

## 401 TRENCHING

### 401.1.00 Description

This section covers all work necessary for trench excavation and disposal of material required in construction of sewers and appurtenances. Trench excavation is the removal of all materials encountered in the trench to the depths and widths as shown or as directed, and is unclassified, or classified as either common or rock excavation.

#### 401.1.01 Unclassified Excavation

Unclassified excavation includes all excavation, regardless of type, nature or condition of materials encountered. When excavation is unclassified, the contractor shall assume full responsibility to estimate the kind and extent of various materials to be encountered in order to accomplish work.

#### 401.1.02 Classified Excavation

##### 401.1.02A Rock Excavation

Rock excavation is the removal of all material which by actual demonstration cannot, in Engineer's judgement, be reasonably excavated with equipment comparable to types listed in TABLE 1 and equipped with rippers or similar approved equipment and which is, in fact, systematically drilled and blasted or broken by power-operated tools designed for rock excavation. Engineer may waive the demonstration if material encountered is well-defined rock. The term rock excavation shall be understood to indicate a method of removal and not a geological formation.

TABLE 1

Manufacturer	Model	Type of Excavation
Komatsu	220	Trench
Caterpillar	EI-240	Trench
Kobelco	SK-220	Trench

Boulders or pieces of concrete larger than 1/2 cubic yard will be classified as rock if drilling and blasting or other approved methods are actually needed for their removal. If material which would be classified as rock by the above definition is mechanically removed with excavating equipment of a larger size than specified in TABLE 1, it shall be understood that any added costs for removal of material by this method shall be included in the unit price for common excavation.

#### 401.1.02B Common Excavation

Common excavation is the removal of all material not classified as rock excavation.

#### 401.1.03 Foundation Stabilization

Foundation stabilization is the removal of unsuitable material in the bottom of a trench and replacement with specified material for support of a pipe or appurtenances.

### 401.2.00 Material

#### 401.2.01 General

All material required to complete the work as specified shall be provided.

### 401.3.00 Construction

#### 401.3.01 Utilities Notification

The contractor shall contact the Utilities Notification Center at least 48 hours prior to beginning trenching activities. Additional follow-up calls shall be made as necessary as the work progresses to ensure that all utilities within the work zone are located to prevent damage.

#### 401.3.02 Trench Excavation

##### 401.3.02A General

All trench excavation shall conform to the requirements of regulatory agencies having jurisdiction over the work or within the work site.

##### 401.3.02B Clearing the Right of Way

Where clearing of the right of way is necessary, it shall be completed in accordance with Section 203.00 CLEARING AND GRUBBING prior to the start of the trenching.

##### 401.3.02C Open Trench Limit

The length of open trench shall be kept to a minimum and shall not exceed 100 feet unless approved by Engineer. The engineer may limit the amount of trench allowed open based upon work conditions of the area. The length of unrestored work area and total unfinished trench construction shall not exceed a length approved by Engineer.

#### 401.3.02D Trench Width

In all cases, trenches must be of sufficient width to allow for the shoring and permit proper joining of the pipe and backfilling of material along the side of the pipe. The minimum trench width in the

pipe zone must provide a clear working space of 6 inches outside the maximum outside diameter of the pipe. Excavation for manholes and other structures shall be wide enough to provide a minimum of 12 inches between the structure surfaces and the sides of the excavation. Trench widths shall be as specified in Subsection 405.4.00, MEASUREMENT AND PAYMENT, or as specified in the Contract Documents.

The top of the trench shall be confined to the rights of way or easements. Special written agreements to extend the width may be made with the affected property owners, provided the agreements are first approved by the engineer.

#### 401.3.02E Trench Grade

The contractor shall excavate the trench to the lines and grades shown or as established by the engineer, with proper allowance for pipe thickness, pipe bedding and foundation stabilization. The foundation upon which the bedding is to be placed shall be firm, undisturbed, and true to grade. If the trench is excavated below grade without authorization, the contractor shall restore to grade with material of the type specified for pipe bedding at no expense to the owner.

#### 401.3.02F Trench Protection

The contractor shall provide the materials, labor and equipment necessary to protect trenches at all times. The trench protection shall provide safe working conditions in the trench and protect the work, existing property, utilities, pavement, etc. The method of protection shall be according to the contractor's design, but all methods shall be subject to acceptance by the Engineer. Such acceptance, if given, shall not be construed as admission of liability by the Engineer for any failure of trench or shoring. The structural integrity of trenches and shoring shall be the sole responsibility of the Contractor. The contractor may elect to use a combination of shoring, overbreak, sliding trench shields, or other methods of accomplishing the work provided the method meets with the approval of all applicable local, state, and federal safety codes. The Contractor shall refer to publications by O.S.H.A. as needed.

Before beginning work, the Contractor shall submit to the Owner for approval all details of shoring intended to be used. This approval shall in no way relieve Contractor of responsibility for its safety and sufficiency.

Damage resulting from improper shoring, improper removal of shoring or from failure to shore shall be the sole responsibility of the contractor. Existing improvements damaged in the Contractors operation shall be restored or replaced at no expense to the Owner.

#### 401.3.02G Existing Abandoned Facilities

The contractor shall remove and dispose of existing abandoned sewer pipe, structures, and other facilities as necessary to construct the sewer. The cost of such removal will be considered incidental to the work. Contractor shall comply with Subsection 301.3.03, EXCAVATION OF EXISTING IMPROVEMENTS.

