewalks, driveways, stairs, etc., shall conform to the requirements of OSHD Section 00759, Miscellaneous Portland Cement Concrete Structures.
- e. No heavy construction vehicle shall operate on any pavement, curbing, or sidewalks. Contractor shall keep the concrete structures free from contact, strain and public traffic for at least seven (7) calendar days or as directed by the City.
- f. No concrete shall be mixed, transported, placed, or finished when the temperature of the base, subgrade, or air is below 40°F or whenever, in the opinion of the

City, the temperature may fall below 40°F within 24 hours after the concrete has been placed.

- g. The Contractor shall take such precautions as are necessary to protect newly placed concrete from rain.
- h. The Contractor shall protect newly placed concrete from freezing for no less than seven (7) days.

3.2 CURBING

- a. Drop curbs shall be installed per the drawing details and as required for driveway and new handicapped access ramps.
- b. Curbs shall be blocked out as required for catch basins.
- c. Contractor shall cooperate with the City in locating and constructing curb depressions for handicapped ramps and driveways.
- d. Three (3)-inch Schedule 40 PVC curb weep holes shall be installed every fifty (50) feet in curbs unless otherwise shown on the drawings, at the low points of all lots and on both sides of all driveway drops.
- e. City to inspect curb forms or string line prior to concrete placement. It shall remain the contractor's responsibility to verify that curbs match both design elevations and grades prior to curb placement.
- f. Where new curbing connects to existing curbing or streets, the gutter grade shall match the existing gutter elevation and grade to allow drainage through the transition.
- g. Curbing shall be installed to grades shown on the drawings and so that water drains along the curbline. Ponding or puddling of water along the curbline will not be acceptable.
- h. Inspection by the City does not relieve the contractor of his responsibility to construct the curbs in accordance with the approved construction drawings and the tolerances outlined above.

3.3 SIDEWALKS AND DRIVEWAY APRONS

- a. All sidewalks and handicapped access ramps shall be a minimum of four (4)-inches thick. All driveway aprons and driveways shall be a minimum of six (6)-inches thick.
- b. Sidewalks shall be sloped up ¼-inch per foot from top of curb to drain over the same. Three (3)-inch diameter Schedule 40 PVC roof drain pipe shall be installed under sidewalks where required to meet curb weep holes. Contractor shall construct a tooled joint over roof drain piping.
- c. Expansion joints shall be constructed using preformed filler type at all structures, and at a maximum spacing of forty-five (45) feet.
- d. Contractor shall construct contraction joints not less than 1/8-inch nor more than 1/4-inch wide and 1-inch deep by tooling or other approved method at spacings which equals a minimum of the width of the walk.
- e. Forms, if any, shall be removed from structures after the concrete has taken its initial set and while the concrete is still green. Minor defects shall be repaired with mortar containing one part Portland cement and two parts sand within five (5) days of removal of forms. Plastering on exposed surfaces is prohibited.
- f. The top and face of structures shall be true and straight, free from humps, sags or other irregularities. The surface shall not vary more than 0.02 feet from the edge of 12-foot long straightedge laid on the top or face of the structure, except in curves. Contractor shall furnish the straightedge and operate it as directed. Unless otherwise shown or directed, all edges shall be tooled to 1/4-inch radius.
- g. Concrete surfaces shall be finished smooth and uniform in texture by troweling, floating and cross brooming. Lightly groove or mark surfaces into squares or other shapes as directed.
- h. Concrete shall be placed, cured and finished in accordance with the requirements of OSHD Section 00759, Miscellaneous Portland Cement Concrete Structures, unless otherwise specified, shown or directed.
- i. Place topsoil backfill adjacent to new curb and dress back disturbed area.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02510
ASPHALT CONCRETE PAVEMENTS**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the construction of asphalt concrete (AC) pavements and/or overlays as shown on the drawings, specified herein or directed by the City.
- b. This section includes the construction of one or more courses of AC pavement, adjustment of manhole castings, catch basins, junction and valve boxes, etc. to conform to new pavement courses, and other work and materials incidental to the construction of pavements.
- c. This section includes cutting and preparation of joints where new paving will meet existing paving.
- d. This section includes repaving disturbed asphalt concrete driveways to equal the original condition and blend-in to match drop curbs.

1.2 LABORATORY SERVICES

- a. Contractor shall provide laboratory services in accordance with the requirements of these standards which shall include:
 - 1) A compaction test shall be performed for every 100 tons of material placed.
 - 2) The laboratory shall provide a satisfactory certificate furnished by the manufacturer stating that the bituminous materials conform to OSHD Section 02710, Asphalt Materials, Additives, and Mineral Fines.
 - 3) Asphalt Concrete:
 - a) Plant Certification - The laboratory shall certify or furnish recent certification (within one year) from the OSHD that the plant meets State requirements.
 - b) Plant Inspection - For the first day of production and for every day when more than 200 tons of material is being delivered to the project, the laboratory shall provide a representative at the plant

who will inspect the plant, make mix design adjustments, check the temperature and take the required samples.

- c) Quality Control Testing - Each day the laboratory representative is on the project, a sample of the mix shall be taken for each 400 tons of bituminous material or fraction thereof delivered to the project. An extraction test AASHTO T164-70 and a mechanical analysis AASHTO T-3070 shall be performed on the mix samples.

1.3 SUBMITTALS FOR CITY'S APPROVAL

- a. Submittals shall be in accordance with the requirements of these standards and shall include:
 - 1) Manufacturer's or supplier's certificates for bituminous material.
 - 2) Mix design.

PART 2: PRODUCTS

2.1 TACK COAT

- a. The tack coat material shall be CSS-1, or CSS-1h, and shall meet the requirements of OSHD Section 00730, Asphalt Tack Coat.
- b. Hot oil tack coat (PBA-5 or approved equivalent) shall be used prior to placement of the overlay fabric or AC overlays. Use of emulsion tack coats shall be prohibited.

2.2 JOINT SEAL

- a. The joint seal shall meet the test requirements of ASTM D-244.
- b. The joint seal material shall be CRS-1 or CRS-2 and shall meet the requirements of OSHD Section 02710, Asphalt Materials, Additives, and Mineral Filler, for cationic emulsified rapid setting asphalt.

**SECTION 02634
CARRIER PIPE AND BORED CASING**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes all work necessary to install all railroad and highway bored crossing and all related work for the construction of the designated pipeline and other incidental work.
- b. Work shall include, but is not limited to, the following:
 - 1) Obtain all necessary permits, bonds and insurance required by the railroad, ODOT and other regulating authorities.
 - 2) Furnish and install casing for bored crossing as shown on the drawings.
 - 3) Installation of carrier pipe and appurtenances in casing.
 - 4) Coordinate with railroad, ODOT, and other regulating authorities.
 - 5) Furnish any and all protective fencing, berms and/or guard rails as required by the regulating authority.

1.2 SUBMITTALS

- a. Submittals shall conform to the requirements of these standards and shall include:
 - 1) Proof of insurance.
 - 2) Copies of applicable permits.
 - 3) As-built location and elevation of the casing (following installation).

PART 2: PRODUCTS

2.1 EXCAVATION AND BACKFILL

- a. Conform to requirements of applicable sections contained herein.
- b. Backfill with same material as that used for carrier pipe.

2.2 CASING PIPE

- a. Contractor shall provide casing of a size to permit proper construction of the carrier pipe to the required lines and grades. Casing shall be welded smooth steel pipe conforming to the requirements of ASTM A-53 or approved equal.
- b. Minimum casing wall thickness shall as outlined below.

1) Casing Pipe - Minimum Size and Thickness

Carrier Pipe Diameter (Inches)	Casing Pipe Diameter (Inches)	Casing Minimum Wall Thickness (Inches)
<6	10	0.188 (3/16)
6	12	0.281 (9/32)
8	14	0.281 (9/32)
10	16	0.313 (5/16)
12	18	0.344 (11/32)
14	20	0.375 (3/8)
16	22	0.406 (13/32)
18	24	0.438 (7/16)
20	26	0.469 (15/32)

- c. Casing pipe shall have a minimum yield strength of 35,000 psi.
- d. The class of casing specified is based upon the superimposed loads and not upon the stresses resulting from jacking or boring operations. Any increase in casing strength to withstand jacking or boring operations shall be the responsibility of the Contractor, supplied at no additional cost to the City.

2.3 CARRIER PIPE

- a. Carrier pipe shall conform to the plan requirements and specifications contained herein.

2.4 CASING SPACERS (SKIDS)

- a. Casing spacers shall be Model SSI as manufactured by APS (Advanced Products and Systems, Inc.), or approved equivalent.
- b. A minimum of three (3) casing spacers per length of pipe shall be required, or 6-foot on center maximum spacing, whichever is greater.

2.5 END SEALS

- a. End seals shall be Model AC (pull-on) or Model AW (adhesive) end seals as manufactured by APS, or approved equivalent.

PART 3: EXECUTION

3.1 GENERAL

- a. Construction in all cases shall conform to the requirements of regulating authority. A minimum of seven (7) days notice to the regulating authority is required prior to entry of right-of-way for construction of bored crossing.
- b. Before the start of work, Contractor shall submit satisfactory evidence to the City that he has complied with all permit and insurance requirements.
- c. Temporary fencing and warning barricades shall be installed around the boring pit(s) in accordance with all Federal, State, local and regulating authority requirements.

3.2 EXCAVATION

- a. Excavation shall be unclassified and shall include whatever materials are encountered to the depths shown or required. Contractor shall provide shoring and dewatering as required. Shoring and dewatering systems shall be of Contractor's design.

3.3 INSTALLATION OF CASING PIPE

- a. Casing pipe shall not deviate from established line or grade at either end by more than the following:

Line	±1.0 feet
Grade	±0.5 feet (0.2 feet for sewer lines)

- b. Sections of casing pipe shall be joined by welding joints with a continuous weld around the circumference of the pipe. It shall be the Contractor's responsibility to provide joints capable of resisting boring or jacking forces without failure.
- c. Boring pits shall be braced and shored as required by Federal, State or local laws and regulations. A safe and satisfactory means of removing boring material from the pit shall be provided.
- d. The boring shall be no larger than the outside diameter of the casing.

3.4 PIPE INSTALLATION IN CASING

- a. Casing spacers shall be placed on the carrier pipe as shown on the drawings or specified herein so that pipe is supported continuously by the skids and is not supported by the bells.
- b. Carrier pipe and casing spacers shall be gently pulled through casing to avoid damage to pipes and couplings.
- c. Contractor shall provide a means of pulling the toning wire through the casing when the use of non-metallic carrier pipe is specified.
- d. PVC Pressure Pipe
 - 1) In order to prevent over belling of PVC pipe while installing it through the casing, the Contractor shall provide a method for restricting the movement between the assembled bell and spigot in accordance with the recommendations of the pipe manufacturer.

3.5 CLOSURE OF CASING AFTER CARRIER PIPE INSTALLATION

- a. Both ends of the casing shall be sealed with manufactured end seals as specified or shown on the drawings.
- b. End seals shall be fastened in place with stainless steel bands provided by the end seal manufacturer.

3.6 RESTORATION OF TRENCH LINES

- a. Where pipe must be laid across the bore pit, the pit shall be filled with compacted granular material to the pipe spring line.

- b. Trench backfill and surface restoration shall conform to the specification contained herein.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02667
WATER DISTRIBUTION SYSTEM**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing and installing of all pressure piping 2-inches in diameter and larger and appurtenances as shown on the drawings or as required to complete the work.

- b. Work under this section shall include, but not be limited to the following:
 - 1) Furnish and install all pipe, fittings, specials, bends, beveled pipe, adapters, bulkheads, stoppers, plugs, joint restraints, joints and jointing materials, and pipe supports.
 - 2) Furnish and install pipe anchorage and thrust restraint systems as specified or as shown on the drawings, including but not limited to concrete for blocking and encasement of pipelines.
 - 3) Make connections to all existing and/or new facilities and provide temporary services as required.
 - 4) Install temporary plugs and/or stoppers and harnessing.
 - 5) Install valves, valve boxes and fire hydrants as shown or specified.
 - 6) Test and clean pipelines and appurtenances.
 - 7) Disinfect pipelines and appurtenances.
 - 8) Furnish and install water services and meters as shown.
 - 9) Replace sewer laterals and mainlines with C900 PVC pipe where necessary.

1.2 QUALITY CONTROL

- a. **Laboratory Services:** Water quality testing services shall be provided by a laboratory certified by the State of Oregon.

b. Field Inspection:

- 1) All pipe sections, fittings, specials, jointing materials, etc., shall be carefully examined for defects and no piece shall be laid that is known to be defective. Any defective piece discovered after installation shall be removed and replaced with a sound one in a manner satisfactory to the City at the Contractor's expense.
- 2) Defective material shall be marked with lumber crayon and removed from the job site before the end of the following day.

c. Field Testing:

- 1) All materials, process of manufacturing, and finished pipe shall be subject to inspection and approval.
- 2) The City may select one sample of pipe on the job site of each production run of each size and type of pipe to be tested by the laboratory. The Contractor shall furnish the first test piece or pipe core and any additional samples required because of failures. Should the sample fail to meet specifications, retests shall be conducted by the laboratory in conformance with the specifications. Cost of all retests shall be borne by the Contractor.

1.3 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards showing and shall include the following:
- 1) Schedule of pipe fittings and specials.
 - 2) Material and class for each size and type of pipe.
 - 3) Joint details and any special provisions required for assembly.
 - 4) Manufacturer's literature for each size and type of pipe, fittings and valve used.
 - 5) Manufacturer's certification that all materials and products, including pipe and fitting lining, which will come in contact with potable water conform to the requirements of NSF 61. The City may require evidence of certification.

- 6) A certificate from the pipe manufacturer stating that the materials have been sampled and tested in accordance with the provisions of and meet the requirements of the designated specification. The certificate shall be signed by an authorized agent of the manufacturer.
- 7) Manufacturer's certification that all materials and products which will come in contact with potable water meet the requirements of NSF 61 and the specifications contained herein.
- 8) Where set screw adaptor flanges are shown or proposed for use, a listing of the manufacturer's torque installation requirements for all pipe thicknesses shall be included with the fitting submittal.

1.4 CONTRACTOR'S RECORD DRAWINGS

- a. The Contractor shall maintain a neatly marked set of record drawings showing the locations and depths of all waterlines, storm and sanitary sewer laterals, buried conduits and other utilities encountered during construction. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the City at any time.

PART 2: PRODUCTS

2.1 GENERAL

- a. All materials or products specified under this section which will come in contact with or which will be used on materials or products which will come in contact with potable water shall conform to the requirements of OAR 333-61-087, Product Acceptability Criteria.
- b. All materials or products as specified above shall meet the requirements of the National Sanitation Foundation Standard 61, Drinking Water System Components - Health Effects, or equivalent as approved by the Oregon Health Division.
- c. Whenever any material or product is indicated or specified by patent or proprietary name, name of manufacturer or model number, such specification is used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired. Such specification of a particular product shall not be construed as acceptability under the above listed criteria. It shall be the Contractor's responsibility to provide certification as required above or provide an equal quality product for which certification can be provided.

- d. Any material or product installed without certification that it conforms to requirements as specified above shall be removed and replaced by the Contractor at no additional cost to the City.

2.2 PIPE

a. General

- 1) Pipe buried underground, unless otherwise specified or shown, shall be bell and spigot with rubber gasket (push-on) type joints in straight runs and mechanical joints each way from bends. The spigot end of each pipe shall be marked to indicate when the pipe is "home."
- 2) All gaskets shall be a single molded rubber ring fitted into a specially shaped recess and forming a pressure tight seal.
- 3) The thickness class or pressure class of the pipe, as well as the material type, size and designation (ie. AWWA ____) shall be permanently stencilled on the exterior of each pipe at the factory.

b. Ductile Iron (DI) Pipe

- 1) All ductile iron pipe shall be centrifugally cast in conformance to AWWA C-151, and shall be cement mortar lined and seal coated in accordance with AWWA C-104.
- 2) All ductile iron pipe shall be minimum Class 52 thickness, unless otherwise shown or specified.
- 3) All ductile iron pipe buried underground shall be coated on the outside with a standard coating of black bituminous paint a minimum of 1 mil thick unless otherwise specified.
- 4) Restrained Joint Pipe
 - a) Restrained joint ductile iron pipe and fittings shall have a flexible, positively restrained boltless push-on joint system capable of being deflected after assembly.
 - b) Unless otherwise specified, all restrained joint ductile iron pipe and fittings shall be "TR-Flex" as manufactured by U.S. Pipe or approved equivalent.

- 5) All ductile iron pipe shall be as manufactured by Pacific States, US Pipe, Tyler Pipe, or approved equivalent.

c. PVC Pressure Pipe

- 1) 2-inch Through 3-inch PVC (ASTM 2241)
 - a) PVC pressure pipe 2-inches through 3-inches in diameter shall conform to the requirements of ASTM 2241, NSF approved. PVC pipe shall be Class 160 pipe.
- 2) 4-inch Through 12-inch PVC (AWWA C-900)
 - a) PVC pressure pipe 4-inches through 12-inches in diameter shall conform to the requirements of AWWA C-900 (design stress of 4000 psi), NSF approved, with cast iron pipe equivalent (CI) outside diameter dimensions. PVC pipe shall be Class 150 pipe with wall thickness equivalent to a standard dimension ratio (SDR) of 18.
- 3) 14-inch Through 24-inch PVC (AWWA C-905)
 - a) PVC pressure pipe 12-inches through 24-inches in diameter shall conform to the requirements of AWWA C-905 (design stress of 4000 psi), NSF approved, with cast iron pipe equivalent (CI) outside diameter dimensions. PVC pipe shall be Class 165 pipe with wall thickness equivalent to a standard dimension ratio (SDR) of 25.
- 4) All PVC pipe shall be as manufactured by J-M Pipe and P-W Pipe, or approved equivalent.

2.3 PIPE JOINTS

a. General

- 1) Gaskets and glands shall be provided by the manufacturer of the fitting on which they are to be used and shall be specifically designed for the pipe O.D. equivalent used.
- 2) Where required a non-toxic vegetable soap lubricant shall be supplied with the pipe or fittings in sufficient quantities for installing the pipe.

- 3) All bolts and nuts shall be low carbon steel conforming to ASTM A-307, Grade B, or Corten T-bolts. All bolts and nuts shall conform to the requirements of AWWA C-111.

b. Ductile Iron Pipe Joints

1) Push-On Joints

- a) All push-on joints shall be single rubber gasket push-on joints conforming with the requirements of AWWA C-111 unless otherwise specified. Gaskets and lubricant shall be provided by the manufacturer of the pipe on which they are to be used.

b) Restrained Push-On Joints

- (1) Restrained joint ductile iron pipe and fittings shall have a flexible, positively restrained boltless push-on joint system capable of being deflected after assembly.

2) Mechanical Joints

- a) All components of mechanical joints shall be in conformance with AWWA C-111.

b) Retainer Glands

- (1) Retainer glands shall be used at locations shown on the drawings.
- (2) The use of retainer glands in lieu of concrete for thrust restraint is limited to applications specified herein or shown on the drawings.
- (3) Retainer glands shall be "Mega-Lug" as manufactured by EBAA Iron Inc., or approved equivalent.

3) Flanged Joints

- a) Flanged joints for ductile iron pipe shall conform with the requirements of AWWA C-115. Unless otherwise shown or specified, flanged spools shall be minimum Class 53 thickness. Gaskets shall be 1/8-inch thick rubber, full face, conforming to the pipe manufacturer's requirements and AWWA C-111.

b) Adaptor Flanges (Exposed Locations)

- (1) Where shown on the drawings or approved by City, adaptor flanges for use in making custom ductile iron spools in exposed (not buried) locations shall be Uni-Flange Series 200 for pipe 4-inches through 12-inches in diameter, and Uni-Flange Series 400 for pipe greater than 12-inches in diameter, as manufactured by Uni-Flange Corporation, or approved equal.
- (2) Gaskets shall conform with AWWA C-111 and shall be provided by the manufacturer of the adaptor flange.
- (3) Set screws shall be square head design. A listing of the manufacturer's torque installation requirements for all pipe thicknesses shall be included with the adapter flange.

c) Adaptor Flanges (Buried Locations)

- (1) Adaptor flanges for use in connecting plain-end pipe to flanged fittings in buried locations shall be mechanical joint by flange adapters.
- (2) Gaskets shall conform with AWWA C-111 and shall be provided by the manufacturer of the adaptor flange.

c. PVC PIPE JOINTS

1) Push-On Joints

- a) All push-on joints shall be single rubber gasket push-on joints conforming with the requirements of AWWA C-111 unless otherwise specified. Gaskets and lubricant shall be provided by the manufacturer of the pipe on which they are to be used.

2) Mechanical Joints

- a) All components of mechanical joints shall be in conformance with AWWA C-111.

3) Joints Restrainers

- a) Joint restrainers shall be used at locations shown on the plans.

- b) The use of joint restrainers in lieu of concrete for thrust restraint is limited to applications specified in the standards or approved by the City. Joint restrainers shall be specifically designed for use on PVC pipe.
 - c) Joint restraints shall be Uni-Flange Series 1300, 1350 or 1390, as manufactured by Uni-Flange Corporation or approved equal.
- 4) Adaptor Flanges (Buried Locations)
- a) Adaptor flanges for use in connecting plain-end pipe to flanged fittings in buried locations shall be mechanical joint by flange adapters.
 - b) Gaskets shall conform with AWWA C-111 and shall be provided by the manufacturer of the adaptor flange.