#### 401.3.03 Rock Excavation

Where rock is encountered during trench excavation, it shall be removed to provide a minimum of 6 inches of clearance to each side of and below all pipe and appurtenances. The contractor will be required to excavate and remove the overburden and expose the rock to allow the engineer to profile or cross section the rock for measurement of pay quantity. The measurement shall be completed prior to removal of the rock.

Explosives use shall be avoided as much as practicable. Any use of explosives shall comply with the requirements of Section 107 LEGAL RELATIONS AND RESPONSIBILITIES of the GENERAL REQUIREMENTS. The contractor shall provide all tools and devices required for loading and using explosives, blasting caps, and accessories. When blasting in rock trenches, cover the area to be shot with blasting mats or other protective material to prevent the scattering of rock fragments outside of the excavation.

The contractor shall assume all liability and responsibility connected with or accruing from the blasting or the use of explosives or dangerous material. The contractor shall comply with Subsection 301.3.08C USE OF EXPLOSIVES as well as all applicable laws regarding Explosives.

#### 401.3.04 Dewatering

Contractor shall furnish, install, and operate all necessary machinery, appliances, and equipment to keep excavations free from water during construction. Dewatering and disposing of water shall be accomplished so as to prevent injury to public or private property, or nuisance or menace to the public. At all times sufficient pumping equipment and machinery in good working condition shall be on hand for all ordinary emergencies, including power outage. At all times competent workers shall be available for operation of the pumping equipment. Surface runoff shall be controlled to prevent entry or collection of water in excavations. All excavations shall be kept free of water when concrete is being deposited or during placement of backfill.

Ground water shall be controlled such that softening of the bottom of excavations or formation of "quick" conditions or "boils" during excavation shall be prevented.

Dewatering systems shall be designed and operated so as to prevent removal of natural soils and so that ground water level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

Before dewatering is started, a statement of the method, installation, and details of the dewatering system proposed to be used shall be submitted to the Engineer. Open or cased sumps shall not be used as primary dewatering for excavations deeper than 3 feet below static water table unless authorized.

Ground water shall be released to its static level in such a manner as to maintain the undisturbed state of natural foundation soils. Disturbance of compacted backfill and flotation or movement of structures, water mains, sewers, and other utilities shall be prevented.

The Contractor shall comply with Section 204 DUST, NOISE, EROSION AND POLLUTION CONTROL.

#### 401.3.05 Trench Foundation

When, in the judgement of the engineer, the existing material in the bottom of the trench is unsuitable for supporting the pipe, the contractor shall excavate below grade, as directed. The excavated material shall be replaced with foundation material as directed by the Engineer. The removal will be measured and paid for as trench excavation.

#### 401.3.06 Surface Removal and Replacement for Trenches

##### 401.3.06A Removal and Replacement of Topsoil

Where trenches cross lawns, garden areas, pasturelands, cultivated fields, or other areas on which reasonable topsoil conditions exist, topsoil shall be removed to a depth of 12 inches for full width of the trench to be excavated. Topsoil shall be stockpiled and not mixed with remaining excavated material.

In lieu of stockpiling topsoil, approved imported topsoil may be substituted at no expense to owner. Payment for removing, stockpiling and replacing topsoil in the trench is incidental to the item bid. No further compensation will be made unless directed by Engineer to place imported topsoil material.

##### 401.3.06B Removal Curb, Driveways, Sidewalk and Pavements

Cuts in bituminous pavement, Portland Cement concrete pavement, curbs, and sidewalks, regardless of thickness, shall be made with a pavement saw. At the option of Engineer, Contractor may be required to replace complete section of Portland Cement concrete pavement, curbs, and sidewalks between expansion and/or contraction joints.

Curbs shall be sawcut perpendicular to their alignment at the minimum width for the excavation, or as directed by the Engineer.

Sidewalks shall be sawcut and removed between complete sections between expansion and contraction joints.

Driveways shall be sawcut at the direction of the Engineer, either the minimum width for excavation or removal of entire sections.

Replacement of pavement, curb, and sidewalk shall conform to the requirements of Section 407 RESURFACING, or as specified in the Contract Documents.

#### 401.3.07 Disposal of Excavated Materials

Excavated materials not suitable or not required for backfill or embankment as directed by the Engineer shall be disposed of in accordance with Subsection 107.20 WASTE SITES.

Excavated material, suitable for embankment or backfills which is necessary to the completion of the work may be placed within the construction easement, right-of-way, or approved working area. Prior to stockpiling material on private property, the contractor shall furnish the Engineer a copy of the property owners written approval. Material shall be piled in such a manner that it will cause a minimum of inconvenience to the public. Emergency access shall be maintained to all utilities, and clearance shall be left to enable free flow of storm water in all gutters, conduits, and natural watercourses. Contractor shall comply with Section 204, DUST, NOISE, EROSION AND POLLUTION CONTROL.

Except as otherwise specified, the removal and disposal of unsuitable or excess materials shall be responsibility of the contractor. It shall be the responsibility of the Contractor to obtain the required permits for materials disposal.

#### 401.4.00 MEASUREMENT AND PAYMENT

##### 401.4.01 Trench Excavation

###### 401.4.01A General

Trench excavation will be considered incidental to the cost of pipe in-place except when shown separately in the Contract Documents, in which case trench excavation will be measured on a cubic yard basis. The quantity measured for payment will include only material excavated from within the limits defined herein, and will not include material excavated under any other pay item.

###### 401.4.01B Common and Unclassified Trench Excavation

Volume for trench excavation will be computed upon the following basis for length, width, and depth of trench:

#### Length

Length will be the entire horizontal distance on a linear foot basis measured along centerline of trench, including measurement through manholes or structure locations. The measurement through such structures will be deducted if the Proposal contains a separate provision for payment of this item that is applicable to those structures.

#### Width and Depth

Width and depth upon which sewer excavation will be calculated shall be as shown in the Contract Documents or as described in Subsections 405.4.00, Measurement and Payment and 401.3.02E, Trench Grade.

#### 401.4.02 Trench Rock Excavation

Rock excavation will be measured on a cubic yard basis as follows:

#### Length

Length will be the entire horizontal distance where rock is encountered, measured on a linear foot basis along centerline of trench, excluding measurement through manholes and other structures. Measurement will commence at the first location where rock is encountered and continue to the point where rock terminates.

#### Width

The width for payment of trench rock excavation shall conform to applicable provisions of Subsections 401.3.03 Rock Excavation, and 405.4.00 Measurement and Payment.

#### Depth

Measurement for depth will be the vertical distance from top of rock to a depth that is 6 inches below the bottom of future pipe. Depth will be measured at intervals of 25 feet along centerline of trench, beginning at the first location that rock is encountered, and the average depth between measuring points will be the depth used for computing depth of rock.

Rock excavation quantities for sewer manholes and other sewer structures shall be computed from the actual profile depth as above, multiplied by the area within a line parallel to and one foot outside of the actual dimensions of the

manhole or structure base.

#### 401.4.03 Hard Surface Removal and Replacement for Trenches

Measurement and payment for the removal and replacement of Portland Cement Concrete pavement, asphaltic concrete pavement and surfacing, curbs, driveways, and sidewalks shall conform to the provisions of Section 407 RESURFACING TRENCH AREAS.

#### 401.4.04 Excavation for Foundation Stabilization

Measurement for this item will be made on a cubic yard basis. Volume will be computed upon the following basis for length, width, and depth of trench. Payment shall be as for Trench Excavation.

##### Length and Width

Length and width shall conform to pay limits as contained in Subsections 401.4.01B Common and Unclassified Trench Excavation and 405.4.00 Measurement and Payment. Length shall include only the actual linear footage of excavation for foundation stabilization as directed by the Engineer.

##### Depth

Depth measured will be the actual depth as directed below the level of bottom of bedding. Depth will be measured at intervals of 25 feet along centerline of trench, and the average depth between measuring points will be the depth used for computing the depth of foundation stabilization between measuring points.

#### 401.4.05 Shoring and Cribbing Incidental

Shoring and cribbing, including all work and materials expended in furnishing, placing and removing such shoring and cribbing necessary to complete the excavation shall be considered incidental to the pay item for pipe in place.

#### 401.4.06 Dewatering Incidental

Dewatering shall be considered as incidental to and included in the pay item for pipe in place unless otherwise shown in the Contract Documents.

#### 401.4.07 Payment

Payment will be made for any or all of the following items when listed as pay items in the Proposal for any particular Contract:

<u>Pay Item</u>	<u>Unit of Measure</u>
Asphalt and Concrete Removal	S.F. or S.Y. or L.F.
Unclassified Excavation	C.Y.
Rock Excavation	C.Y.
Common Trench Excavation	C.Y.
Excavation for Foundation Stabilization	C.Y.

Some or all items may be considered incidental to other bid items.

## 402 TUNNELING, BORING AND JACKING

### 402.1.00 DESCRIPTION

#### 402.1.01 Tunneling

Tunneling shall include all methods by which the underground passageway is first excavated and the pipe or conduit brought in and placed.

#### 402.1.02 Boring

Boring shall include all methods by which a pipe or casing is pushed or pulled into place and by which the excavation precludes the presence of workers within the pipe or casing without stopping or removing the excavation equipment.

#### 402.1.03 Jacking

Jacking shall include all methods by which a pipe or casing is pushed or pulled into place with one or more workers inside to excavate and assist in keeping the casing on grade and alignment.

#### 402.1.04 Permitter

The term "Permitter" shall designate the owner of railroad tracks, state highways, or other facilities with prior rights, under which a pipe or casing must be tunneled, jacked, or bored.

#### 402.1.05 Boring Chart

Projects which include the tunneling, boring, or jacking of any subterranean structure, shall require a boring chart be furnished, either as a part of the project plans at the time of bidding, or as an item incidental to the Contract, and shall be the responsibility of the boring Contractor. The boring chart shall include the following:

1. Confirm all known or suspected obstacles.
  - a. Ascertain; size, shape and depth
  - b. Pothole all underground utilities.
  - c. Plot all confirmed obstacles on the boring chart.
2. In addition, the boring chart shall show the following data:
  - a. Lowest known elevation of obstacle to be bored under.
  - b. Highest proposed elevation of top of boring tube.

- c. Closest distance to obstacle that boring will be allowed.
- d. Depth, length and width of boring pit.
- e. Type of material to be encountered.

402.2.00 MATERIALS

The materials used shall conform to the requirements of Subsections 403.3.04 Pipe Bedding and Pipe Zone and 403.2.11 Pipe Bedding and Zone Material.

402.2.01 Pipe

Pipe shall conform to Subsection 403.2.00 MATERIALS and Subsection 404.2.00 MATERIALS.