2.4 DUCTILE AND CAST IRON FITTINGS

a. General

- 1) All fittings shall be mechanical joint unless otherwise specified or shown on the drawings.
- 2) The size, gasket manufacturer's mark, county where molded, year of manufacture shall be molded or permanently marked on all gaskets on non-sealing surfaces. In addition, the letters MJ shall be appear on all MJ gaskets.
- 3) Unless otherwise shown or specified, all fittings shall be as manufactured by Mueller, Tyler, US Pipe or approved equal.

b. Mechanical Joint Fittings

- 1) All follower glands shall be ductile iron. In addition to casting marks on the fittings, follower glands shall have cast or stamped on them the manufacturer's identification, country where cast, nominal size, and the letters DI or ductile.

- 2) 4-inch through 24-inch
 - a) All MJ tees, crosses, elbows, reducers, adapters, combinations thereof, and other miscellaneous fittings 4-inches through 24-inches in diameter shall be ductile iron compact fittings in conformance with AWWA C-153.
 - b) Unless other specified, the minimum working pressure for all MJ cast iron or ductile iron fittings 4-inches through 24-inch in diameter shall be 350 psi.
- 3) Larger than 24-inch
 - a) All MJ tees, crosses, elbows, reducers, adapters, combinations thereof, and other miscellaneous fittings greater than 24-inches in diameter shall be ductile iron fittings in conformance with AWWA C-110.
 - b) Unless otherwise specified, the minimum working pressure for all MJ cast iron or ductile iron fittings greater than 24-inches in diameter shall be 250 psi.

c. Flanged Fittings

- 1) All flanged tees, crosses, elbows, reducers, adapters, combinations thereof, and other miscellaneous fittings 4-inches through 48-inches in diameter shall be cast iron or ductile iron fittings in conformance with AWWA C-110.
- 2) Unless otherwise specified, the minimum working pressure for all flanged cast iron or ductile iron fittings shall be 250 psi.
- 3) All fitting shall have distinctly cast on the outside of the fitting the pressure rating, nominal diameter of openings, manufacturer's identification, country where cast, and number of degrees or fraction of the circle on all bends. Size of lettering shall conform to AWWA C-110.

2.5 DUCTILE AND CAST IRON COATINGS AND LININGS

- a. All pipe and fittings, with the exception of solid sleeve couplings, shall be cement-mortar lined and seal coated in accordance with AWWA C-104.
- b. Pipe or fittings which have a damaged cement lining or no cement lining will be rejected at the job site. Cement linings that are installed or repaired by the

distributor/supplier shall be completed in strict accordance with AWWA C-104. Cement linings shall not be repaired at the job site.

- c. All cast pipe and fittings buried underground shall be coated on the outside with a standard coating of black bituminous paint a minimum of 1 mil thick unless otherwise specified. The finished coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun, and shall be strongly adherent to the pipe.
- d. Unless otherwise specified, cast pipe used within buildings and structures and which is to receive field coats of paint shall not be coated with any black bituminous paint. Such pipe, after proper cleaning, shall be painted with one coat of primer paint that is compatible with the field coats. Painting specifications shall be followed for cleaning and painting.

2.6 COUPLINGS AND ADAPTERS

- a. Couplings shall be limited in their application to connection of new pipe work to existing waterlines, temporary installations, and where specifically approved by the City Engineer.
- b. Couplings shall be mechanical joint solid sleeve or mechanical joint split sleeve type couplings consisting of a ductile iron sleeve, ductile iron follower rings, rubber gaskets, and corrosion-resistant bolts and hex nuts.
- c. Mechanical joint couplings shall have minimum pressure ratings that will accommodate maximum pressures which will be experienced during hydrostatic and leakage testing.
- d. Solid sleeve couplings shall be Romac, Smith-Blair, Mueller or approved equivalent.
- e. Dresser type couplings are not an approved option unless specifically approved by the Director of Public Works. Applications shall be limited to transitions between pipe types for which mechanical joint couplings are not available.

2.7 VALVES

a. General

- 1) All valves and appurtenances shall have the name, monogram, or initials of the manufacturer cast thereon. They shall be built and equipped for the type of operation as specified herein or as shown on the drawings.
- 2) Where requested by the Contractor and approved by the City, additional valves may be installed by the Contractor to facilitate installation, testing, or connection to existing pipe work. Unless otherwise specified in writing by the City, such valves requested by the Contractor shall be provided at no additional cost to the City.
- 3) Unless otherwise specified, all valves shall have a minimum pressure rating that will accommodate maximum pressure which will be experienced during hydrostatic leakage testing.

b. Valve Operators

- 1) All valve operators shall be totally enclosed traveling nut type manual operators, sealed and lubricated for underground service.
- 2) All buried valves shall be supplied with a 2-inch square operating nut. Nuts shall have a flanged base on which shall be cast an arrow at least 2-inch long with the word "OPEN" cast on the nut to clearly indicate the direction of opening.
- 3) Extension stems shall be provided for buried valves when the operating nut is four (4) feet or more below finished grade. Extension stem shall extend to within twelve (12) inches (maximum) of the finished ground surface and shall be provided with spacers which will center the stem in the valve box.
- 4) Valve Wrenches: Unless otherwise specified, T-handle valve wrenches shall be delivered to the City Public Works shop by the Contractor prior to final acceptance of public waterlines by the City. A minimum of two (2) valve wrenches, or one (1) valve wrench for each five (5) square nut operated valves or portion thereof, whichever is greater, shall be supplied by the Contractor. The length of the valve wrench stems shall be such that the valves can be properly operated from a standing position (i.e., handle at ± 3 feet above floor or finish grade).

- 5) Unless otherwise specified or shown on the drawings, handwheel operators shall be provided on all exposed valves. Handwheels shall be of the spoked type only. An arrow with the word "OPEN" shall be cast into the handwheel, located so as to be readily readable, showing the opening direction of the valve. The outside diameter of the handwheels shall not be less than shown on the table below.

Valve Diameter (inches)	Minimum Diameter of Handwheel (inch)
3	10
4	10
6	12
8	14
10	16
12 & larger	16

c. Valve Boxes (VB)

- 1) All buried valves shall be provided with valve boxes. Valve boxes shall conform to Standard Details.
- 2) All parts of valve boxes, bases, and covers shall be coated by dipping in bituminous varnish.

d. Gate Valves (GV)

- 1) All gate valves shall be resilient wedge gate valves conforming to the requirements of AWWA C-509, except as herein modified.
- 2) Gate valves shall be epoxy coated iron-body, resilient wedge non-rising stem gate valves. The wedge shall be cast iron completely encapsulated in a elastomer covering with polymer guide bearing caps on each side. The valves shall have a full diameter waterway with no grooves or recesses at the valve seat location. Flanges, where required, shall be 125 pound, full faced, drilled per ANSI B16.1.
- 3) Valves shall be tested and certified by the manufacturer for shut-off at a working pressure of 200 psi and a minimum test pressure of 300 psi.

- 4) Gate valves shall be Mueller A-2360, Waterous Series 500 or approved equivalent.

e. Butterfly Valves (BFV)

- 1) All butterfly valves shall conform to AWWA C-504, except as herein modified.
- 2) Butterfly valves shall be epoxy coated short body type AWWA Type-B valves. Flanges, where required, shall be 125 pound, full faced, drilled per ANSI B16.1.
- 3) Valve operators shall be enclosed traveling nut type manual operators, sealed and lubricated for underground service, and shall be rated for submerged operation up to 10 psi (± 23 feet).
- 4) Valves shall be tested and certified by the manufacturer for shut-off at a working pressure of 150 psi and a minimum test pressure of 300 psi.
- 5) Butterfly valves shall be Pratt Groundhog series, or approved equivalent.

f. Air Release Valves (ARV)

- 1) Air release valves shall be APCO Series 140, or approved equal.
- 2) Air release valves shall be installed at the locations and as approved by the City.

g. Shop Painting

- 1) Unless otherwise specified, all valves shall be furnished with a fusion-bonded epoxy coating inside and outside conforming to the requirements of AWWA C-550.

2.8 SERVICE PIPE FITTINGS AND SERVICE SADDLES

- a. All services that are saddle tapped shall use ductile iron service saddles with stainless steel bolts and clamps. All ductile iron service saddles shall be furnished with a fusion bonded epoxy coating conforming to the requirements of AWWA C-550.

- b. Unless otherwise shown on the drawings, single and double residential service pipe shall be 3/4-inch and 1-inch in diameter, respectively.

c. **3/4-inch and 1-inch Services**

Water services are typically installed by the City. If the City allows or requires water services to be installed by the Contractor, the following requirements shall apply.

- 1) Unless otherwise specified herein, all water service lines shall be seamless polyethylene (PE) pressure pipe conforming to AWWA C-901. All water service lines shall be Phillips Driscopipe 5100 copper tube size, conforming to the requirements of the City.
- 2) All corporation stops shall be brass ball valve corporation stops rated to 300 psi with AWWA thread inlet and compression outlet to adapt PE pipe. Corporation stops shall be Ford FB-1100 or approved equivalent.
- 3) Each individual water service line shall be equipped with a locking ball valve meter stop assembly at the inlet to the meter. All meter stop assemblies shall be brass with PE pipe connector as appropriate and outlet for meter coupling.
- 4) Meter stops for 3/4-inch and 1-inch single meter stops shall be locking angle ball valves with CTS PAC joint inlet. 3/4-inch and 1-inch meter stops shall be Ford BA43-232W and Ford BA43-444W, respectively, or approved equivalent.
- 5) Service line couplings shall be CTS pack joint style couplings. Couplings shall be Ford C44 coupling or approved equivalent.

d. **1½-inch and Larger Services**

Water services are typically installed by the City. If the City allows or requires water services to be installed by the Contractor, the following requirements shall apply.

- 1) 1½-inch and 2-inch water service lines shall consist of brass fittings and piping as directed by the Public Works Director for near side services. Far side services shall be installed using PVC pressure pipe as specified in Paragraph 2.2(c) contained herein.

- 2) 1½-inch and 2-inch water services shall be provided with high bypass coppersettlers for flanged meters, Ford 70 series or approved equivalent conforming to standard details.
 - a) The coppersetter shall be provided with ball valves on the inlet and outlet, with inlet valve provided with a lockwing and the outlet valve provided with a handle.
 - b) The bypass line shall be 1-inch diameter minimum, and shall be provided with a lockwing ball valve.
- 3) 2-inch and larger services shall have a mainline tee with flanged side outlet and flanged resilient wedge gate valve conforming the requirements specified herein.
- 4) 3-inch and larger water service lines shall be reviewed on a case-by-case basis. Pipe and fittings shall be as required by the City Engineer and the Director of Public Works.

2.9 WATER METERS AND METER BOXES

- a. Unless otherwise approved by the Director of Public Works, all meter boxes must be as shown below:

WATER METER BOXES			
Service Line Size	Non-Traffic Area	Traffic Area	Inside Dimensions
3/4-inch	¹ Brooks 36-H	¹ Brooks 36-T	10½" x 17¼"
1-inch	¹ Brooks 36-H	¹ Brooks 36-TR	10½" x 17¼"
1½-inch	¹ Brooks 66-S(CI)	¹ Brooks 66-TR	17" x 30"
2-inch	¹ Brooks 66-S(CI)	¹ Brooks 66-TR	17" x 30"
3-Inch and larger	Vault built to Public Works requirements.		
¹ -or approved equivalent.			

- b. Meter boxes outside of traffic areas shall be reinforced concrete boxes with reinforced concrete covers and cast iron reading lids.

- c. Meter boxes within traffic areas shall be reinforced concrete boxes with steel covers and cast iron reading lids.
- d. Unless otherwise shown or specified, all meter boxes to be set to finish grade.
- e. Where connecting to existing water meters, Contractor shall supply all required fittings to make connection.

2.10 FIRE HYDRANTS

- a. Unless otherwise required by the Department of Public Safety, all fire hydrants shall conform to the following:
 - 1) All fire hydrants shall be improved, dry barrel, 5-1/4-inch compression type valve, traffic model.
 - 2) Fire hydrants shall be equipped with two 2-1/2-inch hose ports (NST), one 4-1/2-inch pumper port (NST), 1-1/2-inch pentagon nut, and barrel drains.
 - 3) Fire hydrants shall be oriented so as to optimize access to ports, or as directed by the City.
 - 4) Fire hydrants shall be Mueller Super Centurion 250, Model A-423, and shall be painted yellow. Paint shall be Rodda All-Purpose equipment enamel, Medium Yellow # 1998 or approved equivalent.
 - 5) All fire hydrants shall conform to local fire district requirements.

2.11 MAINLINE BLOWOFFS

- a. Minimum allowable blowoff size shall be 2-inch.
- b. Unless otherwise shown or authorized by the City, all mainline blowoffs shall have consist of brass or bronze fittings and valves as specified herein or shown on the drawings tapped into a blind flange, cap or plug as appropriate.
- c. Unless otherwise shown or authorized by the City, all blowoffs shall be provided with valve boxes and/or meter boxes as shown or specified.

2.12 TAPPING TEES

- a. Tapping tees used for making connections to existing, in-service lines shall have Class 125 outlet flanges.
- b. In all cases, the tapping tee shall be designed for use with the existing pipe materials and O.D. equivalent.
- c. Unless otherwise specified or approved by the City, all tapping tees shall be all stainless steel construction with full perimeter gaskets.
- d. The tapping tees shall be as manufactured by Mueller, or approved equal.

2.13 BACKFILL AND BEDDING MATERIAL

- a. Unless otherwise shown on the drawings or specified herein, all pipe bedding materials shall be in conformance with the applicable excavation and backfill specifications contained herein.
- b. Concrete bedding and encasement in lieu of standard bedding material shall be installed as shown on the drawings or as specified.

2.14 CONCRETE

- a. Concrete shall conform to OSHD Standard Specification Section 00440, "Minor Structures Concrete", 3,300 psi.
- b. Reinforcing steel shall be deformed bars conforming to ASTM A-615, Grade 60.

2.15 UNDERGROUND WARNING TAPE

- a. Detectable or non-detectable acid and alkali resistant safety warning tape shall be provided with all mainline construction.
- b. The tape shall consist of a minimum 4.0 mil (0.004") thick, virgin low density polyethylene plastic film formulated for extended use underground. The tape shall be in accordance with the APWA national color code and shall be permanently imprinted in lead free black pigments suitable for direct burial.
- c. The tape shall be safety blue and shall be provided with the legend "CAUTION BURIED WATER LINE BELOW" or approved equivalent printed continuously down the length of the tape.

2.16 TONING WIRE

- a. A continuous insulated 14 gauge stranded copper toning wire shall be supplied with non-metallic pipe. Insulation shall be blue in color for potable water piping.
- b. Additional wire shall be supplied as necessary to allow the toning wire to be looped up at all valve boxes on all lines.

PART 3: EXECUTION

3.1 PRODUCT HANDLING

- a. Care shall be taken in handling and transporting to avoid damaging pipe and appurtenances. Loading and unloading shall be accomplished with the material under control at all times and under no circumstances shall the material be dropped. Material shall be securely wedged and restrained during transportation and supported on blocks when stored in the shop or field. Manufacturer's recommendations shall be carefully followed during material handling and storage.
- b. Store all pipe on a flat surface so that the blocking will support the barrel evenly. It is not recommended that pipe be stacked higher than four (4) feet. Plastic pipe, if stored outside, shall be covered with an opaque material to protect it from sunlight.
- c. Lower all pipe and fittings into trench in a manner to prevent damage to pipe or fittings. Heavy impact may cause a slight longitudinal indentation in the outside of PVC pipe and a crack on the inside. This may result in a split as soon as the pipe is placed under pressure. Any pipe that has been impacted shall be examined closely for this type of damage.

3.2 PREPARATION OF TRENCH

- a. Trench excavation shall conform to requirements of applicable sections contained herein.
- b. Unless otherwise specified or shown on the drawings, the width of the trench at the top of the pipe shall not exceed the values outlined below. Trench widths are based on the width of the pipe plus the distance from each side of the pipe to the face of the trench (or the back of the sheeting, if used).
 - 1) For pipe twenty-four (24)-inches in diameter or less, trench width shall not exceed width of the pipe plus nine (9) inches on each side.

- 2) For pipe greater than twenty-four (24)-inches in diameter, trench width shall not exceed width of the pipe plus fifteen (15) inches on each side.
- c. Unless otherwise directed or called for on the drawings, all pipe trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the drawings.

3.3 GRADE AND ALIGNMENT

- a. All waterlines shall be installed with a minimum depth of bury of three (3) feet measured from the top of pipe to finish grade unless a deeper depth is shown on the drawings. A greater depth may be necessary to avoid underground obstructions or as shown on the drawings. A minimum of six (6) inches of clearance shall be maintained between the pipe and obstructions.
- b. When waterlines are designed to be laid in a straight line and/or at a specific grade, the deviation from line and grade shall not be in excess of 0.2 feet horizontally for line and 0.1 feet vertically for grade.

3.4 UTILITY CONFLICTS

- a. The Contractor shall be responsible for exposing potential utility conflicts far enough ahead of pipeline construction to make necessary adjustments in grade and alignment of the new work within the recommended limits of pipe and fitting deflection and/or the lines and grades stated in these standards.
- b. The Contractor shall be responsible for informing the City of the need for a grade and/or alignment adjustment. Where failure to expose potential utility conflicts in advance results in the necessity of removing and/or relocating newly laid pipe, this additional work shall be performed by the Contractor at no additional expense to the City.
- c. The Contractor shall not deviate from the design line and grade stated in the approved construction drawings without the approval of the City.

3.5 SANITARY SEWER CROSSINGS

- a. Where sanitary sewer lines are above or within 18-inches vertical separation below a waterline, sewer mains and/or laterals shall be replaced with AWWA C-900 PVC pipe in accordance with OAR 333. Center one full (20 ft.) length of AWWA C-900 PVC pipe (DR 18) at point of crossing. Connect to existing sewer lines with City-approved rubber couplings.

- b. Contractor shall contact City when sewer lines are found within the above described zone. City may field verify the need for ductile iron sewer lines. Contractor shall replace sewer lines only after direction from the City.

3.6 OPERATION OF EXISTING VALVES

- a. The City will operate or supervise the operation of all existing valves during the course of the work. The Contractor shall not operate any existing valve unless specifically instructed to do so by the City.
- b. The Contractor shall be responsible for coordination of the work with the City to provide for the timely operation of existing valves.
- c. The Contractor shall coordinate and perform the work so as not to require the City's personnel to operate any valves outside of the City's normal work hours.

3.7 SANITARY PRACTICES DURING INSTALLATION

- a. Pipe shall not be laid in standing water. Precautions shall be taken to prevent dirt, debris, or other foreign materials from entering the pipe during all phases of construction. Tools, rags, and other materials shall be kept out of the pipe at all times.
- b. At the end of each day, or at other times when the trench site is left unattended, the open ends of the pipe shall be sealed with a water tight plug to prevent trench water and foreign materials from entering the pipe. If water is in the trench, the seal shall remain in place as long as water is able to enter the pipe.

3.8 PIPE INSTALLATION

- a. Pipe shall be laid and joined one length at a time to the required line and grade. Pipe shall be placed with the bell end facing the direction of laying unless otherwise specified.
- b. Where pipe is laid on grades in excess of fifteen percent (15%), the bells shall face upgrade. Where pipe is laid on grades in excess of twenty percent (20%), pipe anchorage systems shall be required.
- c. The outside of the spigot and the inside of the bell shall be clean before the pipe or fittings are installed. If the pipe contains dirt or other foreign matter, the interior of the pipe shall be cleaned as necessary to remove the material prior to installation.

- d. As the pipe is placed in the trench, bell holes shall be dug and the pipe supported on bedding materials the full length of the barrel.
- e. Where required, lubricate the outer surface of the rubber gaskets and the spigot end of the pipe using approved lubricant.
- f. Assemble the pipe in accordance with the manufacturers recommendations. Regardless of the method used to assemble the pipe, the pipe shall be kept in alignment during installation of the spigot into the bell end or the fitting.
- g. After each length of pipe is installed in the trench, the pipe shall be secured in place with approved backfill material tamped under and along sides to prevent movement. Additional backfill material shall be placed and compacted in layers to the height shown on the plans and details or as directed. The remainder of the trench shall be backfilled as specified and called for in these standards.
- h. Pipe ends shall be kept clear of backfill at all times.
- i. Wherever piping passes through walls, a wall casting pipe or sleeve shall be installed unless otherwise shown on the drawings.

3.9 UNDERGROUND WARNING TAPE

- a. Underground warning tape shall be placed a minimum of 12-inches and a maximum of 18-inches below the finish ground surface, and shall be continuous the entire length of the mainline installed.

3.10 FITTING INSTALLATION

- a. All connections shall be made in strict accordance with manufacturer's recommendations.
- b. The connection of ductile iron pipe with plain ends of the same diameter in new construction shall be accomplished with ductile iron, mechanical joint sleeve couplings unless otherwise approved by the City.
- c. All fittings shall be supported by concrete independently of the pipe.
- d. Contractor shall use the correct rubber ring with the ductile iron bell or fitting, (Tyton ring with Tyton bell; MJ ring with MJ fitting) and specifically designed for the pipe O.D. equivalent used.

3.11 CUTTING PIPE

a. General

- 1) Where new or existing pipe requires cutting in the field it shall be done in a manner to leave a smooth end at right angles to the pipe centerline. The pipe shall be marked around its entire circumference prior to cutting.
- 2) After cutting and dressing or beveling, the reference mark on the spigot shall be accurately relocated and marked at the proper distance from the end as recommended by the manufacturer. The reference mark may be located by using a factory marked end of the same size as a guide.

b. Ductile Iron Pipe

- 1) Ductile iron pipe shall not be flame cut.
- 2) The cut end of the pipe shall be ground smooth as required. For push-on joint connections, the cut end shall be beveled as necessary to remove sharp edges which may damage the gasket. The width and general appearance of the bevel shall closely resemble the bevel on an original pipe end.
- 3) Any lining or coating damaged during the cutting process, as determined by the City, shall be cause for removing the damaged section by recutting the pipe or for rejecting the pipe altogether.

c. PVC Pipe

- 1) For push-on joint connections, the cut end shall be beveled as specified herein.
- 2) Factory finished beveled end may be used as a guide to determine the angle and length of taper. The end may be beveled using a plastic pipe beveling tools which will cut the correct taper automatically. A portable type sander or abrasive disc may also be used to bevel the pipe end. Any equivalent tool or equipment which will produce a smooth bevel surface may be substituted.