402.2.02 Casing

The casing used for all boring, tunneling, or jacking operations shall be as shown on the Plans, or specified in the proposal. Corrugated metal casing shall only be used where specified and approved. Coupling bands for corrugated metal casing shall be coated with a protective material similar to the casing. Corrugated metal pipe shall conform to the requirements of Subsection 404.2.06 GALVANIZED CORRUGATED STEEL PIPE, Subsection 404.2.07 CORRUGATED ALUMINUM ALLOY PIPE and Subsection 404.2.08 Flared End Sections.

The casing shall be of a size that will permit proper construction to the required lines and grades. The casing shall be of the type shown in the following table:

AASHTO M 36

Diameter Standard Gauge	Corrugated Metal Min. Thickness	Smooth Steel Inches U.S.
15-24	12	1/4" ASTM A 53
30-36	10	5/16" AWWA C 201
48-78	8	As Specified

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.

Jacked casings shall be equipped with nipples at the springline and crown on 10 foot centers when pressure grouting is specified.

402.2.03 Grout

Grout for filling the annular space between the carrier pipe and casing pipe shall be proportioned one part portland cement, five parts sand, and seven parts pea gravel, by volume, or as approved.

Grout for pressure grouting outside jacked carrier or casing pipe shall be one part portland cement and three parts sand, by volume, or as approved.

#### 402.3.00 CONSTRUCTION

##### 402.3.01 General

All work shall conform to all Federal, State, and local laws and regulations pertaining to tunneling and specifically the standards set forth in the Oregon Safety Code for places of employment, Chapter 24, Safety Code for Mining Tunneling and Quarrying, published by the Oregon Industrial Accident Commission.

All insurance coverage required by the City of Springfield and/or the permitter shall be obtained prior to the start of any work. Satisfactory evidence of such required insurance will be submitted to the Engineer not less than 48 hours prior to such work being done.

All proposed construction methods and materials shall be approved by Engineer and/or permitter before the start of construction. The approval of permitter shall be submitted in writing.

##### 402.3.02 Line and Grade

Line and grade for sewers shall conform to SubSection 403.3.01 LINE AND GRADE FOR GRAVITY AND PRESSURE SEWERS. Pipe and/or casing installed to a grade that diminishes system capacity or design shall be removed and relayed at no expense to the Owner.

##### 402.3.03 Excavation

Excavation shall be unclassified and shall include whatever materials are encountered to the depths as shown or as required. An estimate will be made of the kind and extent of the various materials which will be encountered in the excavation.

##### 402.3.04 Tunneling Details Required

Details of the following shall be submitted to Engineer for approval before beginning the tunnel construction:

1. Tunnel shaft bracing and dimensions

2. Tunnel supports
3. Method of backpacking tunnel supports
4. Bracing to prevent pipe or conduit shifting and flotation
5. Backfill material or pressure grout mix, placement method and equipment.
6. Poling plate dimensions and details, when required

#### 402.3.05 Jacking and Boring Details Required

Details of the following shall be submitted to Engineer for approval before beginning the jacking or boring construction:

1. Jacking pit bracing
2. Casing, pipe or conduit
3. Jacking head
4. Excavation method
5. Tee or wye installation
6. A substitute design for any part of the system that must be changed as a result of the jacking or boring operation. (Manhole, headwall, etc.)
7. Any structure that is required because of the particular method or procedure used by contractor.
8. If placed in a casing, bracing to prevent pipe shifting and flotation, backfilling material, method and equipment.
9. Backfill material or pressure grout mix, placement method and equipment.

#### 402.3.06 Tunneling

Tunneling will be permitted only where shown, specified or approved.

The subgrade, upon which the pipe is to be placed or constructed, shall be firm, thoroughly compacted and true to grade. Pipe bedding shall conform to the standard plans for the type of bedding specified. If the material in the bottom of the tunnel is ledge

rock, excavation of the tunnel shall extend to a depth below the bottom of the pipe and a bedding of crushed aggregate or concrete shall be provided as specified in Subsection 403.2.11A Bedding.

All excavation below grade which is made inadvertently or without authority will be backfilled with an approved bedding material at no expense to the owner.

#### 402.3.07 Alternate of Jacking or Boring

Jacking or boring may be allowed in lieu of the open-trench method or tunneling. However, written approval by Engineer must first be obtained. Engineer retains the right to reject either the jacking or boring method without rejecting the other.

#### 402.3.08 Jacking and Boring

A jacking head shall be securely attached to the leading section of pipe or casing and all excavation shall be carried out entirely within the jacking head.

Should appreciable loss of ground occur during the jacking or boring operations, all voids will be backpacked before the completion of the shift. All voids will be filled with grout or approved granular material.

#### 402.3.09 Concrete Pipe and Box Sections

The driving ends of concrete pipe or conduit will be protected against spalling or other damage. Intermediate joints shall be similarly protected by the installation of sufficient bearing shims to properly distribute the bearing stresses. Any section of pipe showing signs of failure shall be removed and replaced with a new section. A cast-in-place section may be allowed if in the judgement of Engineer such cast-in-place pipe will carry the loads imposed.

#### 402.3.10 Smooth Steel Casing

Sections of smooth steel casing shall be jointed by welding with a continuous bead for the full circumference of the casing. The welded joints shall be capable of resisting the jacking and boring forces without failure.

The pipe or conduit within the casing shall be braced to prevent shifting or flotation. The void between casing and pipe shall be filled with grout or other material, as specified or approved.

#### 402.3.11 Grouting Voids Outside Casing or Tunnel Liner

When specified, the Contractor shall pressure grout the void outside the casing or liner plates through the grout holes provided. Grouting shall start at the spring line hole at one end and grout pumped until it appears in the grout hole at the crown. The opposite spring line shall then be pumped with grout until the grout appears at the crown hole. Grout shall then be pumped into the crown hole until grout appears at the next set of holes. The first set of holes shall then be plugged and the grouting sequence repeated until the full length of the jacked, bored, or tunneled casing has been grouted. Grouting, once started, shall continue without stopping.

#### 402.3.12 Cased or Tunneled Pipe

When specified or shown, timber cradles shall be strapped under the barrel of the pipe. The pipe barrel shall bear continuously on the cradles during and after installation. Pipe installation shall conform to the applicable requirements of Sections 403 SANITARY SEWER PIPE, FITTINGS, APPURTANCES and 404 DRAINAGE STRUCTURES, STORM SEWER PIPE AND FITTINGS, including hydrostatic or air testing when specified.

#### 402.3.13 Placing Backfill Outside Carrier Pipe

Where shown or when directed, the space between the casing and carrier pipe shall be backfilled with an approved material. The method used will ensure that all voids are filled.

#### 402.3.14 Railroad Crossings

All aspects of the permit issued by the railroad company and the Public Utilities Commission (P.U.C.) shall be upheld.

### 402.4.00 MEASUREMENT AND PAYMENT

#### 402.4.01 Tunneling, Boring and Jacking

Tunneled, bored or jacked conduit will be measured and paid for at the unit price for each size and type listed in the bid schedule.

Where casing is shown or is used at the option of the contractor, the cost of the casing and the backfill between the pipe and the casing shall be considered incidental work.

Where jacking, boring, tunneling, or open trench is used in lieu of another method at the contractor's option, measurement and payment shall be made as originally bid.

#### 402.4.02 Tees and Wyes

Measurement and payment for tees and wyes in a tunneled, jacked or bored pipe or conduit (not in open trench) will be made at the Contract unit price for tees and wyes installed as provided for in Sub-sections 403.4.01 Sewer Pipe and 403.4.02 Tee and Wye Fittings.

## 403 SANITARY SEWER PIPE - FITTINGS - APPURTENANCES

### 403.1.00 DESCRIPTION

This section covers the following work:

1. Gravity and Pressure Line Sewer Pipe
2. Sanitary Service Lines
3. Sanitary Manholes and Cleanouts

### 403.2.00 Materials

#### 403.2.01 General

Sanitary sewers shall be constructed of pipe and fittings of the size, strength, material, and joint type included herein or as specified in contract documents. Only that jointing material as hereinafter specified for each pipe material shall be used. Each piece of pipe shall be clearly identified as to strength, class and date of manufacture. The manufacturer or fabricator shall furnish appropriate certification based on manufacturer's routine quality control tests that the material in the pipe and fittings meet the requirements specified herein. Strength, permeability, hydrostatic tests and pipe joints will be used as the basis of acceptance as described under proof tests herein. Minimum length of pipe shall be 3.5 feet.

It is not intended that materials listed herein are to be considered equal or generally interchangeable for all applications. The Engineer shall determine the materials suitable for the project and so specify.

Pipe and fittings for service lines shall be of one type of material throughout, unless shown or directed otherwise by the plans or Engineer. No interchanging of pipe and fittings will be allowed. Service laterals from mains located in the public right of way shall have a minimum size of 4 inches. Service laterals from mains located in public utility easements shall have a minimum size of 4 inches. Any lateral designed to serve two or more properties shall have a minimum size of 6 inches and shall be installed with a double wye clean out at the joint property line.

Sanitary sewer lines to be constructed in such proximity to water supply lines that Oregon Department of Environmental Quality requirements for 'watertight' pipe materials are applicable, shall be limited to those pipe materials specified by that agency.

#### 403.2.02 Concrete Pipe

#### 403.2.02A Non-Reinforced Concrete Pipe

Nonreinforced concrete pipe shall conform to ASTM C 14.

#### 403.2.02B Reinforced Concrete Pipe

Reinforced concrete pipe shall conform to ASTM C 76.

#### 403.2.03 Asbestos-Cement Pipe

Shall not be accepted.

#### 403.2.04 Cast Iron Pipe

Cast iron pipe shall conform to AWWA C 106 or C 108, or ANSI Specification A21.6, with push-on joint or mechanical joint as specified, conforming to Federal Specification WW-P-421c and ANSI A21.11. Cast iron pipe shall be lined with cement mortar and seal coated in accordance with ANSI Specification A21.4 and AWWA C 104. All foundry records of pipe as described in ANSI A21.6 will be provided when requested.

#### 403.2.05 Ductile Iron Pipe

Ductile iron pipe shall conform to ANSI A21.51 or AWWA C 151, with push-on joint or mechanical joint as specified, conforming to Federal Specification WW-P-421c and ANSI Specification A21.11. When specified Ductile iron pipe shall be lined with cement mortar and seal coated in accordance with ANSI Standard A21.4 and AWWA C 104.

#### 403.2.06 ABS Pipe

ABS single wall pipe shall conform to ASTM D 2751 with SDR 23.5 wall thickness and ABS composite pipe shall conform to ASTM D 2680 with solvent-cemented or mechanical-seal joints as specified.