3.12 CONNECTION TO EXISTING, IN-SERVICE MAINS

- a. Immediately prior to installation, all fittings, valves and appurtenances, including tool surfaces which will come in contact with potable water, shall be thoroughly cleaned by washing with potable water and then swabbed or sprayed with a one

percent (1%) hypochlorite solution in accordance with the requirements of AWWA C-651 and OAR 333.

b. Cut-In Connections

- 1) All valves shall be operated by or under the supervision of the City.
- 2) Prior to taking any waterline out of service, the Contractor shall assemble all personnel, equipment, and materials necessary to complete the work, completely assemble all fitting assemblies and check components for compatibility with the existing waterline, and accomplish all excavation that is required to make the connection.
- 3) Existing valves may leak. The Contractor shall be prepared to make required connections in situations where there is still a partial flow of water after the isolation valves have been closed.
- 4) In situations where an existing pipe joint is found adjacent to a proposed connection and the City determines that construction operations may compromise the joint, the Contractor shall remove the existing pipe between the joint and the new work as directed by the City, and replace that section with new materials.

c. Tapping Tees

- 1) Contractor shall fully support the weight of the tapping tee, associated valve and the existing pipeline. Under no circumstances shall the weight of the tapping unit be supported by the existing pipe. Pipe which is damaged due to failure of the Contractor to follow this requirement shall be replaced at no additional cost to the City.

3.13 STANDARD MAIN BLOW-OFFS

- a. At all permanent dead-ends on new waterlines and at other locations specified or shown on the drawings, a blow-off assembly shall be installed as specified herein and in accordance with drawing details.
- b. On all lines not specifically designated as permanent dead-end lines, thrust blocks shall not be placed in front of the end of the pipe. The mainline shall be tied back to allow for future connection without taking the line out of service.

- c. Valve boxes and/or meter boxes shall be provided for all blow-offs as shown and shall be installed flush with finished grade and be kept free of rocks and debris .

3.14 PIPE ANCHORAGE

- a. Pipe anchorage systems shall be installed as shown on the drawings or as specified herein.
- b. All plugs, caps, tees, and bends of 11-1/4° or more on waterlines that are 4-inches in diameter or larger shall be securely anchored by concrete thrust blocking. The use of threaded tie back rods for thrust restraint shall not be used unless specifically shown on the drawings or directed by the City.
- c. Thrust blocks shall be installed where specified herein, shown on the drawings, or as directed by the City. Installation shall be in conformance with drawing details and the following:
 - 1) All concrete thrust blocks shall be placed using forms as necessary to allow access to the bolt circles after the placement of the thrust blocking concrete. The bearing surface shall be placed so that the pipe and fitting joints will be accessible for repair. Concrete shall in no case extend around more than one-half the circumference of the fitting at any point.
 - 2) A plastic sheet or other similar protection shall be placed between the concrete and any portions of the valve, fitting, or nuts and bolts with which the concrete comes in contact. Do not encase pipe joints or cover bolt circles with concrete.
 - 3) Concrete thrust blocking shall be placed between undisturbed earth and the fittings to be anchored. If, in the opinion of the City, the undisturbed earth against which the bearing surface will be established is compromised by adjacent trenches or excavations, the Contractor shall excavate additional material as required to establish a new bearing surface that is consistent with the size, configuration, and location of the piping.

3.15 SERVICE TAPS

- a. Service pipe and fittings shall conform to City standard details. Installation shall be in accordance with pipe manufacturer's recommendations.

- 1) Tapping requirements for water service lines shall be as outlined below.

WATER SERVICE TAPPING REQUIREMENTS		
Service Size	Mainline Type	Tapping Requirements
3/4" through 1½"	All pipe types	Service Saddle
2" & larger	All pipe types	Mainline tee with flanged valve

3.16 FIRE HYDRANTS

- a. Installation of hydrants to conform to plan details. Installation shall be in accordance with AWWA C-600 and set where indicated on plans or directed by the City.
- b. Hydrants shall be installed true and plumb.
- c. Hydrants shall be set behind the curb/sidewalk as shown on the City standard details unless otherwise directed by the City.
- d. Hydrants shall set so that the center of the safety breakaway flange is located a minimum of 2 inches and a maximum of 6 inches above finished curb, sidewalk or finished grade.
- e. Where utility conflicts may require changes in grade, Contractor shall pothole existing utilities far enough in advance to allow the proper height hydrants to be on hand.
- f. Hydrants set too high shall be removed and replaced with an appropriate hydrant by the Contractor at no additional cost to the City. Extensions required for hydrants set too low shall be supplied and installed by the Contractor at no additional cost to the City.

3.17 VALVE AND VALVE BOX INSTALLATION

- a. Valve installation shall be in accordance with AWWA C-600 and applicable sections contained herein. A valve box shall be supplied for each valve, conforming to plan requirements and at locations shown on plans or staked in field.
- b. Contractor shall install an extension stem on all valves where operator nut is four (4) or more feet below finish grade.

- c. Valve boxes shall be centered over the valve and installed plumb, with the cover flush with the finished grade. Valve boxes shall be set so they do not transmit shock or stress to the valves.
- d. Backfill shall be placed around the valve boxes and thoroughly compacted in conformance with the compaction requirements for the adjacent backfill, and in a manner that will not damage or displace the valve box from proper alignment or grade. Misaligned valve boxes shall be excavated, plumbed and backfilled at Contractor's expense.
- e. Toning wire, where required, shall be looped up at all valve boxes.
- f. Valve boxes shall be kept free of rocks and debris at all times.

3.18 PRESSURE AND LEAKAGE TESTS FOR PRESSURE PIPE

- a. The Contractor shall furnish the pump, pipe connections, taps, gauges, auxiliary water container, bulkheads, plugs and other necessary equipment and perform pressure and leakage tests on all lines unless otherwise directed by the City.
- b. Tests shall be conducted on all pipelines or valved sections thereof. Tests on lines anchored or blocked by concrete shall not be conducted until the concrete has taken permanent set.
- c. Hydrostatic leakage testing shall be performed in conformance to the applicable sections of AWWA C-600 or local jurisdiction requirements, whichever is more stringent, except as modified below. Unless otherwise authorized by the City, all hydrostatic leakage tests shall be witnessed by the City.
- d. The test pressure shall be 150 lbs/sq. in., or 50 percent (50%) above the normal operating pressure, whichever is greater. Hydrostatic pressure shall be applied by pumping water from an auxiliary supply. The Contractor shall accurately determine the amount of water required to reach the initial test pressure and the amount required to re-pressurize the pipe structure at the completion of the test period.
- e. The test pressure shall be maintained for a minimum of two (2) hours and additional time as required for thorough inspection to find any leaks or defects in the water main and appurtenances. Should the pipe section fail to pass the tests, the Contractor shall find and correct failures and repeat the tests until satisfactory results are obtained at no additional cost to the City.

- f. The hydrostatic test shall be performed with all service line corporation stops open and meter stops closed. Where test pressure is 250 psi or less, the hydrostatic test shall be performed with the hydrant line valves open.
- g. Air Removal - Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the City.
- h. Allowable Leakage

- 1) No pipe installation will be accepted if the leakage is greater than that determined by the formula outlined below or local jurisdiction requirements, whichever is more stringent.

$$L = \frac{SD\sqrt{P}}{133,200} 1$$

Where:

L=allowable leakage, in gallons per hour

S=length of pipe tested, in feet

D=nominal diameter of the pipe, in inches

P=average test pressure during the leakage test, in pounds per square inch (gauge)

NOTE: This formula is based on an allowable leakage of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

- 2) The allowable leakage in gallons per hour at various pressures and pipe sizes is shown below. In the event of discrepancies between formulas and table values, the more stringent shall apply. The maximum pressure drop over the duration of the test shall not exceed 5 psi.

ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPELINE - *gph*

AVG. TEST PRESSURE <i>psi</i>	NOMINAL PIPE DIAMETER - <i>in.</i>									
	3	4	6	8	10	12	14	16	18	20
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37
225	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84

- 3) If the pipe structure under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size. No additional leakage allowance will be given for fire hydrant assemblies or valves.

3.19 CLEANING POTABLE WATER MAINS

- a. All water mains shall be cleaned in accordance with AWWA C-650.
- b. After the pressure test and prior to disinfecting, the water lines shall be thoroughly flushed through hydrants, blow offs or by other means as approved by the City.

3.20 DISINFECTING POTABLE WATER MAINS

- a. All water mains shall be disinfected in accordance with the requirements of AWWA C-651 or OAR 333, whichever is more stringent, except as modified herein.
- b. The Contractor shall furnish required materials and apparatus and perform the work of disinfection. If additional taps and open trenches at points of connection are required, the Contractor shall bear the responsibility of making taps and maintaining open trenches until a satisfactory laboratory analysis has been obtained.
- c. Unless otherwise approved by the City, water distribution systems shall be disinfected by the introduction of calcium or sodium hypochlorite as a water mixture. Chlorinating powders shall be mixed with water, in proportions of 5%

powder to 95% water by weight, to a paste and thinned to a slurry, to be introduced into the pipe by pumping, or other means approved by the City.

- d. Application shall be made at the beginning of the line through a corporation stop with water supplied from the pressure side of a valve to fill the line, controlled to a very low flow. Extremities of the lines being treated shall be opened to ensure removal of air and complete filling.
- e. The City shall witness the application of the chlorine solution.
- f. The dosage of chlorinating agent shall be of the amount to produce a minimum chlorine residual of 25 mg/L of free chlorine at all points in the line. Tests with the DPD method shall be made at selected points, including the meterstop end of service laterals, to determine the residual.
- g. Treated water shall be retained in the lines for sufficient time to accomplish the desired disinfection but not less than 24 hours. Valves in the line shall be operated during the retention period. At the end of this 24 hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.
- h. Following chlorination, all treated water shall be flushed from the lines at their extremities until the replacement water throughout the lines shall, upon test, be chemically and bacteriologically acceptable to the Public Authority having jurisdiction. Contractor to pay for laboratory analysis of water samples taken by the City. Should the initial treatment prove ineffective, the chlorination shall be repeated at no additional cost to the City until confirmed tests show acceptable results.

i. Disposal of Heavily Chlorinated Water

- 1) Unless otherwise approved, the chlorine residual of water being disposed of shall be neutralized by treating with one of the chemicals listed below.

Pounds of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 Gallons of Water				
Residual Chlorine Concentration mg/L	Sulfur Dioxide (SO ₂) lb	Sodium Bisulfite (NaHSO ₃) lb	Sodium Sulfite (Na ₂ SO ₃) lb	Sodium Thiosulfate (Na ₂ S ₂ O ₃ · 5H ₂ O) lb
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

- 2) A substantial excess of dechlorinating chemical may be harmful to the environment. Care should be exercised to balance the amount of dechlorinating chemical against the chlorine present.
- 3) The dechlorinating chemical shall not be added directly to the water holding structure.

3.21 CLEANUP

- a. Cleanup of construction area shall closely follow pipe-laying activities.
- b. Contractor shall remove all excess materials, broken pavement, construction equipment, etc., within three (3) days after pipe is laid in any area.
- c. Contractor shall level and reseed lawn areas, grade and gravel shoulder or parking areas, and replace any signs, mailboxes, etc. which were removed or damaged.
- d. Surface restoration shall conform to the requirements contained herein.

PART 4: SPECIAL PROVISIONS

None

WATERLINE PRESSURE TEST REPORT

Project Location:	Project Name:	Date:
Inspector: (Print)	Waterline to be tested. From Station:	To Station:
Prior to start of test, verify that all in-line valves, including hydrant mainline valves, are open? Yes / No		
Prior to start of test, verify that all services installed to meter location and all corp stops are open? Yes / No		
Verify that pressure gauge is mounted at high point of line to be tested? Yes / No If no, correct for elevation difference (ie. add 0.433 psi per foot elevation difference).		
System Static Pressure (psi):	Starting Pressure (psi): (greater of 150 psi or 1.5 times static)	Ending Pressure (psi):
Test Length: (2 hours minimum)	Starting Time:	Ending Time:
Volume Required to Reach Initial Test Pressure (gal):	Allowable Leakage (gal): (2 times table value below)	Measured Leakage (gal):
TEST RESULTS: Pass / Fail		

ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPELINE - gph

Test Pressure <i>psi</i>	NOMINAL PIPE DIAMETER - <i>in.</i>									
	3	4	6	8	10	12	14	16	18	20
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84

If the pipeline under test contains various diameters, the allowable leakage shall be the sum of the allowable leakage for each size. No additional leakage allowance will be given for fire hydrant assemblies or valves.

Allowable leakage based on : $L = SD(P)^{1/2} / 133,200$

Where:

- L = allowable leakage, in gallons per hour
- S = length of pipe tested, in feet
- D = nominal diameter of the pipe, in inches
- P = test pressure during the leakage test, in psig

Regardless of leakage, maximum pressure drop during test period shall not exceed 5 psi.

TEST PROCEDURE

1. Apply hydrostatic pressure by pumping water from an auxiliary supply basin. Accurately determine the amount of water required to reach the initial test pressure by refilling the supply basin with a calibrated container following pressurization of pipeline.
2. Monitor test pressure for 2 hour period.
3. At the completion of the test period, re-pressurize the pipeline by pumping water from the auxiliary supply basin. Accurately determine the amount of water required to reach the test pressure by refilling the supply basin with a calibrated container following pressurization of pipeline. If the measured leakage is less than the allowable leakage, the test is successful.

**SECTION 02715
SANITARY SEWER SYSTEM**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing, installing and testing of all sanitary sewer lines as shown on the drawings or as required to complete the work.
- b. Material to be furnished and installed shall include, but not be limited to all sanitary sewer piping, fittings, accessories, joints and jointing materials.
- c. Work shall include maintaining existing sanitary sewer flows at all times during the course of construction.

1.2 RELATED SECTIONS

- a. Section 02607, Concrete Manholes.
- b. Section 02226, Trench Excavation and Backfill.

1.3 QUALITY CONTROL

a. **Field Inspection:**

- 1) All pipe sections, specials, and jointing materials shall be carefully examined for defects and no piece shall be laid that is known to be defective. Any defective piece discovered after installation shall be removed and replaced with a sound one in a manner satisfactory to the City at the Contractor's expense.
- 2) Defective material shall be marked with lumber crayon and removed from the job site before the end of the following day.

b. **Field Testing:**

- 1) All materials, process of manufacturing, and finished pipe shall be subject to inspection and approval.
- 2) The City may select one sample of pipe on the job site of each production run of each size and type of pipe to be tested by the laboratory. The Contractor shall furnish the first test piece or pipe core and any additional samples required because of failures. Should the sample fail to meet

specifications, retests shall be conducted by the laboratory in conformance with the specifications. Cost of all retests shall be born by the Contractor.

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards showing and shall include the following:
 - 1) Manufacture's literature for each size and type of pipe and fittings used.
 - 2) Joint details and any special provisions required for assembly.
 - 3) A certificate from the pipe manufacturer stating that the materials have been sampled and tested in accordance with the provisions of and meet the requirements of the designated specification. The certificate shall be signed by an authorized agent of the manufacturer.

1.5 CONTRACTOR'S RECORD DRAWINGS

- a. The Contractor shall maintain a neatly marked set of record drawings showing the locations and depths of all waterlines, storm and sanitary sewer laterals, buried conduits and other utilities encountered during construction. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the City at any time.

PART 2: PRODUCTS

2.1 PIPE

- a. Non-Pressure (Gravity) PVC Pipe
 - 1) Pipe and fittings fifteen (15)-inches in diameter or less shall conform to ASTM D-3034, SDR 35.
 - 2) Pipe and fittings eighteen (18) through twenty-four (24)-inches in diameter shall conform to ASTM F 679, SDR 35.
 - 3) Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM classification.

b. Pressure PVC Pipe

- 1) PVC pipe for pressure applications shall conform to ASTM D-2241, SDR 26.

c. PVC Pipe Joints

- 1) Joints for PVC pipe shall be push-on joints using factory installed elastomeric ring gaskets.
- 2) Unless otherwise specified, the gaskets shall be securely fixed into place by the manufacturer so that they cannot be dislodged during joint assembly.
- 3) The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use.
- 4) The joints shall conform to ASTM D-3212, Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

d. Ductile Iron Pipe

- 1) All ductile iron pipe shall be centrifugally cast in conformance to AWWA C-151 unless otherwise specified.
- 2) All ductile iron pipe shall be minimum Class 50 thickness, unless otherwise shown or specified.
- 3) All ductile iron pipe and fittings, with the exception of solid sleeve couplings, shall be cement-mortar lined and seal coated in accordance with AWWA C-104.
- 4) All cast pipe and fittings buried underground shall be coated on the outside with a standard coating of black bituminous paint a minimum of 1 mil thick unless otherwise specified. The finished coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun, and shall be strongly adherent to the pipe.

2.2 MANHOLES

- a. Manholes shall be constructed as shown on the drawings to size, shape, depth and at locations indicated, but never less than 4'-0" inside diameter.
- b. Main and Lateral Pipes: Neatly cut off main and lateral pipes flush with inside of manhole or inlet where they enter structure walls, and point up irregularities and rough edges with non-metallic non-shrink grout.
- c. Inverts: Shape inverts for smooth flow across structure floor as shown on drawings. Use concrete and mortar to obtain proper grade and contour and finish surface to allow smooth transition.

2.3 PIPE ACCESSORIES

- a. Fittings shall be of the same material as the pipe, molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations as required.
- b. Flexible, Mechanical Couplings and Adapters
 - 1) Flexible, mechanical couplers and adapters shall be used for connecting plain ends of non-compatible types or sizes of pipe and for the installation of cut-in tee connections and other fittings into existing lines.
 - 2) Couplers and adapters shall be supplied with stainless steel bands.
 - 3) Flexible mechanical couplers and adapters shall be as manufactured by Fernco or approved equal.

2.4 MAINLINE CLEANOUTS

- a. Unless otherwise shown in the drawings or specified, cleanouts shall consist of the following:
 - 1) Lid and frame of heavy duty cast iron construction with closed lid design.
 - 2) A cast iron shaft of internal diameter as shown on the drawing, with a 3,300 psi concrete collar for cleanouts located in paved areas.
 - 3) Cast-in-place concrete base pad with leveled top surface to receive cast iron shaft sections, and sleeved to receive sanitary sewer pipe sections.

2.5 SERVICE LATERAL CLEANOUTS

- a. Unless otherwise shown in the drawings or specified, service lateral cleanouts shall be of the same size, pipe and material as the service lateral.
- b. Unless otherwise directed by the City, the top of all property line service lateral cleanouts shall be set at finish grade.

2.6 UNDERGROUND WARNING TAPE

- a. Detectable or non-detectable acid and alkali resistant safety warning tape shall be provided with all mainline and service lateral construction not located under paved portions of public streets.
- b. The tape shall consist of a minimum 4.0 mil (0.004") thick, virgin low density polyethylene plastic film formulated for extended use underground. The tape shall be in accordance with the APWA national color code and shall be permanently imprinted in lead free black pigments suitable for direct burial.
- c. The tape shall be safety blue and shall be provided with the legend "CAUTION BURIED SANITARY SEWER LINE BELOW" or approved equivalent printed continuously down the length of the tape.

2.7 TONING WIRE

- a. A continuous insulated 14 gauge stranded copper toning wire shall be supplied with non-metallic pipe. Insulation shall be green in color for sanitary sewer piping.
- b. Additional wire shall be supplied as necessary to allow the toning wire to be looped up at all service laterals on all lines.

PART 3: EXECUTION

3.1 PRODUCT HANDLING

- a. Care shall be taken in handling and transporting to avoid damaging pipes and their coatings. Loading and unloading shall be accomplished with the pipe under control at all times and under no circumstances shall the pipe be dropped. Pipe shall be securely wedged and restrained during transportation and supported on blocks when stored in the shop or field.

- b. **Storage:** Store all pipe on a flat surface so as to support the barrel evenly. Pipe shall not be stacked higher than 4 feet. Plastic pipe, if stored outside, shall be covered with an opaque material to protect it from sunlight.

3.2 PREPARATION OF TRENCH

- a. Trench excavation shall conform to requirements of the applicable sections contained herein.

3.3 GRADE AND ALIGNMENT

- a. The Design Engineer or a registered surveyor shall provide line and grade stakes at 50 foot intervals or closer as judged necessary. The Contractor shall utilize sufficient string lines, targets, batterboards and survey instruments as necessary for accurate installation.
- b. Deviation from line and grade shall not exceed 1/2-inch (0.04 feet) on line and 1/4-inch (0.02 feet) on grade at any point, provided such variations in grade do not result in a pipe or run of pipe having a level or reverse slope.
- c. Any pipe or run of pipe that has not been installed within the allowable tolerance for line and grade or impounds water to any extent shall be removed and reinstalled or replaced as necessary to bring the work into compliance with the specified requirements.

3.4 UTILITY CONFLICTS

- a. The Contractor shall be responsible for exposing potential utility conflicts far enough ahead of pipeline construction to make necessary adjustments in grade and alignment of the new work as may be directed by the City.
- b. The Contractor shall be responsible for informing the City of the need for a grade and/or alignment adjustment.
- c. The Contractor shall not deviate from the design line and grade stated in the approved construction drawings without the approval of the City.

3.5 INSTALLATION

- a. All pipes shall be installed in accordance with methods set forth by the manufacturer's written installation manuals.
- b. Pipes shall be let into manholes and connections grouted in with non-metallic non-shrink grout.