#### 403.2.07 Polyvinyl Chloride (PVC) Pipe

PVC sewer pipe shall conform to ASTM D 3034, or ASTM C 900. The pipe shall have a minimum wall stiffness of 46 psi or an Standard Dimension Ratio of 35 or less. PVC shall be used for sanitary sewers 30" and smaller.

#### 403.2.08 Preformed Elastomeric Joint Seals

Preformed elastomeric joint seals, compression joint seals, and strip joint seals shall conform to the requirements of AASHTO M 220 (ASTM D 2628).

#### 403.2.09 Service Connection Markers

The Contractor shall use new 2" x 4" utility grade or better lumber in one piece. No splicing will be permitted.

#### 403.2.10 Jointing Materials

Only lubricants for jointing materials approved by the manufacturer shall be used as approved by the Engineer.

#### 403.2.10A Concrete Pipe

Rubber gaskets for bell and spigot pipe shall conform to ASTM C 443. Captive gasket in groove design shall be used for pipe 24 inch diameter and larger.

#### 403.2.10B Cast Iron and Ductile Iron Pipe

Rubber gaskets shall conform to ANSI A21.11.

#### 403.2.10C ABS Pipe

Solvent and cement or gasket shall be used as specified in ASTM D 2680 and ASTM D 2751.

#### 403.2.10D PVC Pipe

Rubber gaskets for PVC pipe shall conform to ASTM F 1869.

#### 403.2.11 Pipe Bedding and Pipe Zone Material

##### 403.2.11A Bedding

Unless otherwise specified, the bedding material for all rigid pipe and conduit installations shall be classified as Class 'A' or Class 'B'.

Class 'A' bedding material shall be Class 2500-3/4 Portland cement concrete meeting all the requirements of Section 311 CONCRETE STRUCTURES.

Class 'B' and Class C bedding shall be 3/4"-0 crushed rock or stone meeting all the requirements of Section 305 AGGREGATE BASES. Concrete sand meeting the requirements of Subsection 311.2.02B COURSE AGGREGATE may be substituted for crushed rock when approved by the Engineer.

##### 403.2.11B Pipe Zone Material

Pipe zone materials shall be 3/8" round pea rock, 3/4"-0 crushed rock or blended sand meeting the requirements of Section 305 AGGREGATE BASES, unless otherwise specified in the contract documents.

#### 403.2.12 Proof Tests

##### 403.2.12A General

The intent of this requirement is to prequalify a joint system, components of which meet the joint requirements, as to the watertightness capability of that joint system. This proof test shall be understood to apply to all sanitary sewers and to storm drains which are to be tested for watertightness prior to acceptance.

Material and test equipment for proof testing shall be provided by the manufacturer. Joints shall meet the requirements of yard testing specified below. The pipe manufacturer shall submit results of the yard tests made, certified by a testing agency approved by the Engineer. When approved, internal hydrostatic pressure may be applied by a suitable joint tester. In general, each pipe material and joint assembly shall be subject to the following three proof tests at the discretion of the Engineer:

1. Pipe in Straight Alignment. No less than three nor more than five pipes selected from stock by the Engineer shall be assembled according to the manufacturer's installation instructions with the ends suitably plugged and restrained against internal pressure. The pipe shall be subjected to 10 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall shall be grounds for rejection of the pipe.
2. Pipe in Maximum Deflected Position. A test section shall be deflected as described hereinafter for each pipe material. The pipe shall be subjected to 10 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall shall be grounds for rejection of the pipe.
3. Joints Under Differential Load. The test section shall be supported on blocks or otherwise as described hereinafter for each pipe material. There shall be no visible leakage when the stressed joint is subjected to 10 psi internal hydrostatic pressure for 10 minutes.

##### 403.2.12B Concrete Pipe

For deflected position, the Contractor shall create a position 1/2 inch wider than the fully compressed position, on one side of the outside perimeter.

For differential load, one pipe shall be suspended freely between adjacent pipe bearing only on the joints. In addition to the weight of the suspended pipe, a test load as given in

the following table shall be added:

TEST LOADS FOR CONCRETE PIPES UNDER DIFFERENTIAL LOAD

Pipe Size	Load Per Foot Laying	
	Length Up to 4 Feet	Total Load For Pipe 4 Feet and Over
4 inches	650	2,600
6 inches	1,000	4,000
8 inches	1,300	5,200
10 inches	1,400	5,600
12 inches	1,500	6,000
15 inches	1,850	7,400
18 inches	2,200	8,800
21 inches	2,500	10,000
24 inches or over	2,750	11,000

403.2.12C Cast Iron Pipe and Ductile Iron Pipe

For deflected position, a position 1/2 inch wider than the fully compressed section will be created on one side of the outside perimeter.

For differential load, one of the pipes will be suspended freely between adjacent pipe, bearing only on the joints. A force per the following table will be applied along a longitudinal distance of 12 inches, immediately adjacent to one of the joints.

Pipe Size	Force Pounds	Pipe Size	Force Pounds
4 inches	600	15 inches	3,700
6 inches	900	18 inches	4,400
8 inches	1,200	21 inches	5,000
10 inches	1,500	24 inches	5,500
12 inches	1,800	and over	

403.2.12D A.B.S.

For deflected position, two 12-1/2 foot lengths will be joined and deflected along an arc of 720 feet radius (0.11 feet offset at the end of each length, from a tangent at the joint).

For differential load, one of the pipes will be suspended freely between adjacent pipe, bearing only on the joints. A force of 150 pounds per inch diameter will be applied over an arc of not less than 120 degrees and along a longitudinal distance of 12 inches immediately adjacent to one of the joints. Only solid wall plastic pipe will be allowed.

#### 403.2.12E PVC Pipe

For deflected position, two 12-1/2 foot lengths will be joined and then deflected along an arc of 720 feet radius (0.11 feet offset at the end of each length from a tangent at the joint).

For differential load, two lengths will be joined and uniformly supported for at least 2 feet on both sides of the joint with vertical load applied sufficient to deflect the joint and adjacent pipe to 95 percent of its initial vertical diameter. Only solid wall plastic pipe will be allowed.

#### 403.2.13 Fittings

#### 403.2.13A General

The Contractor shall provide tee or wye fittings in the sewer main for service line sewers. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. All fittings shall be of the same materials as the pipe unless otherwise specified. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface. New tees or wyes shall be installed during mainline construction.

#### 403.2.13B Concrete Pipe

All fittings used on concrete pipe shall be manufactured fittings.

The Contractor shall submit and obtain approval of fabrication details for shop fabricated fittings prior to delivery of fittings to the job-site.

#### 403.2.13C Cast Iron and Ductile Pipe

Mechanical joint cast iron fittings shall conform to ANSI A21.10 and AWWA C 110, and of a class at least equal to that of the adjacent pipe. Push-on fittings of gray iron with body thickness and radii of curvature shall conform to ANSI A21.10 and joints shall conform to ANSI A21.11 and AWWA C 111 or Federal Specification WW-P-421C.

#### 403.2.13D PVC Pipe

Push-on type fittings for joints shall conform to ASTM D 3034 elastomeric seals conforming to ASTM F 477-76.

#### 403.2.13E ABS Plastic Pipe

Fittings shall conform to ASTM D 2751 or D 2680 elastomeric seals conforming to ASTM F 477-76.

#### 403.2.14 Manholes

##### 403.2.14A Standard Precast Manhole Sections

Contractor shall furnish sections as specified to the details on the Standard Drawings and to ASTM C 478. Cones shall have same wall thickness and reinforcement as manhole section. Top and bottom of all sections shall be parallel.

Prior to the delivery of any size of precast manhole section on the job-site, yard permeability tests will be conducted at the point of manufacture. The precast sections to

be tested will be selected at random from the stockpiled material which is to be supplied for the job. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 14 and ASTM C 497.

#### 403.2.14B Precast Concrete Bases

Precast base sections may be used provided all details of construction are approved prior to construction. Base sections shall have the base slab integral with sidewalls. Base slab shall be 6 inches thick with No. 4 reinforcing bars 8 inch centers both directions in center of slab. Reinforcing steel will be tied to wall.

#### 403.2.14C Manhole Grade Rings

Concrete grade rings for extensions shall be a maximum of 6 inches high and shall be approved before installation.

#### 403.2.14D Jointing Materials

Pre-formed elastomeric joint seals conforming to the requirements of AASHTO M 220 (ASTM D 2628), and other types of jointing materials approved by Engineer, shall be used.

#### 403.2.14E PVC Manholes

Shall only be used when approved by Engineer.

#### 403.2.15 Manhole Frames and Covers

##### 403.2.15A General

All castings shall be true to size and tolerances shown on the Standard Drawings. Delivered weight shall be  $\pm 5$  percent of specified weight. The bearing seat shall not rock when checked by the test jig. The foundry shall supply all test gauges and shall not subcontract any of the work other than testing procedure, patterns, machining and cartage. The casting shall not be made by the open mold method and shall be free of porosity, shrink cavities, cold shuts or cracks, or any defects which would impair serviceability. Repair of defects by welding, or by the use of 'smooth-on' or similar material will not be permitted. All castings shall be shot or sandblasted and the application of paint or other coating will not be permitted. All sanitary manhole covers shall be fabricated with regularly spaced vent holes unless 'water tight' covers are specified.

##### 403.2.15B Cast Iron Frames and Covers

Secured manhole covers shall be as approved by the Engineer.

Manholes that are located so as to fall within sidewalks, pathways, or crosswalks shall be installed with locking frames and lids as shown on the Standard Drawing.

#### 403.2.15C Aluminum Frames and Covers

Aluminum manhole frames and covers meeting Federal Highway Administration Standards RRF-621B with H-20 loading may be allowed when approved by the Engineer.

Only those types of aluminum covers fabricated with locking devices shall be considered suitable for use when specified.

### 403.3.00 CONSTRUCTION

#### 403.3.01 Line and Grade for Gravity and Pressure Sewers

Line and grade as established by the Engineer shall not be deviated from more than 1/2 inch for line and 1/4 inch for grade, provided that such variation does not result in a level or reverse sloping invert. Measurement for grade shall be at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness. Contractor shall establish line and grade for pipe by the use of approved lasers or by transferring the cut from the offset stakes to batter boards at maximum intervals of 25 feet. If batter boards prove impractical because of trench conditions, other methods of grade and alignment control shall be submitted for approval.

The Engineer will drive a stake into the ground at the pre-selected location for the service line. The end of the service line sewer shall have a minimum of 3.5 feet of cover at the property line, but in no case shall the depth of cover exceed 6 feet.

The service line will be laid on a straight line and at a uniform grade between the tee and the stake. Minimum slope shall be 1/4 inch per foot unless otherwise permitted by the Engineer, but in no case less than 1/8 inch per foot.