- c. Pipe laid directly over or within eighteen (18) vertically inches of proposed or existing water mains shall have one full length of ductile iron pipe centered over the waterline and shall be cradled in 3,300 psi concrete cushion to adequately spread imposed loads and prevent crushing of the pipe.
- d. Any field connections to existing sewers such as cut-in tees shall be subject to approval by the City.

3.6 TEMPORARY PLUGS

- a. When pipe installation work in trenches is not in progress, the open ends of the pipe shall be closed with temporary watertight plugs. Contractor shall take all precautions necessary to prevent flotation of pipe.
- b. If water is in the trench when work is resumed, plugs shall not be removed until all danger of water entering the pipe is eliminated.
- c. The use of pipelines as conductors for trench drainage during construction shall be prohibited.

3.7 SEWER SERVICE LATERALS

- a. Sewer service laterals shall be a minimum diameter of 4 inches.
- b. Unless otherwise shown on the drawings, sewer service laterals shall be installed at a minimum slope of ¼-inch per foot of run.
- c. Minimum depth of service laterals at the edge of the easement or public right-of-way shall be 4½ feet below finish surface grade.
- d. Individual sewer service laterals shall not be connected to manholes unless shown on the drawings or approved by the City.
- e. Unless otherwise shown on the drawings, the maximum line or grade change made with any one fitting shall not exceed 22½°. All changes in line or grade within the public right-of-way or public easements shall be accomplished with "long radius" type bends.
- f. Ends of all service lines and service fittings shall be provided with approved watertight plugs, caps, or stoppers, suitably braced to prevent blow-off during internal air testing. Such plugs or caps shall be removable without damage to the pipe or fitting.

3.8 MARKERS

- a. The ends of all service lateral pipe not reconnected to existing service lines and that are to be covered with backfill shall be marked with a metal T-post marker wired to the pipe stub and extending above grade.
- b. Markers shall be in one piece if possible. Splicing of posts used for markers is only permitted in situations where the depth of the pipe is in excess of standard post lengths.
- c. Markers shall be installed in a vertical position with the bottom end of the marker against the end of the pipe. Markers shall be extended a minimum of twelve (12) inches above finish grade of the ground surface. Markers that are broken, too short, or are not installed vertically in the ground shall be replaced by removing the backfill and replacing and/or repositioning the marker.
- d. The entire portion of the marker above ground level shall be painted with weatherproof green paint. After the paint has dried, weatherproof black marker or other permanent material shall be used to neatly indicate the distance from the ground surface at the marker to the top of the pipe.
- e. In areas where it is not practical to extend markers above the ground surface, as determined by the City, the tops of the markers shall be installed flush with the ground surface.

3.9 UNDERGROUND WARNING TAPE

- a. Underground warning tape shall be placed a minimum of 12-inches and a maximum of 18-inches below the finish ground surface, and shall be continuous the entire length of the mainline and service laterals installed.

3.10 CLEANUP

- a. Cleanup of construction area is to closely follow pipe-laying activities.
- b. Removal of all excess materials, broken pavement, construction equipment, etc., to be done within three (3) days after pipe is laid in any area.
- c. Level and reseed lawn areas. Grade and gravel shoulder or parking areas. Replace any signs, mailboxes, etc., which were removed or damaged.

3.11 PIPE FLUSHING AND CLEANING

- a. Prior to mandrel testing and/or TV inspection, flush and clean all sewers, and remove all foreign material from the mainlines and manholes.
- b. In cases where a new sewer line is connected to an existing sewer line and extended upstream, the contractor shall clean the debris from the existing line segment downstream of the connection point as required to ensure a smooth and uninterrupted flow line. In all cases, the entire line segment between structures shall be cleaned to ensure that debris is not left in the lines.

3.12 TESTING SANITARY SEWERS

- a. The contractor shall be responsible for submitting completed test report forms to the City for all sewer lines tested.
- b. Pressure Testing
 - 1) All gravity sanitary sewers including service laterals and appurtenances shall successfully pass the air test prior to final acceptance and shall be free of leakage and visible infiltration of water. Pressure sewer lines shall be tested as specified herein.
 - 2) Sewer pipe thirty (30)-inches in diameter and larger may be tested using an approved pneumatic joint testing device. Such testing methods and equipment shall meet the approval of the City.
 - 3) Sanitary sewers shall not be coated internally or externally with any substance of any kind in an effort to improve the performance of the pipe when tested.
 - 4) The City may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of completed portions of the system and allow connections prior to the whole system being completed.
 - 5) Except as modified herein, test methods shall conform to the requirements of APWA Section 303.3.09, Pipe and Joint Testing, or local jurisdiction requirements, whichever are more stringent.
- c. Deflection Testing for Flexible Pipe
 - 1) In addition to hydrostatic or air testing, the Contractor shall conduct deflection tests of sanitary sewers constructed of flexible pipe. The testing shall be conducted by pulling an approved mandrel through the completed

pipeline. The diameter of the mandrel shall be 95 percent of the pipe initial inside diameter.

- 2) Testing shall be conducted on a manhole-to-manhole basis and shall be done after the line has been completely flushed out with water. The tests shall be conducted not less than 30 days after the trench backfill and compaction has been completed and may be conducted concurrently with television inspection.

PART 4: SPECIAL PROVISIONS

None

SANITARY SEWER AIR TEST REPORT

Project Location: (City)	Project Name:
Inspector: (Print)	Date: (Separate Report Required for Each Test Session)
TV Inspection Required? Yes / No	Mandrel Testing Completed? Date Completed or Scheduled:

Station (# Manhole #)		Main/ Lateral	Size & Material	Total Length (ft)	C ¹	K ¹	Test Time (Seconds) for Pressure Drop Shown (psi)			Comments
							Required ²	4.0 - 3.5	3.5 - 2.5	
From	To									
		Main								Pass / Fail
		Laterals								
		Totals								
		Main								Pass / Fail
		Laterals								
		Totals								
		Main								Pass / Fail
		Laterals								
		Totals								
		Main								Pass / Fail
		Laterals								
		Totals								

¹ For C and K values, see table and formulas on reverse side.

² For total C ≤ 1.0, test time (seconds) required = 2 times K
 For total C > 1.0, test time (seconds) required = 2 times (K/C)

TEST PROCEDURE

1. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig. Increase the test pressure by 0.433 psi for each foot of average ground water depth over the invert of the pipe under test.
2. After an internal pressure of 4.0 psig is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.
3. After the 2 minute period, disconnect the air supply.
4. When the pressure decreases to 3.5 psi (or as required due to groundwater), start stopwatch. Determine the time in seconds required for the internal air pressure to reach 2.5 psig. If this time exceeds the required time, the test is successful.

ACCEPTANCE: The tested sewer section shall be considered acceptable when tested as described herein if the section under test does not loose air at a rate greater than 0.0015 cfm per square foot of internal sewer surface.

SEWER AIR TEST C AND K VALUES

Pipe Size (inch)	C-Value ¹ per foot length	K-Value ² per foot length
4	0.00155	0.176
6	0.00233	0.396
8	0.00311	0.704
10	0.00388	1.100
12	0.00466	1.584
15	0.00582	2.475
18	0.00699	3.564
21	0.00815	4.851

¹ C = 0.0003882dL Where d = diameter (inches)
² K = 0.011d²L L = Length (ft)

Example:

Air Test a system consisting of two mainline segments as follows:

Segment 1: 395 feet of 8-inch mainline, 100 feet of 4-inch laterals, and 35 feet of 6 inch laterals.

Segment 2: 200 feet of 8-inch mainline, 30 feet of 4-inch laterals, and 20 feet of 6 inch laterals.

Station (# Manholes #)		Main/ Lateral	Size & Material	Total Length (ft)	C'	K'	Test Time (Seconds) for Pressure Drop Shown (psi)			Comments
							Required ²	4.0 - 3.5	3.5 - 2.5	
0+00 MH A1	3+95 MH A2	Main	8" PVC	395	1.2285	278.1	310/1.46= 212			Pass / Fail
		Laterals	4" PVC	100	0.155	17.6				
			6" PVC	35	0.01855	13.86				
		Totals			1.465	309.54	212*2= 414 sec			
3+95 MH A2	5+95 MH A3	Main	8" PVC	200	0.622	140.8	2*154= 308 sec			Pass / Fail
		Laterals	4" PVC	20	0.0465	5.28				
			6" PVC	30	0.0466	7.92				
		Totals			0.715	154.0				

Note: For total C ≤ 1.0, test time (seconds) required = 2 times K
 For total C > 1.0, test time (seconds) required = 2 times (K/C)

SANITARY SEWER MANDREL TEST REPORT

Project Location: (City)	Project Name:
Inspector: (Print)	Date: (Separate Report Required for Each Test Session)
Mandrel Diameters Verified? Yes / No	

Station (& Manhole #)		Size & Material	Length (ft)	Results	Backfill Compaction Completed?	Date Sewer Flushed & Cleaned	Comments
From	To						
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		

1. Mandrel testing shall be conducted on a manhole to manhole (or cleanout) basis and shall be done after the line has been completely flushed out with water.
2. Mandrel testing shall be conducted after trench backfill and compaction has been completed.
3. The mandrel diameter shall be 95% of the pipe initial inside diameter. The inspector shall verify the diameter of each mandrel used during each test session.

**SECTION 02716
SANITARY SEWER MAIN CLEANING AND TV INSPECTION**

PART 1: GENERAL

1.1 SCOPE

- a. Furnish all labor, materials, equipment and incidentals necessary for cleaning and TV inspection of sanitary sewer main lines.
- b. Work specified under this section shall include, but not be limited to the following:
 - 1) Cleaning and TV inspection of designated sanitary sewer main lines.
 - 2) Traffic control as shown or required by the City, County or ODOT.
 - 3) Other incidental work specified or shown on the drawings.
- c. Safety Work: Contractor shall conform to all OSHA requirements, including those for confined space entry.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards showing and shall include the following:
 - 1) Information on all cleaning and TV inspection equipment proposed for use by the Contractor, including a listing of size, type and capabilities of each piece of equipment.
 - 2) Contractor's written certification that all equipment conforms to the requirements of the specifications contained herein.

1.3 CONTRACTOR'S RECORD DRAWINGS

- a. The Contractor shall maintain a neatly marked set of construction drawings showing any differences in alignment, pipe size and manhole or cleanout location discovered during the progress of the work. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the City at any time.
- b. The location, alignment, lengths and sizes of the sanitary sewer lines shown on the drawings are compiled from available records and/or field surveys. The City does not guarantee the completeness of such records.

PART 2: PRODUCTS

2.1 WATER FOR CLEANING

- a. The City will provide water required for cleaning operations from metered hydrants at locations approved by the City. The Contractor shall provide all hoses, adapters and appurtenances required for obtaining water from the designated hydrants. Access to the hydrant shall not be obstructed in case of fire in the area served by the hydrant. The Contractor shall be responsible for payment to the City for all water used.

2.2 CLEANING EQUIPMENT

- a. The Contractor shall furnish and utilize combination high velocity hydraulic cleaning equipment and vacuum unit as specified or required. High velocity cleaning equipment shall be used to clean all sewer mainlines unless otherwise specified or approved by the City. Low velocity or mechanical cleaning equipment shall not be used in lieu of high velocity equipment.
- b. **High Velocity Cleaning Equipment with Vacuum Pickup of Materials**
 - 1) High velocity equipment shall be capable of providing 65 gallons per minute at 1200 pounds per square inch working pressure. Contractor shall provide a minimum of 500 feet of 1" ID high pressure hose with at least two cleaning nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. The equipment shall also include a high velocity "gun" for cleaning manhole walls and bottoms. The equipment shall be complete including 1200 gallon water tanks suitable for holding corrosive or caustic chemicals, pumps, hose, hydraulically driven hose reel, auxiliary engines, controls and all safety features required by law.
 - 2) The cleaning equipment shall have an integral vacuum unit to allow the material cleaned from the pipes to be vacuumed directly from the manhole.

2.3 TV INSPECTION EQUIPMENT

- a. A closed circuit color television (CCTV) camera capable of providing still pictures and video tapes shall be used on all lines. The CCTV equipment shall be specifically designed for sewer inspection operations and shall be operative in 100 percent humidity conditions. Lighting and camera quality shall be suitable to

allow a clear focused picture a minimum of 6 linear feet in front of the camera of the entire inside periphery of the pipe. The camera shall have an adjustable focus distance from 6 inches to infinity, and the camera lights shall be variable intensity, with light, focus and aperture remotely controlled by the operating technician at the monitoring station.

- b. Camera travel speed shall be from 1.8 to 30 feet per minute (fpm) with smooth, uniform motion. Sudden stops and starts will not be acceptable. Camera shall be capable of stopping and reversing direction as necessary to document sewer conditions. Video pictures shall be clear, sharp and free from vibratory or electrical interference when the camera is in operation.
- c. A CCTV camera with pan-tilt capabilities shall be used on all lines larger than 6-inches in diameter. The CCTV camera shall be a tractor powered camera being able to inspect dead end lines, and shall be remotely controlled by an operating technician.
- d. For lines 6-inches and smaller in diameter, or for larger lines which have diameters which are too small due to obstructions or damage to accept a tractor powered camera, a mainline skid mounted camera shall be used. The mainline camera shall be pulled through the line by a winch controlled by the operating technician. A CCTV push camera shall be used in lines which are too small to accept a mainline skid mounted camera.
- e. The monitoring station shall be truck mounted, capable of seating two viewing personnel and one operating technician. The monitoring station shall be fully enclosed within a rigid weatherproof enclosure on the TV truck.
- f. A minimum of two color display monitors (minimum 650 lines horizontal resolution) operating simultaneously shall be used in the monitoring station. The monitors shall be of a proper size to allow all viewing personnel in the monitoring station a satisfactory view, and shall continuously display the current date, manhole designation of the mainline section being inspected, and a continuous forward and reverse read-out of the camera distance from the manhole of reference.
- g. Contractor shall provide a polaroid-type still color camera capable of photographing the monitor picture in its entirety. Photographs shall be taken at City's request or at the discretion of the operating technician.

PART 3: EXECUTION

3.1 TEMPORARY TRAFFIC CONTROL

- a. Contractor shall provide temporary traffic control as required by MUTCD, City, County and ODOT and as specified to minimize obstruction and convenience to the public and to protect pedestrian and vehicular traffic. The Contractor shall pay any permit fees or costs for traffic control requirements as required by public agencies having jurisdiction.
- b. Contractor shall adequately warn the public at all times of existing conditions on all streets affected by work operations.
- c. Contractor shall notify affected residents, businesses and emergency services in writing during business hours 48 hours in advance of parking removal and/or street, driveway, and alley detour or closures. Failure to provide proper, timely notification will be grounds to deny the commencement of the work.
- d. Emergency traffic such as police, fire, and disaster units shall be provided access to the work area at all times.
- e. Contractor shall conform to all applicable local, State and Federal regulations relating to temporary traffic control and protection of the public.

3.2 MAINTAINING SEWER FLOWS AND CLEANING PRECAUTIONS

- a. All sanitary sewer system components shall remain in service through the cleaning and TV inspection operations unless specific exceptions are approved in writing by the City.
- b. During cleaning operations, precautions shall be taken by the Contractor in the use of cleaning equipment. When hydraulically propelled cleaning tools or tools which retard the flows in the sewer lines are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. Precautions shall be taken to protect the sewer lines from damage that may result from the improper use of cleaning equipment. The Contractor shall be solely responsible for the repair of any damage to structurally sound lines or damage to properties connected to the sewer which results from the cleaning operations.
- c. The methods used to maintain flows shall be at the Contractor's option and may include use of flow-through plugs with periodic release of sewage flow or bypass pumping. The bypass system, if used, shall be capable of conveying flows when

the sewers are flowing full.

3.3 CLEANING

- a. Clean all sewer lines and manholes designated on the drawings or directed by the City preparatory to CCTV inspection including the manholes at both ends of the section to be inspected. Equipment as specified shall be used for cleaning.
- b. All dirt, sand, grease, rocks, roots, or other accumulations shall be removed from pipe walls and manholes. Existing lines shall be protected from damage caused by cleaning operations. Hydraulic cleaning operations shall be conducted with care to avoid damage to pipes or flooding of adjacent property.
- c. All sewers shall be cleaned with high velocity equipment unless City allows otherwise. The City may order the use of other methods or equipment when it appears necessary.
- d. All materials removed from the pipes during the cleaning operations shall be collected by a vacuum unit from the manhole downstream of the section being cleaned and removed by the Contractor. Passing accumulated materials from manhole section to manhole section shall not be permitted.
- e. All materials resulting from the cleaning operation shall be disposed of at a dump site approved by and in a manner acceptable to the City.
- f. All manhole and sewer cleaning reports shall be submitted on forms matching the format of the cleaning report forms included in Section 4. All reports shall be completely filled out and provide all essential data, including:
 - 1) location of mainline segment or manhole being cleaned (street name and manhole designation as shown on the drawings);
 - 2) diameter in inches for sewers;
 - 3) amount and type of material removed from pipe or manhole;
- g. Two copies of the typed and book-bound Cleaning Report forms shall be furnished to the City as specified below.
- h. Acceptance of the cleaning work will not be made until after the submittal of the cleaning reports and the CCTV inspection reports and tapes. Lines will be considered acceptable when sufficient material has been removed to restore the sewer line to 95 percent of its original flow capacity and inspection, testing and sealing equipment may pass unobstructed. If the TV inspection shows the cleaning to be unsatisfactory, the Contractor shall reclean and re-TV inspect the

line at no additional cost to the City until the cleaning is satisfactory to the City.

3.4 SEWER FLOW CONTROLS

- a. The methods used to maintain flow shall be at the Contractor's option and may include use of flow-through plugs or bypass pumping.
- b. When the sewer depth of flow at the downstream manhole of the mainline section being inspected is above the maximum allowable for television inspection, the Contractor shall provide flow-through plugs or other means where necessary to ensure that the flows are reduced to the levels specified below.
- c. Depths of flow at the downstream manhole during television inspection shall not exceed that shown below when performing television inspection of the lines.

1)	<u>Pipe Diameter (in)</u>	<u>Maximum Depth of Flow</u>
	3" - 6" pipe	20% of pipe diameter
	6" - 10" pipe	20% of pipe diameter
	12" - 24" pipe	25% of pipe diameter

- d. High Flows During Cleaning Operations: During periods of very high flows when lines are surcharged, sewer cleaning operations may be suspended by the Contractor until the lines are no longer surcharged. Conditions during all periods during which cleaning operations are suspended shall be documented in writing and submitted to the City within 24 hours of the suspension of work, including the depth of flow in other lines which have not yet been cleaned and are available for cleaning at the time.
- e. High Flows During TV Inspection Operations: During periods of very high flows when lines flow greater than 3/4 full, TV inspection operations may be suspended by the Contractor until flows are again less than 3/4 full. Conditions during all periods during which TV inspection operations are suspended shall be documented in writing and submitted to the City within 24 hours of the suspension of work, including the depth of flow in other lines which have been cleaned and are available for TV inspection at the time.
- f. Failure to document the depth of flows in other lines available for cleaning or TV inspection shall result in the Contractor being ineligible to apply for a Contract time extension for the delay. The Contractor shall obtain authorization from the City prior to the suspension of operations for more than 4 hours due to excessive flows.

3.5 CCTV INSPECTION

- a. Internal CCTV inspection of sanitary sewer main lines as shown on the drawings shall be performed only after the sewers have been thoroughly cleaned so that service connections and structural failures may be located.
- b. The CCTV inspection shall be performed on one manhole section at a time. Each manhole section being inspected shall be isolated from the remainder of the line as necessary by the use of a line plugs or by-pass pumping to insure viewing of the inside periphery of the pipe. The TV inspection shall be performed by putting the television camera through the line along the axis of the pipe. The inspection shall be performed in a forward and/or backward direction, according to line conditions at the time the inspection is made.
- c. The pan tilt camera shall be turned to view directly up the axis of each service lateral encountered.
- d. During the CCTV inspection, a record shall be kept which shows clearly the exact location in relation to the center line of the adjacent manhole of each service connection and crack or structural fault discovered. To insure accurate measurement, the measurement shall be made at or above ground level by means of a meter device. Marking on a cable or the like which would require interpolation for the depth of the manholes shall not be used. Accuracy of the distance meter shall be checked by use of a walking meter, measuring wheel or other suitable device, and the accuracy shall be satisfactory to the City.
- e. Still photos shall be taken at the request of the City or the discretion of the operating technician to record conditions of interest during the inspection. The Contractor shall provide the camera, film and pictures. The photos shall be catalogued so each picture can be readily identified as to the exact location within the mainline segment.
- f. The TV inspection record shall be submitted on forms matching the format of the report forms included in Section 4. All reports shall be completely filled out and provide all essential data, including:
 - 1) location of mainline segment being tested (street name and designation as shown on the drawings);
 - 2) pipe diameter in inches;
 - 3) type and condition of pipe;
 - 4) length and type of joints;
 - 5) presence and location of roots or visible leaks;
 - 6) location and description of any cracks, breaks, misalignments or

- 7) obstructions;
 - 7) location and diameter of service laterals, including clock position as viewed from camera;
 - 8) condition of the portion of lateral visible from pan-tilt camera;
 - 9) estimates of flows from service pipes and estimates of whether flow is domestic or I/I.
- g. Two copies of the printed and book-bound TV Inspection Report form shall be furnished to the City. All inspections shall also be recorded on VHS video tape together with voice transmissions of sewer conditions. The video tapes shall be accurately referenced to the inspection reports and shall be organized and cataloged so that specific faults can easily be found and reviewed from the tapes.
- h. Video tape(s) and runs shall be numbered sequentially. Each video tape have a label which lists the tape number and all runs (including run number and mainline segment) included on the tape. The video tapes shall become the property of the City.

3.6 TURNAROUNDS

- a. The intent is to clean and TV inspect all mainline segments in their entirety. In some cases it may be necessary to clean and/or TV inspect the sewer from both the upstream and downstream ends to obtain a complete TV record of the sewer mainline segment.
- b. A turnaround shall be defined as an obstruction or pipe condition which in the opinion of the City does not permit the TV camera to pass the complete distance from one end of the line segment to the other, and for which the camera must be installed in the opposite end of the line segment in order to TV from the opposite direction. If the camera fails due to an obstruction to reach the line condition of obstruction which caused the turnaround, the TV inspection may be considered complete subject to approval by the City.
- c. In cases where more than 85% of the length of the line segment has been successfully TV inspected and the Contractor must set up at the second manhole to TV inspect the next line segment, the turnaround shall be considered incidental to the setup and TV inspection of the next line segment. For lines sizes 8-inches or smaller in diameter, turnarounds shall not be paid for unless a skid mounted mainline camera is also unable to traverse the line segment.

3.7 MANHOLE INSPECTION

- a. Inspection of manholes shown on the drawings shall be performed after the manholes have been cleaned so that cracks, leaks and structural failures may be located.
- b. The inspection shall be performed on one manhole at a time. Each manhole being inspected shall be isolated from the lines as necessary by the use of a line plugs to insure viewing of the pipe collar where it enters the manhole. The inlet and outlet pipes shall be no more than $\frac{1}{4}$ full during the manhole inspection.
- c. The manhole inspection record shall be submitted on forms matching the format of the report forms included in Section 4. All reports shall be completely filled out and provide all essential data, including:
 - 1) location of manhole being tested (street name and manhole designation as shown on the drawings);
 - 2) type of surface cover at manhole;
 - 3) assessment of ability to access manhole;
 - 4) condition of manhole;
 - 5) traffic conditions at manhole location;
 - 6) diameter and type of manhole casting;
 - 7) diameter and materials of construction of manhole riser, cone and wall;
 - 8) location and diameter of mainline pipes and service laterals, including position relative to outlet;
 - 9) estimates of flows from any leaks in cover, ring, riser, cone, wall, bench or pipe collars;
 - 10) Manhole depth, depth of flow, location and height of inside or outside drop inlets, and leak locations.

3.8 REPORTS

- a. All cleaning, manhole inspection and TV inspection reports shall be typed and bound into books, organized sequentially by manhole numbers and drainage basins. All forms for each drainage basin shall be bound into separate books.
- b. To the extent possible, reports shall be organized such that the cleaning report, manhole inspection report and TV inspection report forms progress from the bottom of the basin to the top and are in the order listed below:
 - 1) Cleaning report forms.
 - 2) Downstream manhole inspection report form.
 - 3) Mainline (upstream of manhole) TV inspection report form(s).

- 4) Upstream manhole inspection report form.
- 5) Etc.

PART 4: SPECIAL PROVISIONS

None

TELEVISION INSPECTION REPORT

Date:	Client: City:	Basin No.			
Technician:	Inspector:	Weather:	Cleaned By:	Report No.	Tape No.
From M.H. #: Street:	Pipe Dia. (in)	Joint Length (ft)	Section Length (ft)	Joint Type:	Pipe Material
					To M.H. #: Street:

PIPELINE DATA: Cleanliness: _____ Alignment: _____ Grade: _____ Age: _____ Condition: _____ %Est. Leaking Joints: _____ Other: _____ _____ _____			
PROBLEM CODE LEGEND: BP = Broken Pipe CC = Circumferential Crack LC = Longitudinal Crack G = Break in Grade L = Leak PT = Protruding Tap ST = Service Tap SL = Service Left SR = Service Right RT = Roots U = Unpassable PIPE MATERIAL LEGEND: AC = Asbestos Cement CIP = Cast Iron Pipe C(M) = Conc., Mortar Joint C(R) = Conc., Rubr. Gasket Jnt PVC = Polyvinylchloride Pipe TC = Terra Cotta VC = Vitrified Clay MANHOLE DATA: See Attached Manhole Inspection Report.			
TURNAROUND: Requested (Date/time): _____ Authorized (Date/time): _____			

MANHOLE INSPECTION REPORT

Date:	Client: City:	Basin No.
Technician:	Weather:	Cleaned By:
M.H. #:	M.H. Location (Street & Cross Street or Address):	

SURFACE COVER:
 Cover: AC ___ Concrete ___ Gravel ___ Dirt ___ Other _____
 Ability to Access MH: Satisfactory ___ Poor ___

<p>CONDITION:</p> <p>Deterioration: Light _____ Medium _____ Heavy _____</p> <p>Condition of Rim: Satisfactory _____ Poor _____</p>	<p>TRAFFIC:</p> <p>Light _____ Medium _____ Heavy _____</p>
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<p>MATERIALS OF CONSTRUCTION:</p> <table style="width: 100%;"> <tr> <td style="text-align: center;"><u>Diameter (in)</u></td> <td style="text-align: center;"><u>Type</u></td> </tr> <tr> <td>Casting _____</td> <td>Number of holes in lid _____</td> </tr> <tr> <td colspan="2">Manhole Type: Flat Top ___ Cone ___</td> </tr> <tr> <td>Cone _____</td> <td>Precast ___ Brick ___ Block ___ CIP ___</td> </tr> <tr> <td>Wall _____</td> <td>Precast ___ Brick ___ Block ___ CIP ___</td> </tr> <tr> <td>Base _____</td> <td>Precast ___ Brick ___ Block ___ CIP ___</td> </tr> </table>	<u>Diameter (in)</u>	<u>Type</u>	Casting _____	Number of holes in lid _____	Manhole Type: Flat Top ___ Cone ___		Cone _____	Precast ___ Brick ___ Block ___ CIP ___	Wall _____	Precast ___ Brick ___ Block ___ CIP ___	Base _____	Precast ___ Brick ___ Block ___ CIP ___	<p>HYDRAULIC CONDITIONS:</p> <p style="text-align: center;"><u>Est. Qty (gpm I/I)</u></p> <p>Cover _____</p> <p>Ring _____</p> <p>Riser _____</p> <p>Cone _____</p> <p>Wall _____</p> <p>Bench _____</p> <p>Pipe Collar _____</p>
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**SECTION 02716
SANITARY SEWER MAIN CLEANING AND TV INSPECTION**

PART 1: GENERAL

1.1 SCOPE

- a. Furnish all labor, materials, equipment and incidentals necessary for cleaning and TV inspection of sanitary sewer main lines.
- b. Work specified under this section shall include, but not be limited to the following:
 - 1) Cleaning and TV inspection of designated sanitary sewer main lines.
 - 2) Traffic control as shown or required by the City, County or ODOT.
 - 3) Other incidental work specified or shown on the drawings.
- c. Safety Work: Contractor shall conform to all OSHA requirements, including those for confined space entry.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards showing and shall include the following:
 - 1) Information on all cleaning and TV inspection equipment proposed for use by the Contractor, including a listing of size, type and capabilities of each piece of equipment.
 - 2) Contractor's written certification that all equipment conforms to the requirements of the specifications contained herein.

1.3 CONTRACTOR'S RECORD DRAWINGS

- a. The Contractor shall maintain a neatly marked set of construction drawings showing any differences in alignment, pipe size and manhole or cleanout location discovered during the progress of the work. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the City at any time.
- b. The location, alignment, lengths and sizes of the sanitary sewer lines shown on the drawings are compiled from available records and/or field surveys. The City does not guarantee the completeness of such records.

PART 2: PRODUCTS

2.1 WATER FOR CLEANING

- a. The City will provide water required for cleaning operations from metered hydrants at locations approved by the City. The Contractor shall provide all hoses, adapters and appurtenances required for obtaining water from the designated hydrants. Access to the hydrant shall not be obstructed in case of fire in the area served by the hydrant. The Contractor shall be responsible for payment to the City for all water used.

2.2 CLEANING EQUIPMENT

- a. The Contractor shall furnish and utilize combination high velocity hydraulic cleaning equipment and vacuum unit as specified or required. High velocity cleaning equipment shall be used to clean all sewer mainlines unless otherwise specified or approved by the City. Low velocity or mechanical cleaning equipment shall not be used in lieu of high velocity equipment.
- b. **High Velocity Cleaning Equipment with Vacuum Pickup of Materials**
 - 1) High velocity equipment shall be capable of providing 65 gallons per minute at 1200 pounds per square inch working pressure. Contractor shall provide a minimum of 500 feet of 1" ID high pressure hose with at least two cleaning nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. The equipment shall also include a high velocity "gun" for cleaning manhole walls and bottoms. The equipment shall be complete including 1200 gallon water tanks suitable for holding corrosive or caustic chemicals, pumps, hose, hydraulically driven hose reel, auxiliary engines, controls and all safety features required by law.
 - 2) The cleaning equipment shall have an integral vacuum unit to allow the material cleaned from the pipes to be vacuumed directly from the manhole.

2.3 TV INSPECTION EQUIPMENT

- a. A closed circuit color television (CCTV) camera capable of providing still pictures and video tapes shall be used on all lines. The CCTV equipment shall be specifically designed for sewer inspection operations and shall be operative in 100 percent humidity conditions. Lighting and camera quality shall be suitable to

allow a clear focused picture a minimum of 6 linear feet in front of the camera of the entire inside periphery of the pipe. The camera shall have an adjustable focus distance from 6 inches to infinity, and the camera lights shall be variable intensity, with light, focus and aperture remotely controlled by the operating technician at the monitoring station.

- b. Camera travel speed shall be from 1.8 to 30 feet per minute (fpm) with smooth, uniform motion. Sudden stops and starts will not be acceptable. Camera shall be capable of stopping and reversing direction as necessary to document sewer conditions. Video pictures shall be clear, sharp and free from vibratory or electrical interference when the camera is in operation.
- c. A CCTV camera with pan-tilt capabilities shall be used on all lines larger than 6-inches in diameter. The CCTV camera shall be a tractor powered camera being able to inspect dead end lines, and shall be remotely controlled by an operating technician.
- d. For lines 6-inches and smaller in diameter, or for larger lines which have diameters which are too small due to obstructions or damage to accept a tractor powered camera, a mainline skid mounted camera shall be used. The mainline camera shall be pulled through the line by a winch controlled by the operating technician. A CCTV push camera shall be used in lines which are too small to accept a mainline skid mounted camera.
- e. The monitoring station shall be truck or trailer mounted. The monitoring station shall be fully enclosed within a rigid weatherproof enclosure on the TV truck or trailer.
- f. A minimum of one color display monitors (minimum 650 lines horizontal resolution) operating simultaneously shall be used in the monitoring station. The monitors shall be of a proper size to allow all viewing personnel in the monitoring station a satisfactory view, and shall continuously display the current date, manhole designation of the mainline section being inspected, and a continuous forward and reverse read-out of the camera distance from the manhole of reference.
- g. Contractor shall provide a polaroid-type still color camera capable of photographing the monitor picture in its entirety. Photographs shall be taken at City's request or at the discretion of the operating technician.

PART 3: EXECUTION

3.1 TEMPORARY TRAFFIC CONTROL

- a. Contractor shall provide temporary traffic control as required by MUTCD, City, County and ODOT and as specified to minimize obstruction and convenience to the public and to protect pedestrian and vehicular traffic. The Contractor shall pay any permit fees or costs for traffic control requirements as required by public agencies having jurisdiction.
- b. Contractor shall adequately warn the public at all times of existing conditions on all streets affected by work operations.
- c. Contractor shall notify affected residents, businesses and emergency services in writing during business hours 48 hours in advance of parking removal and/or street, driveway, and alley detour or closures. Failure to provide proper, timely notification will be grounds to deny the commencement of the work.
- d. Emergency traffic such as police, fire, and disaster units shall be provided access to the work area at all times.
- e. Contractor shall conform to all applicable local, State and Federal regulations relating to temporary traffic control and protection of the public.

3.2 MAINTAINING SEWER FLOWS AND CLEANING PRECAUTIONS

- a. All sanitary sewer system components shall remain in service through the cleaning and TV inspection operations unless specific exceptions are approved in writing by the City.
- b. During cleaning operations, precautions shall be taken by the Contractor in the use of cleaning equipment. When hydraulically propelled cleaning tools or tools which retard the flows in the sewer lines are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. Precautions shall be taken to protect the sewer lines from damage that may result from the improper use of cleaning equipment. The Contractor shall be solely responsible for the repair of any damage to structurally sound lines or damage to properties connected to the sewer which results from the cleaning operations.
- c. The methods used to maintain flows shall be at the Contractor's option and may include use of flow-through plugs with periodic release of sewage flow or bypass pumping. The bypass system, if used, shall be capable of conveying flows when

the sewers are flowing full.

3.3 CLEANING

- a. Clean all sewer lines and manholes designated on the drawings or directed by the City preparatory to CCTV inspection including the manholes at both ends of the section to be inspected. Equipment as specified shall be used for cleaning.
- b. All dirt, sand, grease, rocks, roots, or other accumulations shall be removed from pipe walls and manholes. Existing lines shall be protected from damage caused by cleaning operations. Hydraulic cleaning operations shall be conducted with care to avoid damage to pipes or flooding of adjacent property.
- c. All sewers shall be cleaned with high velocity equipment unless City allows otherwise. The City may order the use of other methods or equipment when it appears necessary.
- d. All materials removed from the pipes during the cleaning operations shall be collected by a vacuum unit from the manhole downstream of the section being cleaned and removed by the Contractor. Passing accumulated materials from manhole section to manhole section shall not be permitted.
- e. All materials resulting from the cleaning operation shall be disposed of at a dump site approved by and in a manner acceptable to the City.
- f. All manhole and sewer cleaning reports shall be submitted on forms matching the format of the cleaning report forms included in Section 4. All reports shall be completely filled out and provide all essential data, including:
 - 1) location of mainline segment or manhole being cleaned (street name and manhole designation as shown on the drawings);
 - 2) diameter in inches for sewers;
 - 3) amount and type of material removed from pipe or manhole;
- g. Two copies of the typed and book-bound Cleaning Report forms shall be furnished to the City as specified below.
- h. Acceptance of the cleaning work will not be made until after the submittal of the cleaning reports and the CCTV inspection reports and tapes. Lines will be considered acceptable when sufficient material has been removed to restore the sewer line to 95 percent of its original flow capacity and inspection, testing and sealing equipment may pass unobstructed. If the TV inspection shows the cleaning to be unsatisfactory, the Contractor shall reclean and re-TV inspect the

line at no additional cost to the City until the cleaning is satisfactory to the City.

3.4 SEWER FLOW CONTROLS

- a. The methods used to maintain flow shall be at the Contractor's option and may include use of flow-through plugs or bypass pumping.
- b. When the sewer depth of flow at the downstream manhole of the mainline section being inspected is above the maximum allowable for television inspection, the Contractor shall provide flow-through plugs or other means where necessary to ensure that the flows are reduced to the levels specified below.
- c. Depths of flow at the downstream manhole during television inspection shall not exceed that shown below when performing television inspection of the lines.

1)	<u>Pipe Diameter (in)</u>	<u>Maximum Depth of Flow</u>
	3" - 6" pipe	20% of pipe diameter
	6" - 10" pipe	20% of pipe diameter
	12" - 24" pipe	25% of pipe diameter

- d. High Flows During Cleaning Operations: During periods of very high flows when lines are surcharged, sewer cleaning operations may be suspended by the Contractor until the lines are no longer surcharged. Conditions during all periods during which cleaning operations are suspended shall be documented in writing and submitted to the City within 24 hours of the suspension of work, including the depth of flow in other lines which have not yet been cleaned and are available for cleaning at the time.
- e. High Flows During TV Inspection Operations: During periods of very high flows when lines flow greater than 3/4 full, TV inspection operations may be suspended by the Contractor until flows are again less than 3/4 full. Conditions during all periods during which TV inspection operations are suspended shall be documented in writing and submitted to the City within 24 hours of the suspension of work, including the depth of flow in other lines which have been cleaned and are available for TV inspection at the time.
- f. Failure to document the depth of flows in other lines available for cleaning or TV inspection shall result in the Contractor being ineligible to apply for a Contract time extension for the delay. The Contractor shall obtain authorization from the City prior to the suspension of operations for more than 4 hours due to excessive flows.

3.5 CCTV INSPECTION

- a. Internal CCTV inspection of sanitary sewer main lines as shown on the drawings shall be performed only after the sewers have been thoroughly cleaned so that service connections and structural failures may be located.
- b. The CCTV inspection shall be performed on one manhole section at a time. Each manhole section being inspected shall be isolated from the remainder of the line as necessary by the use of a line plugs or by-pass pumping to insure viewing of the inside periphery of the pipe. The TV inspection shall be performed by putting the television camera through the line along the axis of the pipe. The inspection shall be performed in a forward and/or backward direction, according to line conditions at the time the inspection is made.
- c. The pan tilt camera shall be turned to view directly up the axis of each service lateral encountered.
- d. During the CCTV inspection, a record shall be kept which shows clearly the exact location in relation to the center line of the adjacent manhole of each service connection and crack or structural fault discovered. To insure accurate measurement, the measurement shall be made at or above ground level by means of a meter device. Marking on a cable or the like which would require interpolation for the depth of the manholes shall not be used. Accuracy of the distance meter shall be checked by use of a walking meter, measuring wheel or other suitable device, and the accuracy shall be satisfactory to the City.
- e. Still photos shall be taken at the request of the City or the discretion of the operating technician to record conditions of interest during the inspection. The Contractor shall provide the camera, film and pictures. The photos shall be catalogued so each picture can be readily identified as to the exact location within the mainline segment.
- f. The TV inspection record shall be submitted on forms matching the format of the report forms included in Section 4. All reports shall be completely filled out and provide all essential data, including:
 - 1) location of mainline segment being tested (street name and designation as shown on the drawings);
 - 2) pipe diameter in inches;
 - 3) type and condition of pipe;
 - 4) length and type of joints;
 - 5) presence and location of roots or visible leaks;
 - 6) location and description of any cracks, breaks, misalignments or

- 7) obstructions;
location and diameter of service laterals, including clock position as viewed from camera;
 - 8) condition of the portion of lateral visible from pan-tilt camera;
 - 9) estimates of flows from service pipes and estimates of whether flow is domestic or I/I.
- g. Two copies of the printed and book-bound TV Inspection Report form shall be furnished to the City. All inspections shall also be recorded on VHS video tape together with voice transmissions of sewer conditions. The video tapes shall be accurately referenced to the inspection reports and shall be organized and cataloged so that specific faults can easily be found and reviewed from the tapes.
- h. Video tape(s) and runs shall be numbered sequentially. Each video tape have a label which lists the tape number and all runs (including run number and mainline segment) included on the tape. The video tapes shall become the property of the City.

3.6 TURNAROUNDS

- a. The intent is to clean and TV inspect all mainline segments in their entirety. In some cases it may be necessary to clean and/or TV inspect the sewer from both the upstream and downstream ends to obtain a complete TV record of the sewer mainline segment.
- b. A turnaround shall be defined as an obstruction or pipe condition which in the opinion of the City does not permit the TV camera to pass the complete distance from one end of the line segment to the other, and for which the camera must be installed in the opposite end of the line segment in order to TV from the opposite direction. If the camera fails due to an obstruction to reach the line condition of obstruction which caused the turnaround, the TV inspection may be considered complete subject to approval by the City.
- c. In cases where more than 85% of the length of the line segment has been successfully TV inspected and the Contractor must set up at the second manhole to TV inspect the next line segment, the turnaround shall be considered incidental to the setup and TV inspection of the next line segment. For lines sizes 8-inches or smaller in diameter, turnarounds shall not be paid for unless a skid mounted mainline camera is also unable to traverse the line segment.

3.7 MANHOLE INSPECTION

- a. Inspection of manholes shown on the drawings shall be performed after the manholes have been cleaned so that cracks, leaks and structural failures may be located.
- b. The inspection shall be performed on one manhole at a time. Each manhole being inspected shall be isolated from the lines as necessary by the use of a line plugs to insure viewing of the pipe collar where it enters the manhole. The inlet and outlet pipes shall be no more than ¼ full during the manhole inspection.
- c. The manhole inspection record shall be submitted on forms matching the format of the report forms included in Section 4. All reports shall be completely filled out and provide all essential data, including:
 - 1) location of manhole being tested (street name and manhole designation as shown on the drawings);
 - 2) type of surface cover at manhole;
 - 3) assessment of ability to access manhole;
 - 4) condition of manhole;
 - 5) traffic conditions at manhole location;
 - 6) diameter and type of manhole casting;
 - 7) diameter and materials of construction of manhole riser, cone and wall;
 - 8) location and diameter of mainline pipes and service laterals, including position relative to outlet;
 - 9) estimates of flows from any leaks in cover, ring, riser, cone, wall, bench or pipe collars;
 - 10) Manhole depth, depth of flow, location and height of inside or outside drop inlets, and leak locations.

3.8 REPORTS

- a. All cleaning, manhole inspection and TV inspection reports shall be typed and bound into books, organized sequentially by manhole numbers and drainage basins. All forms for each drainage basin shall be bound into separate books.
- b. To the extent possible, reports shall be organized such that the cleaning report, manhole inspection report and TV inspection report forms progress from the bottom of the basin to the top and are in the order listed below:
 - 1) Cleaning report forms.
 - 2) Downstream manhole inspection report form.
 - 3) Mainline (upstream of manhole) TV inspection report form(s).

- 4) Upstream manhole inspection report form.
- 5) Etc.

PART 4: SPECIAL PROVISIONS

None

MANHOLE INSPECTION REPORT

Date:	Client: City:	Basin No.
Technician:	Weather:	Cleaned By:
M.H. #:	M.H. Location (Street & Cross Street or Address):	

SURFACE COVER:
 Cover: AC ___ Concrete ___ Gravel ___ Dirt ___ Other _____
 Ability to Access MH: Satisfactory ___ Poor ___

<p>CONDITION:</p> <p>Deterioration: Light ___ Medium ___ Heavy ___</p> <p>Condition of Rim: Satisfactory ___ Poor ___</p>	<p>TRAFFIC:</p> <p>Light ___ Medium ___ Heavy ___</p>
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<p>MATERIALS OF CONSTRUCTION:</p> <p style="text-align: center;"><u>Diameter (in)</u> <u>Type</u></p> <p>Casting _____ Number of holes in lid _____</p> <p>Manhole Type: Flat Top ___ Cone ___</p> <p>Cone _____ Precast ___ Brick ___ Block ___ CIP ___</p> <p>Wall _____ Precast ___ Brick ___ Block ___ CIP ___</p> <p>Base _____ Precast ___ Brick ___ Block ___ CIP ___</p>	<p>HYDRAULIC CONDITIONS:</p> <p style="text-align: center;"><u>Est. Qty (gpm /l)</u></p> <p>Cover _____</p> <p>Ring _____</p> <p>Riser _____</p> <p>Cone _____</p> <p>Wall _____</p> <p>Bench _____</p> <p>Pipe Collar _____</p>
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SECTION 02719
SANITARY SEWER MAIN INSPECTIONS AND CHEMICAL GROUTING

PART 1: GENERAL

1.1 SCOPE

- a. Furnish all labor, materials, equipment and incidentals necessary to effect the internal repair of sanitary sewer lines.
- b. Work specified under this section shall include, but not be limited to the following:
 - 1) Cleaning, TV inspection, and air testing pipe joints.
 - 2) Low pressure air testing of all joints, cracks, and other defects.
 - 3) Sealing such defects by the injection of chemical grout sealant.
 - 4) Retesting sealed defects.
 - 5) Warranty retesting.
 - 6) Lateral verification to determine whether lateral tees are live.
 - 7) Air testing dead tees.
 - 8) Sealing off dead tees and laterals.
 - 9) Air test live lateral tees and grout faulty tees.
 - 10) Incidental work shown or specified.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards and shall show and include the following:
 - 1) Information on all cleaning and TV inspection equipment proposed for use by the Contractor, including a listing of size, type and capabilities of each piece of equipment.
 - 2) Contractor's written certification that all equipment conforms to the requirements of the specifications contained herein.

1.3 CONTRACTOR'S RECORD DRAWINGS

- a. The Contractor shall maintain a neatly marked set of construction drawings showing any differences in alignment, pipe size and manhole or cleanout location discovered during the progress of the work. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the City at any time.

- b. The location, alignment, lengths and sizes of the sanitary sewer lines shown on the drawings are compiled from available records and/or field surveys. The City or Owner does not guarantee the completeness of such records.

PART 2: PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- a. **Water for Cleaning**

- 1) The City will provide water required for cleaning operations from metered hydrants at locations approved by the City. The Contractor shall provide all hoses, adapters and appurtenances required for obtaining water from the designated hydrants. Access to the hydrant shall not be obstructed in case of fire in the area served by the hydrant. The contractor shall be responsible for payment to the City for all water used.

- b. **Chemical Grout - Type A Acrylamide**

- 1) Chemical grout shall be an intimate mixture of dry acrylamide and dry N, N1 methylenebisacrylamide proportioned such that properly catalyzed dilute aqueous solutions will still form gels. The chemical grout shall be AV-100 as manufactured by Avanti International or approved equal.
- 2) The grout shall be capable of making a true solution at concentrations as high as three pounds per gallon of water.
- 3) The chemical solution shall have the ability to tolerate groundwater dilution, and to react in moving water. The viscosity of the chemical solution, without additives, shall be less than 2 cps, which remains constant until gelatin occurs.
- 4) The reaction time shall be controllable from 10 seconds to an hour. The reaction shall produce a continuous and irreversible gel at chemical concentrations as low as 0.4 pounds per gallon of water.

- c. **Catalyst shall be Ammonium Persulfate.**

- d. **Activator shall be Triethanolomine or other material approved by City.**

- e. **Inhibitor shall be Potassium Ferricyanide where conditions warrant controlling the chemical reaction time.**

- f. Root Inhibitor shall be Dichlobenil or approved equal, 2 parts per million in grout mixture.
- g. Viscosity and Strength Additive shall be Celite 209 as manufactured by J-M Pipe Company or approved equal.
- h. Sealant Mixture
 - 1) The final sealant mixture shall contain at least ten percent (10%) by weight of chemical grout and five percent (5%) by weight Celite.
 - 2) Unless otherwise directed, root inhibitor shall be used in lines to be sealed.
 - 3) No gel time less than 10 seconds shall be allowed.

2.2 CLEANING EQUIPMENT

- a. The Contractor shall furnish and utilize combination high velocity hydraulic cleaning equipment and vacuum unit as specified or required. High velocity cleaning equipment shall be used to clean all sewer mainlines unless otherwise specified or approved by the City. Low velocity or mechanical cleaning equipment shall not be used in lieu of high velocity equipment.
- b. High Velocity Cleaning Equipment with Vacuum Pickup of Materials
 - 1) High velocity equipment shall be capable of providing 65 gallons per minute at 1200 pounds per square inch working pressure. Contractor shall provide a minimum of 500 feet of 1" ID high pressure hose with at least two cleaning nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. The equipment shall also include a high velocity "gun" for cleaning manhole walls and bottoms. The equipment shall be complete including 1200 gallon water tanks suitable for holding corrosive or caustic chemicals, pumps, hose, hydraulically driven hose reel, auxiliary engines, controls and all safety features required by law.
 - 2) The cleaning equipment shall have an integral vacuum unit to allow the material cleaned from the pipes to be vacuumed directly from the manhole.

2.3 TV INSPECTION EQUIPMENT

- a. A closed circuit color television (CCTV) camera capable of providing still pictures and video tapes shall be used on all lines. The CCTV equipment shall be

specifically designed for sewer inspection operations and shall be operative in 100 percent humidity conditions. Lighting and camera quality shall be suitable to allow a clear focused picture a minimum of 6 linear feet in front of the camera of the entire inside periphery of the pipe. The camera shall have an adjustable focus distance from 6 inches to infinity, and the camera lights shall be variable intensity, with light, focus and aperture remotely controlled by the operating technician at the monitoring station.

- b. Camera travel speed shall be from 1.8 to 30 feet per minute (fpm) with smooth, uniform motion. Sudden stops and starts will not be acceptable. Camera shall be capable of stopping and reversing direction as necessary to document sewer conditions. Video pictures shall be clear, sharp and free from vibratory or electrical interference when the camera is in operation.
- c. A CCTV camera with pan-tilt capabilities shall be used on all lines larger than 6-inches in diameter. The CCTV camera shall be a tractor powered camera being able to inspect dead end lines, and shall be remotely controlled by an operating technician.
- d. For lines 6-inches and smaller in diameter, or for larger lines which have diameters which are too small due to obstructions or damage to accept a tractor powered camera, a mainline skid mounted camera shall be used. The mainline camera shall be pulled through the line by a winch controlled by the operating technician. A CCTV push camera shall be used in lines which are too small to accept a mainline skid mounted camera.
- e. The monitoring station shall be truck or trailer mounted. The monitoring station shall be fully enclosed within a rigid weatherproof enclosure on the TV truck or trailer.
- f. A minimum of one color display monitors (minimum 650 lines horizontal resolution) operating simultaneously shall be used in the monitoring station. The monitors shall be of a proper size to allow all viewing personnel in the monitoring station a satisfactory view, and shall continuously display the current date, manhole designation of the mainline section being inspected, and a continuous forward and reverse read-out of the camera distance from the manhole of reference.
- g. Contractor shall provide a polaroid-type still color camera capable of photographing the monitor picture in its entirety. Photographs shall be taken at City's request or at the discretion of the operating technician.

2.4 JOINT TESTING AND SEALING EQUIPMENT

- a. The testing and sealing apparatus is referred to hereafter as a packer and shall be a cylindrical case of a size less than the mainline pipe size. The packer shall be equipped with cables at either end or other approved device designed to pull the packer through the sewer line.
- b. The packer device shall be constructed in such a manner as to allow a restricted amount of sewage to flow by at all times. Air-impervious sleeves, constructed so that they can be pneumatically expanded, shall be mounted over the cylinder. When the packer is inflated, two widely spaced annular bladders shall be formed, producing an annular void between the cylinder and the inside wall of the pipe to be sealed. Hydraulic or mechanical sealing devices shall be prohibited in order to prevent damage to the pipe.
- c. Pressurized air shall be used for joint testing. Joint testing with liquid shall be prohibited. Continuous monitoring of the void area pressure shall be maintained at all times and recorded on a pressure metering device which accurately displays the pressure to within ± 0.1 psi and responds to and records all changes of pressure in the void space. Pressurized air introduced into this annular space shall be used to test for pipe or joint leaks. The Contractor may be required to demonstrate the accuracy of the testing equipment prior to approval.
- d. The sealing equipment shall contain two separate pumping systems capable of supplying an uninterrupted continuous flow of the sealing material at rates from 0.25 and 10 gallons per minute at a minimum pressure of 60 psi for a continuous period of up to ten (10) minutes. Each pumping system shall include a tank for mixing additive solids and liquids which will form the final grout mixture. These tanks shall be equipped with mixing and/or recirculation systems to allow continuous or frequent agitation of suspended solid additives. Suspended solids shall be agitated continuously throughout the grouting operation. The sealing materials shall pass from the individual mixing tanks through two separate pumps which function as a positive pressuring, metering and proportioning system. Any system of pumps or pressure devices which does not continuously maintain the exact design ratio of the fluids contained in the mixing tanks shall be prohibited.
- e. The packer shall be designed to be positioned over the area of infiltration or leakage by means of a metering device at the surface and a CCTV camera in the line. Once the packer is positioned, the pneumatic sleeves shall be capable of being expanded using precisely controlled pressures. Pressure shall not exceed 25 psi without the approval of the City. The packer sleeve system shall be constructed so that pressure in the sleeves can be increased or decreased at any time during the joint sealing operation. The pneumatically expanded sleeves shall

seal against the inside periphery of the pipe to form annular space at the designated location. The thoroughly mixed sealant shall be pumped into this annular space.

- f. To insure the complete mixing of the grouting materials, the sealing device shall contain a mixing chamber which accepts sealant materials from the pumps and dual hose system and combines them into a single catalyzed liquid which is then injected from a single orifice into the annular space formed between the packer and the pipe wall. The diameter of the orifice exiting from the mixing chamber shall be no larger than the largest hose of the dual hose system.
- g. The pumps, meters and packer shall be integrated so that the proportions and quantities of materials and pressures for sealing can be regulated in accordance with the type and size of leak, percentages of voids being filled, and type of soil surrounding the pipe, and the rate of flow of the sealing solution in relation to the back pressures. The sealing equipment shall be designed to monitor the injection of the grouting materials and determine when the leak has effectively been sealed to the pressures required.

PART 3: EXECUTION

3.1 TEMPORARY TRAFFIC CONTROL

- a. Contractor shall provide temporary traffic control as required by MUTCD, City, County and ODOT and as specified to minimize obstruction and convenience to the public and to protect pedestrian and vehicular traffic. The Contractor shall pay any permit fees or costs for traffic control requirements as required by public agencies having jurisdiction.
- b. Contractor shall adequately warn the public at all times of existing conditions on all streets affected by work operations.
- c. Contractor shall notify affected residents, businesses and emergency services in writing during business hours 48 hours in advance of parking removal and/or street, driveway, and alley detour or closures. Failure to provide proper, timely notification will be grounds to deny the commencement of the work.
- d. Emergency traffic such as police, fire, and disaster units shall be provided access to the work area at all times.
- e. Contractor shall conform to all applicable local, State and Federal regulations relating to temporary traffic control and protection of the public.

3.2 MAINTAINING SEWER FLOWS AND CLEANING PRECAUTIONS

- a. All sanitary sewer system components shall remain in service through the cleaning and TV inspection operations unless specific exceptions are approved in writing by the City.
- b. During cleaning operations, precautions shall be taken by the Contractor in the use of cleaning equipment. When hydraulically propelled cleaning tools or tools which retard the flows in the sewer lines are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. Precautions shall be taken to protect the sewer lines from damage that may result from the improper use of cleaning equipment. The Contractor shall be solely responsible for the repair of any damage to structurally sound lines or damage to properties connected to the sewer which results from the cleaning operations.
- c. The methods used to maintain flows shall be at the Contractor's option and may include use of flow-through plugs with periodic release of sewage flow or bypass pumping. The bypass system, if used, shall be capable of conveying flows when the sewers are flowing full.

3.3 CLEANING

- a. Clean all sewer lines designated on the drawings or directed by the City preparatory to CCTV inspection including the manholes at both ends of the section to be inspected. Equipment as specified shall be used for cleaning.
- b. All dirt, sand, grease, rocks, roots, or other accumulations shall be removed from pipe walls and manholes. Existing lines shall be protected from damage caused by cleaning operations. Hydraulic cleaning operations shall be conducted with care to avoid damage to pipes or flooding of adjacent property.
- c. All sewers shall be cleaned with high velocity equipment unless City allows otherwise. The City may order the use of other methods or equipment when it appears necessary.
- d. All materials removed from the pipes during the cleaning operations shall be collected by a vacuum unit from the manhole downstream of the section being cleaned and removed by the Contractor. Passing accumulated materials from manhole section to manhole section shall not be permitted.
- e. A disposal area will be designated by the Owner for use by the Contractor at the Owner's wastewater treatment plant or other point within five (5) miles of the City

limits. All materials resulting from the cleaning operation shall be disposed of at the dump site and in a manner acceptable to the City.

- f. All sewer cleaning reports shall be submitted on forms matching the format of the cleaning report forms included in Section 4. All reports shall be completely filled out and provide all essential data, including:
 - 1) location of mainline segment being cleaned (street name and manhole designation as shown on the drawings);
 - 2) diameter in inches for sewers;
 - 3) amount and type of material removed from pipe or manhole;
- g. Two copies of the typed and book-bound Cleaning Report forms shall be furnished to the City as specified below.
- h. Acceptance of the cleaning work will not be made until after the submittal of the cleaning reports and the CCTV inspection reports and tapes. Lines will be considered acceptable when sufficient material has been removed to restore the sewer line to 95 percent of its original flow capacity and inspection, testing and sealing equipment may pass unobstructed. If the TV inspection shows the cleaning to be unsatisfactory, the Contractor shall reclean and re-TV inspect the line at no additional cost to the Owner until the cleaning is satisfactory to the City.

3.4 SEWER FLOW CONTROLS

- a. The methods used to maintain flow shall be at the Contractor's option and may include use of flow-through plugs or bypass pumping.
- b. When the sewer depth of flow at the downstream manhole of the mainline section being inspected is above the maximum allowable for television inspection, the Contractor shall provide flow-through plugs or other means where necessary to ensure that the flows are reduced to the levels specified below.
- c. Depths of flow at the downstream manhole during television inspection shall not exceed that shown below when performing television inspection of the lines.
 - 1)

<u>Pipe Diameter (in)</u>	<u>Maximum Depth of Flow</u>
3" - 6" pipe	20% of pipe diameter
6" - 10" pipe	20% of pipe diameter
12" - 24" pipe	25% of pipe diameter
- d. High Flows During Cleaning Operations: During periods of very high flows when

lines are surcharged, sewer cleaning operations may be suspended by the Contractor until the lines are no longer surcharged. Conditions during all periods during which cleaning operations are suspended shall be documented in writing and submitted to the City within 24 hours of the suspension of work, including the depth of flow in other lines which have not yet been cleaned and are available for cleaning at the time.

- e. High Flows During TV Inspection Operations: During periods of very high flows when lines flow greater than 3/4 full, TV inspection operations may be suspended by the Contractor until flows are again less than 3/4 full. Conditions during all periods during which TV inspection operations are suspended shall be documented in writing and submitted to the City within 24 hours of the suspension of work, including the depth of flow in other lines which have been cleaned and are available for TV inspection at the time.
- f. Failure to document the depth of flows in other lines available for cleaning or TV inspection shall result in the Contractor being ineligible to apply for a Contract time extension for the delay. The Contractor shall obtain authorization from the City or the Owner's representative prior to the suspension of operations for more than 4 hours due to excessive flows.

3.5 CCTV INSPECTION

- a. Internal CCTV inspection of sanitary sewer main lines as shown on the drawings shall be performed only after the sewers have been thoroughly cleaned so that service connections and structural failures may be located.
- b. The CCTV inspection shall be performed on one manhole section at a time. Each manhole section being inspected shall be isolated from the remainder of the line as necessary by the use of a line plugs or by-pass pumping to insure viewing of the inside periphery of the pipe. The TV inspection shall be performed by putting the television camera through the line along the axis of the pipe. The inspection shall be performed in a forward and/or backward direction, according to line conditions at the time the inspection is made.
- c. The pan tilt camera shall be turned to view directly up the axis of each service lateral encountered.
- d. During the CCTV inspection, a record shall be kept which shows clearly the exact location in relation to the center line of the adjacent manhole of each service connection and crack or structural fault discovered. To insure accurate measurement, the measurement shall be made at or above ground level by means of a meter device. Marking on a cable or the like which would require

interpolation for the depth of the manholes shall not be used. Accuracy of the distance meter shall be checked by use of a walking meter, measuring wheel or other suitable device, and the accuracy shall be satisfactory to the City.

- e. Still photos shall be taken at the request of the City or the discretion of the operating technician to record conditions of interest during the inspection. The Contractor shall provide the camera, film and pictures. The photos shall be catalogued so each picture can be readily identified as to the exact location within the mainline segment.
- f. The TV inspection record shall be submitted on forms matching the format of the report forms included in Section 4. All reports shall be completely filled out and provide all essential data, including:
 - 1) location of mainline segment being tested (street name and designation as shown on the drawings);
 - 2) pipe diameter in inches;
 - 3) type and condition of pipe;
 - 4) length and type of joints;
 - 5) presence and location of roots or visible leaks;
 - 6) location and description of any cracks, breaks, misalignments or obstructions;
 - 7) location and diameter of service laterals, including clock position as viewed from camera;
 - 8) condition of the portion of lateral visible from pan-tilt camera;
 - 9) estimates of flows from service pipes and estimates of whether flow is domestic or I/I.
- g. Two copies of the printed and book-bound TV Inspection Report form shall be furnished to the City. All inspections shall also be recorded on VHS video tape together with voice transmissions of sewer conditions. The video tapes shall be accurately referenced to the inspection reports and shall be organized and cataloged so that specific faults can easily be found and reviewed from the tapes.
- h. Video tape(s) and runs shall be numbered sequentially. Each video tape shall have a label which lists the tape number and all runs (including run number and mainline segment) included on the tape. The video tapes shall become the property of the Owner upon payment for the line segments inspected.

3.6 TURNAROUNDS

- a. The intent is to clean and TV inspect all mainline segments in their entirety. In some cases it may be necessary to clean and/or TV inspect the sewer from both

the upstream and downstream ends to obtain a complete TV record of the sewer mainline segment.

- b. A turnaround shall be defined as an obstruction or pipe condition which in the opinion of the City does not permit the TV camera to pass the complete distance from one end of the line segment to the other, and for which the camera must be installed in the opposite end of the line segment in order to TV from the opposite direction. If the camera fails due to an obstruction to reach the line condition of obstruction which caused the turnaround, the TV inspection may be considered complete subject to approval by the City.
- c. In cases where more than 85% of the length of the line segment has been successfully TV inspected and the Contractor must set up at the second manhole to TV inspect the next line segment, the turnaround shall be considered incidental to the setup and TV inspection of the next line segment. For lines sizes 8-inches or smaller in diameter, turnarounds shall not be paid for unless a skid mounted mainline camera is also unable to traverse the line segment.

3.7 LATERAL VERIFICATION

- a. Where the City designates, contact property owners of adjacent buildings or otherwise gain access to lateral piping potentially connected to any main tee or wye, and flush toilets, blow smoke, or run water into service pipes to determine if the tee or wye is live or dead.
- b. Work to be done in conjunction with TV inspection of man.
- c. Contractor shall be responsible for the accuracy of the lateral verifications.

3.8 REPAIRS USING CHEMICAL GROUTING EQUIPMENT

- a. Testing and Sealing Equipment Setup
 - 1) Prior to setting up testing and sealing equipment in any section of sewer main, review plans and work orders to determine that, to the extent practical, all repairs requiring such equipment can be accomplished at one time while the equipment is in that main segment.
 - 2) Place packer and TV equipment in sewer main, using manholes for access (unless other provisions are made). To extent possible, located above ground equipment to minimize traffic and pedestrian disruption.

b. Mainline Joint and Defect Testing

- 1) Every joint and sewer main defect, including those next to service tees, wyes, and manholes, except those noted on plans or as directed by City shall be individually air tested to determine the need for sealing. In some sewer segments, as directed by City, only a portion of the man between manholes or selected joints or defects will be tested. Perform joint and defect testing by applying air pressure of 10 psig to the isolated joint or defect. Where ground water is present, the air test pressure shall exceed the pressure of groundwater by 10 psig. The testing device shall be constructed so that individual joints or defects may be isolated for testing and sealing or, by rearranging the testing apparatus so that multiple joints or entire manhole reaches may be tested. After the test pressure has stabilized, continuously monitor the pressure in the test section for 20 seconds. Any joint, defect or test section which fails to sustain pressure between 8 psig and 6 psig for 20 seconds will be considered to have failed the pressure test and shall be sealed or resealed as specified below. On completion of the sealing operation, retest as specified below.
- 2) The Contractor will be required prior to initiating work on this contract to establish the ability of his equipment to perform the functions of this contract and the accuracy of data obtained with his sealing and testing equipment. During the project, the Contractor may be required at any time to redemonstrate the accuracy and ability of his testing and sealing equipment. This will include tees to make certain that his equipment will successfully isolate joints and/or cracks at 25 psi or less inflation pressure, that his equipment will perform adequate pressure tests after sealing without the influence of plugged check valves, hoses or impaired pressure testing devices such as transducers resulting from the grouting operations. If questionable tests result from the inability of the Contractor's equipment to successfully perform repetitive testing operations, the equipment shall be removed and the project discontinued until such time that the Contractor can demonstrate the ability to perform per specifications of this contract.

c. Joint and Defect Sealing

- 1) Seal all leaking joints, joints or defects which fail the pressure test, joints offset by 1-1/2 inches or less, cracks, shears or other sources of leakage by the injection of chemical grout. Control packer sleeve pressure between 0 and 25 psig maximum to prevent damage to the pipe. Use type grout indicated in the proposal.
- 2) Test sealed joints and defects by applying air pressure equal to 0.43 psig

times the depth of the main in feet or 10 psig, whichever is greater, to the sealed area. Joints which fail to sustain this test pressure for 20 seconds will be considered inadequately sealed and shall be resealed and retested. Joints that fail the retest will be considered unrepairable by grouting. Note any such unrepairable joints on the TV inspection report and their location (footage) from one or both adjacent manholes.

- 3) On completion of the sealing operation, cleanup any excess grout, debris or other materials within the pipeline. Also cleanup any work areas used during the sealing operation. Any grout rings which reduce the diameter of the pipe by ½ inch or more shall be removed.

d. Maintaining Sewer Flows

- 1) All sanitary sewer systems must remain in service throughout the cleaning and sealing operations unless specific exceptions are approved in writing by the City. The methods used to maintain flow shall be at the Contractor's option and may include the use of flow through plugs with periodic release of sewage flow or bypass pumping. During periods of very high flows (i.e. when lines flow greater than 3/4 full), sealing operations shall be suspended until flows are again less than 3/4 full.

e. Warranty Testing

- 1) Approximately 5 to 10 percent of all joints sealed shall be later re-tested. The number of pipe sections tested and the location of such sections shall be entirely at the City's discretion, but in each location, all sealed joints in any section of sewer shall be tested.
- 2) Testing shall be done as described herein.
- 3) Any joints or other defects found to fail the leakage test shall be resealed without cost to the Owner under the warranty provisions of this contract. If two or more sealed effects are found to fail the leakage test in any section of sewer, no payment for warrantee testing of that section shall be made to the Contractor.
- 4) If pipe section(s) tested have more than one sealed defect fail the air test, then additional section(s) will be selected by the City and all previously sealed defects retested. This additional testing and sealing, if necessary, will continue until approximately 5 to 10 percent of all defects sealed are satisfactorily retested. Pipe section(s) with more than one previously sealed defect which fails the air test do not count towards the 5 to 10

percent of total defects which will be retested. Should as much as 20 percent of the original project be retested and fail to meet the 5 to 10 percent requirement, Contractor to mobilize additional crews so that retesting will proceed at a faster rate.

- 5) Warranty testing shall be done when directed by the City and shall be done within the Contract time period. No additional time allowed for warranty retest work.

f. Sealing Off Dead Tees and Laterals

- 1) Seal of dead tees, wyes and laterals as directed by the City.
- 2) Air Test (Type A). Position packer over tee or wye in main, inflate end elements and apply 10 psig air pressure to the isolated tee or wye. After the test pressure has stabilized, continuously monitor the pressure for 20 seconds. Any such tee or wye which fails to sustain pressure between 8 psig and 6 psig for 20 seconds fails the air test and shall be sealed off.
- 3) Seal Dead Tee or Wye. Pump chemical grout into the dead tee or wye in sufficient quantity to completely seal off the dead connection. Retest as described above. Repeat sealing operation until a satisfactory air test is obtained.

g. Air Test Live Tees and Grout Faulty Tees

- 1) Air Test selected live tees where indicated by plans or directed by City.
- 2) Locate service line and find a convenient location to uncover the service pipe. City to approve location of excavation. Locate all underground utilities. Excavate, uncover the service pipe, cut, and remove a two to three foot long section of pipe. Excavation and Pipe work to conform to specifications contained herein.
- 3) Push, rod, or float an inflatable plug with long stem down service pipe until it emerges into the sewer main and is viewed by CCTV. Pull plug three feet back into the service pipe and inflate it.
- 4) Position packer in main over tee or wye, inflate end elements, and apply 10 psig air pressure to the isolated tee or wye. After the pressure has stabilized, continuously monitor the pressure for 20 seconds. Any such tee or wye failing to sustain pressure between 6 psig and 8 psig for 20 seconds fails the air test and shall be sealed.

- 5) Seal faulty tee or wye by pumping isolated tee or wye full of Type A chemical grout under sufficient pressure to force grout outward through cracks or faulty joints. Remove packer and plug. Use a high pressure cleaner inserted down the lateral pipe to remove the grout filling from the service tee, wye, and/or pipe. Replace both the packer and plug as described above and repeat the air test. If the air test fails, repeat the sealing operation, remove the grout from the tee, wye and/or pipe and retest. If the second grouting operation fails to adequately seal the tee or wye, abandon the operation and report results to City.
- 6) Replace section of lateral pipe removed with like sized PVC sewer pipe per specifications contained herein. Use Fernco or equal couplings to connect to existing service piping. Carefully bed and compact around pipe to ensure that the line and grade of the PVC section accurately conforms with the adjacent piping. Trench backfill and clean up to conform to specifications contained herein.
- 7) No excavation in traveled roadways, driveways, or walkways shall remain open except during working hours. Such excavations at all times shall be adequately barricaded and protected. All other excavations shall be completely covered by plywood when workers are not actively using the excavation. No excavation shall remain open for more than three consecutive days.
- 8) Notify each property owner 24 hours before his/her lateral is to be sectioned. No lateral shall be out of service for more than two hours.

3.9 REPORTS

- a. All cleaning and TV inspection reports shall be typed and bound into books, organized sequentially by manhole numbers and drainage basins. All forms for each drainage basin shall be bound into separate books.
- b. To the extent possible, reports shall be organized such that the cleaning report and TV inspection report forms progress from the bottom of the basin to the top and are in the order listed below:
 - 1) Cleaning report forms.
 - 2) Mainline (upstream of manhole) TV inspection report form(s).
 - 3) Etc.

PART 4: SPECIAL PROVISIONS

None

MAINLINE CLEANING REPORT

Date: _____

	Client: City:	Basin No.
Technician:	Unit #:	Weather:
		Cleaned By:
		Report No.

Method of Measurement: <input type="checkbox"/> Scaled from map <input type="checkbox"/> TV Report <input type="checkbox"/> Measured by Tape <input type="checkbox"/> Approximated	# TANKS/ HOURS	FOOTAGE/ Diameter (in)	GALLONS REMOVED & TYPE OF DEBRIS/ Line completion status
1. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete? (Yes / No)
2. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete? (Yes / No)
3. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete? (Yes / No)
4. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete? (Yes / No)
5. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete (Yes/No)
6. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete? (Yes / No)
7. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete? (Yes / No)
8. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete? (Yes / No)
9. MH # _____ TO MH # _____. Location _____			
Comments:			Line Complete? (Yes / No)
Type of Debris: S = Sand; R = Rock; G = Grease; B = Broken Pipe; RT = Roots		Total Footage Line Completed This Date SIZE (in) FOOTAGE	
Notes: _____ _____ _____			Line Complete (Yes/No)

TELEVISION INSPECTION REPORT

Date:	Client: City:	Basin No.	
Technician:	Inspector:	Weather:	Cleaned By:
From M.H. #: Street:	Pipe Dia. (in)	Joint Length (ft)	Section Length (ft)
		Joint Type:	Pipe Material
			To M.H. #: Street:

PIPELINE DATA:	Footage	Problem Code	Comments	I/I (gpm)
Cleanliness: _____				
Alignment: _____				
Grade: _____				
Age: _____				
Condition: _____				
%Est. Leaking Joints: _____				
Other: _____				

PROBLEM CODE LEGEND:				
BP = Broken Pipe				
CC = Circumferential Crack				
LC = Longitudinal Crack				
G = Break in Grade				
L = Leak				
PT = Protruding Tap				
ST = Service Tap				
SL = Service Left				
SR = Service Right				
RT = Roots				
U = Unpassable				
PIPE MATERIAL LEGEND:				
AC = Asbestos Cement				
CIP = Cast Iron Pipe				
C(M) = Conc., Mortar Joint				
C(R) = Conc., Rubr. Gasket Jnt				
PVC = Polyvinylchloride Pipe				
TC = Terra Cotta				
VC = Vitriified Clay				
MANHOLE DATA:				
See Attached Manhole Inspection Report.				
TURNAROUND:				
Requested (Date/time): _____				
Authorized (Date/time): _____				

**SECTION 02720
STORM SEWER SYSTEM**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing, installing and testing of all storm sewer lines as shown on the drawings or as required to complete the work.
- b. Material to be furnished and installed shall include, but not be limited to all storm sewerage drainage piping, fittings, accessories, joints and jointing materials.

1.2 RELATED SECTIONS

- a. Section 02606, Catch Basins and Inlets.
- b. Section 02607, Concrete Manholes.

1.3 QUALITY CONTROL

- a. **Field Inspection:**
 - 1) All pipe sections and jointing materials shall be carefully examined for defects and no piece shall be laid that is known to be defective. Any defective piece discovered installed shall be removed and replaced with a sound one in a manner satisfactory to the City at the Contractor's expense.
 - 2) Defective material shall be marked with lumber crayon and removed from the job site before the end of the following day.
- b. **Field Testing:**
 - 1) All materials, process of manufacturing, and finished pipe shall be subject to inspection and approval.
 - 2) The City may select one sample of pipe on the job site of each production run of each size and type of pipe to be tested by the laboratory. The Contractor shall furnish the first test piece or pipe core and any additional samples required because of failures. Should the sample fail to meet specifications, retests shall be conducted by the laboratory in conformance with the specifications. Cost of all retests shall be born by the Contractor.

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards showing and shall include the following:
 - 1) Manufacturer's literature for each size and type of pipe and fittings used.
 - 2) Joint details and any special provisions required for assembly.
 - 3) A certificate from the pipe manufacturer stating that the materials have been sampled and tested in accordance with the provisions of and meet the requirements of the designated specification. The certificate shall be signed by an authorized agent of the manufacturer.

1.5 CONTRACTOR'S RECORD DRAWINGS

- a. The Contractor shall maintain a neatly marked set of record drawings showing the locations and depths of all waterlines, storm and sanitary sewer laterals, buried conduits and other utilities encountered during construction. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the City at any time.

PART 2: PRODUCTS

2.1 STORM DRAIN PIPE

- a. The listing of a particular pipe material in this section does not necessarily indicate that the pipe is acceptable for use in any particular situation. Refer to Public Works Design Standards section 3.8 for allowable pipe types under different conditions and cover depths.
- b. Non-Reinforced Concrete Pipe (PCP):
 - 1) Concrete pipe 18-inches and smaller may be non-reinforced unless otherwise specified or shown on the drawings.
 - 2) Non-reinforced concrete pipe and specials shall conform to AASHTO M86 (ASTM C-14). Class 3 pipe shall be used unless otherwise specified or shown on the drawings.
 - 3) Joints shall be bell and spigot with an O-ring as specified or shown on the drawings and conforming to the following:

- a) Bell and Spigot joints shall be sealed with flexible watertight gaskets meeting or exceeding all requirements of Federal Specifications SS-S-06210 (GSA, FSS Washington, DC) "Sealing Compounds, Preformed Plastic for Pipe Joints," type 1 Ropeform. Such gaskets may be RAMNEK as manufactured by K.T. Snyder Co., Inc., of Houston, Texas; KENTSEAL No. 2 Joint Sealant as manufactured by Hamilton Kent Mfg., Co., of Kent, Ohio, or approved equal.
 - b) O-Ring joints shall conform to ASTM C-443. The gaskets shall conform to material requirements of ASTM C-361.
- c. Reinforced Concrete Pipe (RCP):
- 1) Concrete pipe 21-inches and larger shall be reinforced.
 - 2) Reinforced concrete pipe shall meet the requirements of AASHTO M170 (ASTM C-76), for pipe to 108-inches and shall meet applicable OSHD specifications for pipe larger than 108-inches. Pipe shall be Class IV unless otherwise specified or shown on the drawings.
 - 3) Joints shall be O-ring type in conformance with non-reinforced concrete pipe joint and gasket specifications above.
- d. PVC Gravity Sewer Pipe
- 1) Pipe and fittings shall conform to ASTM D-3034, SDR 35 or ASTM F-679, SDR 35.
 - 2) Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM classification.
 - 3) Joints for PVC pipe shall be push-on joints using factory installed elastomeric ring gaskets.
 - 4) Unless otherwise specified, the gaskets shall be securely fixed into place by the manufacturer so that they cannot be dislodged during joint assembly.
 - 5) The joints shall conform to ASTM D-3212, Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

- 6) Couplings to be Ring-tie or Fluid-Tite, manufactured by Johns-Manville or CertainTeed or equivalent.

e. Corrugated High Density Polyethylene Pipe (CPEP)

- 1) The use of CPEP shall be allowed only where shown on the drawings.
- 2) Pipe and fittings shall conform to the requirements of AASHTO M 252-85I for pipes 3-inches to 10-inches in diameter.
- 3) Pipe and fittings shall conform to the requirements of AASHTO M 294-85I for pipes 12-inches to 24-inches in diameter.
- 4) Pipe and fittings shall have integrally formed smooth interior pipe surface for storm drain and single wall for perforated pipe applications.
- 5) Couplings shall be corrugated to match the pipe corrugations and the width shall not be less than one-half the nominal diameter of the pipe. Split couplings shall be manufactured to engage an equal number of corrugations on each side of the pipe joint. Where approved by the City, a mastic type gasket may be utilized.
- 6) CPEP shall be N-12 as manufactured by Advanced Drainage System, Inc. or approved equal.

f. Corrugated Metal Pipe (CMP)

- 1) The use of CMP shall be allowed only where shown on the drawings.
- 2) Unless otherwise specified, all CMP shall be the riveted type with lap joint construction conforming to the requirements of OSHD Section 02420, Metal Pipe, except as modified herein.
- 3) All CMP pipe, including but not limited to full-circle and elliptical sections, shall be steel conforming to the requirements of AASHTO M-36 (ASTM A-760).
- 4) All CMP pipe shall be galvanized and coated inside and out with a bituminous protective coating in conformance with OSHD Section 02420, Metal Pipe. Class of coating shall be as required by agencies having jurisdiction.

- 5) Coupling bands shall be galvanized steel 0.052-inch thick by 10-inch wide with two (2) neoprene "O" ring gaskets and galvanized steel bolts.

g. Ductile Iron

- 1) Ductile iron pipe shall be Class 52 pipe conforming to AWWA C-151, and cement-mortar lined and seal coated in accordance with AWWA C-104.

2.2 FITTINGS

- a. Unless otherwise specified, fittings to be same material, type, class and grade as sewer pipeline in which it is installed, and shall conform to same specifications as sewer pipe.
- b. Connection of service laterals to the mainline shall be accomplished with manufactured fittings or Inserta-Tees. All holes in mainline pipe shall be core drilled.

2.3 GEOTEXTILE FABRIC

- a. Geotextile fabric used in conjunction with perforated pipe drainage application shall be a Type 2 drainage geotextile conforming to OSHD Section 00350, Geotextile Installation, and OSHD Section 02320, Geotextile and Slope Protection with a minimum AOS of 100 and a minimum weight of 6 ounces per square yard.
- b. The geotextile fabric shall be of non-woven, needle punched construction and consist of long chain polymeric filaments or fibers. Under no circumstances shall slit film or woven geotextiles be allowed.
- c. Geotextile fabric shall be SUPAC 4NP as manufactured by Phillips Fibers Corporation or approved equal.
- d. Drainage geotextile fabric shall be Amoco 4551 non-woven fabric, or approved equivalent.

2.4 UNDERGROUND WARNING TAPE

- a. Detectable or non-detectable acid and alkali resistant safety warning tape shall be provided with all mainline and service lateral construction not located under paved portions of public streets.
- b. The tape shall consist of a minimum 4.0 mil (0.004") thick, virgin low density polyethylene plastic film formulated for extended use underground. The tape shall

be in accordance with the APWA national color code and shall be permanently imprinted in lead free black pigments suitable for direct burial.

- c. The tape shall be safety blue and shall be provided with the legend "CAUTION BURIED STORM DRAIN LINE BELOW" or approved equivalent printed continuously down the length of the tape.

PART 3: EXECUTION

3.1 PRODUCT HANDLING

- a. Care shall be taken in handling and transporting to avoid damaging pipes and their coatings. Loading and unloading shall be accomplished with the pipe under control at all times and under no circumstances shall the pipe be dropped. Pipe shall be securely wedged and restrained during transportation and supported on blocks when stored in the shop or field.
- b. Storage: Store all pipe on a flat surface so as to support the barrel evenly. Pipe shall not be stacked higher than 4 feet. Plastic pipe, if stored outside, shall be covered with an opaque material to protect it from the sunlight.

3.2 PREPARATION OF TRENCH

- a. Trench excavation shall conform to requirements of the applicable sections contained herein.

3.3 GRADE AND ALIGNMENT

- a. The Design Engineer or a registered surveyor shall provide line and grade stakes at 50 foot intervals or closer as judged necessary. The Contractor shall utilize sufficient string lines, targets, batterboards and survey instruments as necessary for accurate installation.
- b. Deviation from line and grade shall not exceed ½-inch on line and ¼-inch on grade at any point, provided such variations in grade do not result in a pipe or run of pipe having a level or reverse slope.
- c. Any pipe or run of pipe that has not been installed within the allowable tolerance for line and grade or impounds water to any extent shall be removed and reinstalled or replaced as necessary to bring the work into compliance with the specified requirements.

3.4 UTILITY CONFLICTS

- a. The Contractor shall be responsible for exposing potential utility conflicts far enough ahead of pipeline construction to make necessary adjustments in grade and alignment of the new work within the recommended limits of pipe and fitting deflection and/or the lines and grades stated in these standards.
- b. The Contractor shall be responsible for informing the City of the need for a grade and/or alignment adjustment.
- c. The Contractor shall not deviate from the design line and grade stated in the approved construction drawings without the approval of the City.

3.5 PIPE INSTALLATION

- a. All pipes shall be installed in accordance with methods set forth by the manufacturers written installation manuals and per OSHD Section 00445, Culvert, Siphon, Sewer and Irrigation Pipe.
- b. Pipes shall be let into manholes and connections grouted in with non-metallic non-shrink grout.
- c. Pipe laid directly over existing water mains shall have one full length of ductile iron pipe centered over the waterline and shall be cradled in 3,300 psi concrete cushion to adequately spread imposed loads and prevent crushing of the pipe.
- d. Any field connections to existing storm sewers such as cut-in tees, shall be subject to approval by the City. Where existing field tile, trench drains, etc., are intercepted by new trunk storm sewers, they shall be plumbed into the trunk in an approved manner.

3.6 UNDERGROUND WARNING TAPE

- a. Unless otherwise approved by the City, underground warning tape shall be placed a minimum of 12-inches and a maximum of 18-inches below the finish ground surface, and shall be continuous the entire length of the mainline and service laterals installed.

3.7 CLEANUP

- a. Cleanup of construction area is to closely follow pipe-laying activities.

- b. Removal of all excess materials, broken pavement, construction equipment, etc., to be done within three (3) days after pipe is laid in any area.
- c. Level and reseed lawn areas. Grade and gravel shoulder or parking areas. Replace any signs, mailboxes, etc. which were removed or damaged.

3.8 PIPE FLUSHING AND CLEANING

- a. Prior to mandrel testing and/or final acceptance, flush and clean all sewers, and remove all foreign material from the mainlines, manholes and catch basins.
- b. In cases where a new storm line is connected to an existing sewer line and extended upstream without a structure at the connection point, the contractor shall clean the debris from the existing line segment downstream of the connection point as required to ensure a smooth and uninterrupted flow line. In all cases, the entire line segment between structures shall be cleaned to ensure that debris is not left in the lines.

3.9 TESTING STORM SEWERS

- a. All storm sewer shall be tested in accordance with local jurisdiction requirements.
- b. Mandrel testing shall be required for all flexible storm pipes, or pipes which are deflected into or out of manholes or catch basins.

PART 4: SPECIAL PROVISIONS

None

STORM SEWER MANDREL TEST REPORT

Project Location: (City)	Project Name:
Inspector: (Print)	Date: (Separate Report Required for Each Test Session)
Mandrel Diameters Verified? Yes / No	

Station (& Manhole #)		Size & Material	Length (ft)	Results	Backfill Compaction Completed?	Date Sewer Flushed & Cleaned	Comments
From	To						
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		
				Pass / Fail	Yes / No		

1. Mandrel testing shall be conducted on a manhole to manhole (or cleanout) basis and shall be done after the line has been completely flushed out with water.
2. Mandrel testing shall be conducted after trench backfill and compaction has been completed.
3. The mandrel diameter shall be 95% of the pipe initial inside diameter. The inspector shall verify the diameter of each mandrel used during each test session.

**SECTION 02832
WOVEN WIRE AND BARBED WIRE FENCING**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing of all materials, equipment, labor and supervision necessary for the installation of new fencing as shown on the drawings and to replace fencing damaged during construction in accordance with the approved construction drawings.
- b. All work performed under this section shall comply and be in accordance with all approved trade practices and manufacturers' recommendations.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards and shall include:
 - 1) Shop drawings, indicating plan layout, spacing of components, post installation and bracing details, and schedule of components.
 - 2) Manufacturer's literature.

PART 2: PRODUCTS

2.1 GENERAL

- a. All materials shall be new products of recognized, reputable manufacturers or producers and shall conform to the requirements of these specifications.
- b. Materials shall carry a tag identifying the manufacturer of the product. In the case of wire and fabric, class of zinc coating shall also be shown.
- c. Used, re-rolled or re-galvanized will not be acceptable.
- d. All materials shall be hot-dip galvanized after fabrication.
- e. Posts and other appurtenances shall have a minimum zinc coating of 2.0 ounces per square foot of surface.

2.2 FABRIC & WIRE

a. Woven Wire Fabric

- 1) Wire fabric shall be the height indicated on the drawings, woven of No. 12½ gauge steel wire in 6"x6" square mesh pattern.
- 2) The woven wire fabric shall be galvanized steel wire conforming to the requirements of ASTM A-116, Class 3 coating or 12-½ gauge aluminum coated steel wire conforming to the requirements of ASTM A-584, Class 2 coating.

b. Barbed Wire

- 1) The barbed wire shall be 2-strand, 12-½ gauge with 4-point barbs spaced at 5-inch intervals and conforming to the requirements of ASTM A-121. Galvanizing shall be Class 3.
- 2) All barbed wire installed on the project shall be the same gauge unless otherwise approved by the City.

2.3 FRAMEWORK

a. General

- 1) Posts shall be standard lengths and as required for special conditions shown.
- 2) All posts shall be galvanized in conformance with the requirements of ASTM A-123.

b. Posts

1) End, Corner, and Pull Posts

- a) Galvanized Steel 2½"x2½"x¼" angle, 4.10 lb/lin. ft., and conforming to ASTM A-702.

2) Line Posts

- a) Galvanized steel, studded T-post, 1.33 lb/lin. ft. and conforming to ASTM A-702.

- 3) Gate Posts: Galvanized steel; for single gate or one leaf of double gate, as follows:
 - a) Up to Six (6) Foot Height: 6-inch diameter pipe, 18.97 lb/lin ft.

2.4 GATES

a. Framework

- 1) All gates shall be the width and height shown on the drawings, and with fabric and/or wire as shown on the drawings.
- 2) Unless otherwise shown, gate frames shall be fabricated of steel pipe, 2-inch outside diameter, weight 2.72 pounds per linear foot, with welded joints.
- 3) Provide 3/8-inch adjustable rods for use as diagonal braces to prevent sagging in conformance with the manufacturer's standard practice and as directed.
- 4) Gates and appurtenances shall be galvanized after fabrication in conformance with ASTM A-123.

b. Hardware

- 1) Provide gates with all necessary malleable iron fittings, sag rods, braces, hinges, and single or plunger bar type latches as required and semi-automatic outer latches to secure gates in opened position.
- 2) Swinging Gate Hardware
 - a) Hinges shall be of size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. An additional hinge shall be provided for each gate leaf over 6'-0" nominal height.
 - b) Latch shall be forked type or plunger-bar type as shown on drawings to permit operation from either side of gate, with padlock eye as integral part of latch.

3) Double Gates Hardware

- a) In addition to hardware outlined above, gate stops shall be provided for double gates, consisting of a 4x4 treated post set a minimum of twenty-four (24) inches in concrete. Locking device and padlock eye shall be included as integral part of latch, using one padlock for locking both gate leaves.

4) Sliding Gate Hardware

- a) Contractor shall provide standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required.
- 5) A heavy duty, weatherproof padlock shall be provided for all gates. The padlock shall be keyed per the City's instruction, and three (3) sets of spare keys provided for each lock.

2.5 FITTINGS AND APPURTENANCES

- a. Fittings shall include stretcher bars and clamps, clips, tension rods, brace rods, hardware, fabric bands and fastenings, post caps, and all accessories, and shall be malleable steel, cast iron, or pressed steel as required, and shall be hot-dip galvanized after fabrication.
- b. Braces: Shall be 2" x 2" x 1/4" galvanized steel angle, 3.19 pounds per foot and conforming to ASTM A-702.
- c. Truss Rods: Steel rod, 3/8" diameter merchant quality with turnbuckle.
- d. Tie Wires: Aluminum, 9 gauge, alloy 1100-H4 or equal.

PART 3: EXECUTION

3.1 GENERAL

- a. Fence lines shall be cleared and grubbed and graded to allow for smooth transitions. Shrubs, logs, snags, and other obstacles to be removed and properly disposed of by Contractor.

- b. Small irregularities in ground surface which will interfere with maintaining specified clearance above ground surface to bottom of wire shall be removed by cutting or filling with unclassified native material.
- c. Gate openings shall be cleared and graded to permit the gate to swing in a horizontal plane.

3.2 INSTALLATION

- a. All fencing materials shall be installed in accordance with the manufacturer's recommendations and as required by these specifications.

- b. Posts

- 1) Posts shall be set vertically, true and in straight lines between angle points, and shall be set in the ground or in concrete as shown on the drawings.
- 2) Placement of end, gate and corner posts shall conform to details shown on the drawings.
- 3) Intermediate posts with braces to be placed at minimum intervals of 100 feet on runs exceeding 150 feet in length.
- 4) Brace all gate, corner and pull posts diagonally to adjacent line posts to insure stability.
- 5) Concrete footings where required shall conform to the dimensions shown on the plans, and specified herein, and the top surface shall be crowned 2-inches above finish grade.
- 6) Where set in concrete, holes for line posts shall be a minimum of 9-inches in diameter.
- 7) Where set in concrete, holes for gate, corner, and pull posts shall be a minimum of 18-inches in diameter.

- c. Fabric, Wire and Appurtenances

- 1) Fabric and accessories shall not be installed until after the concrete is set.
- 2) Fence fabric and barbed wire shall be attached to each post in accordance with recognized standard practice for fence construction.

d. Gates

- 1) Gates and fittings shall be installed and adjusted so that gates operate satisfactorily from open or closed position.
- 2) Each gate shall be hinged in a manner which will prevent gate removal without proper tools. Gate shall be set to swing freely both directions in a horizontal plane and its swing shall be limited by posts so as not to place excessive load on the hinges. The gate shall fasten securely in its latch holder.

3.3 CLEAN UP

- a. Upon completion of the fence installation, clean up all waste material resulting from the operation.
- b. Spread excavated earth from pot holes on the surface and grade smooth.
- c. Dispose of all brush, debris or other materials in conformance with requirements of the standards.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02834
CHAIN LINK FENCING**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing of all materials, equipment, labor and supervision necessary for the installation of new fencing as shown on the drawings and to replace fencing damaged during construction in accordance with the approved construction drawings.
- b. All work performed under this section shall comply and be in accordance with all approved trade practices and manufacturers' recommendations.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these standards and shall include:
 - 1) Shop drawings, indicating plan layout, spacing of components, post installation and bracing details, and schedule of components.
 - 2) Manufacturer's literature.

PART 2: PRODUCTS

2.1 GENERAL

- a. All materials shall be new products of recognized, reputable manufacturers or producers and shall conform to the requirements of these specifications.
- b. Materials shall carry a tag identifying the manufacturer of the product. In the case of fabric, class of zinc coating and/or vinyl coating shall also be shown.
- c. Used, re-rolled, re-galvanized, or open seam posts will not be acceptable.
- d. All materials shall be hot-dip galvanized after fabrication.
- e. Posts and other appurtenances shall have a minimum zinc coating of 2.0 ounces per square foot of surface.

2.2 FABRIC

- a. Wire fabric shall be the height indicated on the drawings, woven of No. 9 gauge wire in 2" diamond mesh pattern. Selvages shall be twisted and barbed or knuckled as shown on the drawings.
- b. Wire fabric shall conform to Federal Specification RR-F-191H 1B, Type 4, Class 1B. Fabric to be vinyl coated, extrusion bonding as manufactured by Color Guard Corp., Raritan, NJ or equal; color to be selected by City.
- c. Wire fabric shall be galvanized after weaving with a minimum of 1.2 ounces of zinc per square foot of surface area conforming to ASTM A-392, Class I.

2.3 FRAMEWORK

a. General

- 1) All posts shall conform to ASTM F-1083, except as hereinafter modified.
- 2) Posts shall be standard lengths for setting in concrete and as required for special conditions shown.
- 3) Rolled form "C" posts of equal or greater bending strength allowed as approved by City.
- 4) All posts shall be fitted with snug-fitting galvanized metal caps.
- 5) All changes in direction of the fence line of 30° or greater shall be considered as a corner.
- 6) Pull posts shall be used at all abrupt changes in grade.

b. Posts and Rails

- 1) End, Corner, Brace and Pull Posts: Galvanized steel; minimum sizes and weights as follows:
 - a) Up to Six (6) Foot Fabric Height: 2.5-inch outside diameter pipe, 5.79 lb/lin. ft.
 - b) Over Six (6) Foot to Eight (8) Foot Fabric Height: 3-inch outside diameter pipe, 5.79 lb/lin ft.

- c) Over Eight (8) Foot Fabric Height: 4-inch outside diameter pipe, 9.10 lb/lin ft.
- 2) Line Posts: Galvanized steel; minimum sizes and weights as follows:
- a) Up to Six (6) Foot Fabric Height: 2-inch outside diameter pipe, 2.72 lb/lin ft.
 - b) Six (6) Foot to Eight (8) Foot Fabric Height: 2.5-inch outside diameter pipe, 3.65 lb/lin ft.
 - c) Over Eight (8) Foot Fabric Height: 3-inch outside diameter pipe, 5.79 lb/lin ft.
- 3) Gate Posts: Galvanized steel; for single gate or one leaf of double gate, as follows:
- a) Up to Six (6) Foot Height: 6-inch diameter pipe, 18.97 lb/lin ft.
 - b) Six (6) Foot to Thirteen (13) Foot Height: 8-inch outside diameter pipe, 28.55 lb/lin ft.
- 4) Top Rail and Intermediate Rails: Galvanized steel, manufacturer's longest lengths.
- a) Typical: 1-5/8-inch outside diameter pipe, 2.27 lb/lin ft
 - b) Expansion type outside sleeve coupling, minimum seven (7) inches long.

2.4 BOTTOM TENSION WIRE

- a. Bottom tension wire shall be coil spring wire not less than 0.177-inches in diameter.
- b. Provide tie clips of approved type for attaching the wire to fabric at intervals not exceeding 24-inches.

2.5 GATES

a. Framework

- 1) All gates shall be the width and height indicated on the drawings, and with fabric and/or wire as shown on the drawings.
- 2) Unless otherwise shown, gate frames shall be fabricated of steel pipe, minimum 2-inch outside diameter, weight 2.72 pounds per linear foot, with welded joints.
- 3) Provide 3/8-inch adjustable rods for use as diagonal braces to prevent sagging in conformance with the manufacturer's standard practice and as directed.
- 4) Gates and appurtenances shall be galvanized after fabrication in conformance with ASTM A-123.

b. Hardware

- 1) Provide gates with all necessary malleable iron fittings, sag rods, braces, hinges, and single or plunger bar type latches as required.
- 2) Provide gates with semi-automatic outer latches to secure gates in opened position. Outer catches (gate keepers) shall be mounted on 2 inch diameter galvanized posts set a minimum of 24 inches in concrete.
- 3) Swinging Gate Hardware
 - a) Hinges shall be of size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. An additional hinge shall be provided for each gate leaf over 6'-0" nominal height.
 - b) Latch shall be forked type or plunger-bar type as shown on drawings to permit operation from either side of gate, with padlock eye as integral part of latch.
- 4) Double Gates Hardware
 - a) Locking device and padlock eye shall be included as integral part of latch, using one padlock for locking both gate leaves.

- 5) Sliding Gate Hardware
 - a) Contractor shall provide standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required.
- 6) A heavy duty, weatherproof padlock shall be provided for all gates. The padlock shall be keyed per City's instruction, and three (3) sets of spare keys provided for each lock.

2.6 EXTENSION ARMS AND SECURITY WIRE

- a. Where shown on the drawings, all fencing shall be furnished with extension arms for supporting security wire.
- b. Extension Arms
 - 1) Extension arms for supporting security wire shall be galvanized, inclined at 45° and shall be capable of supporting a weight of 250 pounds applied at the tip.
 - 2) Extension arms shall be combination post cap/extension arm capable of being securely anchored to posts to prevent rotation and unauthorized removal. Welding will not be acceptable.
 - 3) Extension arms shall have slots as required to support the number of strands of security wire as shown on the drawings.
- c. Security Wire
 - 1) Barbed Wire
 - a) Barbed wire shall be 2-strand, 12½ gauge with 4-point barbs spaced at 5-inch intervals and conforming to the requirements of ASTM A-121. Galvanizing shall be Class 3.

2.7 FITTINGS AND APPURTENANCES

- a. Fittings, including stretcher bars and clamps, clips, tension bars, truss rods, hardware, fabric bands and fastenings, post caps, and all accessories, and shall be malleable steel, cast iron, or pressed steel as required, and shall be hot-dip galvanized after fabrication.

- b. Braces: Shall be 2" x 2" x 1/4" galvanized steel angle, 3.19 pounds per foot and conforming to ASTM A-702.
- c. Post Caps: Pressed steel, cast iron or cast aluminum alloy designed to fit snugly over posts to exclude moisture. Supply cone type caps for terminal posts and loop type for line posts. All fittings to conform to ASTM F-626.
- d. Rail and Brace Ends: Pressed steel, cast iron or cast aluminum alloy, cup-shaped to receive rail and brace ends.
- e. Top Rail Sleeves: Tubular steel, 0.051 thickness x 7" long, expansion type.
- f. Tension Bars: Steel strip, 5/8" wide x 3/16" thick.
- g. Tension Bands: Pressed steel, 14 gauge thickness x 3/4" wide.
- h. Truss Rods: Steel rod, 3/8" diameter merchant quality with turnbuckle.
- i. Tie Wires: Aluminum, 9 gauge, alloy 1100-H4 or equal.

PART 3: EXECUTION

3.1 GENERAL

- a. Fence lines shall be cleared and grubbed and graded to allow for smooth transitions. Shrubs, logs, snags, and other obstacles to be removed and properly disposed of by Contractor.
- b. Small irregularities in ground surface which will interfere with maintaining specified clearance above ground surface to bottom of wire shall be removed by cutting or filling with unclassified native material.
- c. Gate openings shall be cleared and graded to permit the gate to swing or roll in a horizontal plane.

3.2 INSTALLATION

- a. All fencing materials shall be installed in accordance with the manufacturer's recommendations and as required by these specifications.

b. Posts

- 1) Posts shall be set vertically, true and in straight lines between angle points, and shall be set in concrete as shown on the drawings.
- 2) Placement of end, gate and corner posts shall conform to details shown on the drawings.
- 3) Intermediate posts with braces to be placed at maximum intervals of 100 feet on runs exceeding 150 feet in length.
- 4) Brace all gate, corner and pull posts diagonally to adjacent line posts to insure stability.
- 5) Concrete footings shall conform to the dimensions shown on the plans, and specified herein, and the top surface shall be crowned 2-inches above finish grade.
- 6) Holes for line posts shall be a minimum of 9-inches in diameter and 30-inches deep.
- 7) Holes for corner, pull and personnel posts shall be a minimum of 12-inches in diameter and 40 inches deep.
- 8) Holes for gate posts (except personnel gates) shall be a minimum of 18-inches in diameter and 40 inches deep.

c. Fabric, Wire and Appurtenances

- 1) Fabric shall be installed on the side of the fence as designated by the City.
- 2) Fabric and accessories shall not be installed until after the concrete is set.
- 3) Fence fabric and barbed wire shall be attached to each post in accordance with recognized standard practice for fence construction.
- 4) Fasten chain link fabric to end posts with stretcher bars and clamps and to line posts and top rail with wire or bands at approximately 12-inch centers and 24-inch centers, respectively.
- 5) Top rail to extend through line posts tops to form continuous brace from end-to-end of each stretch of fence.

- 6) Tension wire shall be installed and tensioned per manufacture's recommendations. Attach wire to fabric with approved tie clips at intervals not exceeding 24 inches.

d. Gates

- 1) Gates and fittings shall be installed and adjusted so that gates operate satisfactorily from open or closed position.
- 2) Each gate shall be hinged in a manner which will prevent gate removal without proper tools. Gate shall be set to swing freely both directions in a horizontal plane and its swing shall be limited by posts so as not to place excessive load on the hinges. The gate shall fasten securely in its latch holder.

e. Extension Arms and Security Wire

- 1) All extension arms shall be securely anchored to prevent rotation and unauthorized removal.
- 2) Barbed Wire
 - a) A single strand of barbed wire shall be stretched tight through each of the outer slots of each extension arm and secured.

3.3 CLEAN UP

- a. Upon completion of the fence installation, clean up all waste material resulting from the operation.
- b. Spread excavated earth from pot holes on the surface and grade smooth.
- c. Dispose of all brush, debris or other materials in conformance with requirements of these standards.

PART 4: SPECIAL PROVISIONS

None

**SECTION 02936
SEEDING AND MULCHING**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes fine grading, placing sod, seeding and mulching areas designated on the drawings, specified, or ordered.
- b. The work consists of fine grading, furnishing and placing topsoil, sod, seed, mulching material, fertilizer and watering until growth is assured.
- c. The Contractor shall restore all grass areas damaged by his operations.
- d. Unless otherwise specified herein or directed, work shall be in conformance with OSHD Section 01020 Erosion Control Seeding.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
 - 1) Manufacturer's material certification.
 - 2) To Resident Project Representative:
 - a) Invoices showing the weight, brand and composite analysis of all fertilizer used on the project.
 - b) Bag tickets showing weight and composition of all seed used on the project.

1.3 PROTECTION

- a. Seed shall be sown only between the dates of February 1 and May 15, or August 1 and November 15, unless otherwise permitted by the City.
- b. The operation of finish grading and sowing shall not be performed when the ground is frozen or muddy.

PART 2: PRODUCTS

2.1 SEED

- a. Grass seed mixture to consist of 10 pounds Perennial Tetraploid to be selected by the City, 40 pounds K-Y Fescue, 5 pounds Lidino Clover (wetter areas) and 5 pounds sub-clover (well drained areas) per acre.
- b. Seed mixtures shall be in conformance with the requirements of OSHD section 03110.60.

2.2 FERTILIZER

- a. Commercial fertilizers shall be 22-16-8 conforming to OSHD section 03110.10 and applied at 350 pounds per acre.

2.3 MULCHING MATERIAL

- a. Mulching materials shall be cellulose fiber from wood or grass straw free of weed, seed, and other foreign materials. Mulching to conform to OSHD section 03110.40 and applied at 1200 pounds (dry weight) per acre.

3.4 TOPSOIL

- a. Material consisting of loose, friable, loamy topsoil without admixture of subsoil or refuse. It shall be reasonably free from peat, muck, roots, hard clay, coarse gravel, stones, weeds, tall grass, brush, sticks or other litter. Each load of topsoil shall be subject to the approval of the City. For topsoil to be considered loamy, the fraction passing No. 10 sieve shall contain not more than 40% clay. Topsoil shall contain not less than 5% nor more than 20% organic matter as determined by loss on ignition of oven dried samples to constant weight at 212°F.

PART 3: EXECUTION

3.1 PREPARATION OF AREAS TO BE SEEDED

- a. Those areas to be seeded shall be at established grades, cross sections, and finish specified at the time of seeding.
- b. All areas to be seeded shall be made substantially clear and free of weeds, briars, sticks, loose stones greater than 2-inches, and all other debris detrimental or toxic to the growth of grass.

- c. The surface soil on all areas to be seeded shall be in a condition favorable for the germination and growth of grass seed. A minimum of ½ inch and maximum 1-1/2 inches of surface soil shall be in a loose condition.
- d. Soil preparation operations shall be directional along the contours of the areas involved. On cut and fill slopes, the operation shall parallel the roadbed center line to form minor ridges to retard erosion and retain the grass seed.

3.2 SEEDING

- a. Application to be in two steps by hydraulic-type equipment providing continuous mixing and agitation of the water, seed, fertilizer, and mulch. First application to include up to 250 pounds/acre wood cellulose tracer combined with the grass seed and fertilizer. The second application to include the mulch.
- b. The mixture to be applied through a pressure-spray distribution system providing a continuous, non-fluctuating discharge. The application of the materials shall be by using a sweeping, horizontal motion of the distributing device.

3.3 WATERING AND MAINTENANCE

- a. Seeded and sodded areas shall be watered and maintained as specified below until they are established.
 - 1) The seed bed shall be thoroughly watered, as soon as the seed is covered, at the rate of 120 gal/1,000 sf.
 - 2) Water shall be applied by a hydro-seeder or water tank under pressure with a nozzle producing a spray that will not dislodge the mulching material.
 - 3) Water applications shall be made at least once a week, provided significant rainfall has not occurred within the weekly period.
 - 4) The rate of application shall be 120 gal/1,000 sf.
 - 5) The Contractor shall keep all sodded areas, including the subgrade, thoroughly moist for 2 weeks after sodding. After the 2 week period, the Contractor shall water the sod as specified above.
 - 6) Matting areas shall be maintained until all work on the Contract has been completed and accepted.

- 7) Maintenance shall consist of the repair of areas damaged by erosion, wind, fire, or other causes. The soil in these damaged seeded areas shall be restored to the condition and grade existing prior to application of matting, and restored areas shall be re-limed, re-fertilized, and reseeded. Where necessary, the jute matting shall be completely replaced. Damaged sod shall be replaced with new sod.

3.4 NOTIFICATION

- a. The Contractor shall give at least two days notice to the City of the time and place of starting his operations and shall keep the City advised of his schedule of operations. Favorable weather conditions shall be selected by the Contractor and approved by the City.

PART 4: SPECIAL PROVISIONS

None.