#### 403.3.02 Excavation

All aspects of trench excavation for the installation of sanitary sewers and appurtenances shall be in accordance with Section 401 TRENCHING, unless otherwise directed by the Engineer.

#### 403.3.03 Pipe Distribution and Handling

Material shall be distributed on the job no faster than it can be used to good advantage. Pipe will be unloaded only by approved means. Contractor shall not unload pipe of any size by dropping to the ground. More than one week's supply of material shall not be distributed in advance of laying, unless approved.

All pipe and fittings will be inspected prior to lowering into trench to ensure no cracked,

broken, or otherwise defective materials are used. Ends of pipe shall be thoroughly cleaned. Foreign matter and dirt will be removed from inside of pipe and pipe shall be kept clear during and after laying.

Contractor shall use approved implements, tools, and facilities for the safe and proper protection of the work. Pipe will be lowered into the trench in such a manner as to avoid any physical damage to the pipe. All damaged pipe will be removed from the job site. Contractor shall not drop or dump pipe into trenches.

#### 403.3.04 Pipe Bedding and Pipe Zone

##### 403.3.04A Rigid Pipe and Conduit

Bedding for rigid pipe and conduit shall be in conformance with section 403.2.11 Pipe Bedding and Pipe Zone Material. Unless otherwise approved, all bedding material will be 3/4"-0 crushed stone. The Engineer shall have the authority to change bedding classifications and limits thereof, as necessary.

Class A bedding consists of a pipe cradle of Portland cement concrete as specified on the appropriate Standard Drawing. Bottom of trench shall be fully compacted before placement of pipe or cradle. Concrete will be placed in such a manner that no dirt or foreign material becomes mixed with the concrete. Concrete will be allowed sufficient time to reach initial set before any additional backfill material is placed in the trench.

Class B bedding consists of leveling the bottom of trench or top of foundation material and placing bedding material to the horizontal centerline (springline) of pipe. Bedding material shall be as specified herein-before and as shown on the appropriate Standard Drawing. Bedding shall be placed in at least two lifts. First lift will be placed to provide minimum depth of bedding material shown on the appropriate Standard Drawing before pipe is installed. The bedding material will be spread smoothly to proper grade so that pipe is uniformly supported along the barrel. Bell holes will be excavated at each joint to permit proper assembly and inspection of the entire joint. Bedding under pipe shall provide a firm, unyielding support along entire pipe length. Subsequent lifts of not more than 6 inch thickness will be placed up to the horizontal centerline of the pipe. Lifts will be brought up together on both sides of pipe and carefully worked under pipe haunches by slicing with a shovel, vibration, or other approved procedure.

Class C bedding shall conform to requirements for Class B bedding except that bedding material shall be placed only to approximately the lower quadrant of pipe as shown on the appropriate Standard Drawing.

Class B and C bedding shall be considered to include full width of excavated trench from the bottom of trench or top of foundation stabilization material to the top of bedding.

Particular attention must be given to the area from the flow line to horizontal centerline of pipe or top of bedding to ensure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of pipe zone.

#### 403.3.04B Bedding for A.B.S. and P.V.C. Plastic Pipe

Material for bedding flexible conduits of A.B.S. or P.V.C. plastic shall be or 3/4"-0 crushed rock. Bedding shall be placed in more than one lift. First lift shall provide a minimum of 4 inch thickness under any portion of the pipe and be placed before pipe is installed. It will be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts of not more than 6 inch thickness will be installed to the bottom of pipe zone individually compacted to either 90 percent density, as determined by AASHTO T-180 when cohesive material is specified, or 85 percent relative maximum density as determined by ASTM D 3049 when noncohesive material is specified.

#### 403.3.04C Pipe Zone Materials

Pipe zone material shall be either 3/8" round rock (pea rock), 3/4"-0 crushed rock, or blended sand as specified in Subsection 403.2.11B Pipe Zone Material or as approved by the Engineer. Native materials shall not be allowed within the pipe zone areas. Specified pipe zone material will be carefully placed around the pipe in 6 inch layers and thoroughly hand tamped. Pipe will be prevented from movement either horizontally or vertically during placement and compaction of pipe zone material.

#### 403.3.05 Pipe Laying and Jointing of Pipe and Fittings

##### 403.3.05A General

Pipe will be laid upgrade with spigot or tongue ends pointing in direction of flow. Pipe will be placed in such a manner as to ensure solid bearing between the pipe and the full cross-sectional area of the bedding for the full length of the pipe including the joints. Assembly of the joint will be made in accordance with the recommendations of the manufacturer. Contractor shall take care to properly align the pipe before joints are forced entirely home. Upon completion of pipe laying, all pipe joints shall be in the 'home' position, which is defined as the position where the least gap (if any) exists, when the pipe components that comprise the joint are fitted together as tightly as the approved joint design will permit. Joints with gaps exceeding the normal gap in the 'home' position shall be repaired as directed by Engineer at no cost to Owner if in his judgement these gaps detract significantly from the integrity of the joint, based on soil conditions and the intended use of the pipe line. For curved sewers the normal gap will be the gap existing when the pipe joints are in the 'home' position as described above, for the pipe in the specified deflected position. After installation, movement from any cause including uplift or floating will be prevented.

Special care will be taken to prevent movement of the pipe after installation when laid within a movable trench shield.

When laying operations are not in progress, the open end of the pipe will be protected from entry of foreign material and the pipe blocked to prevent movement or creep of gasketed joints.

Pipes which are stubbed out for manhole construction or for connection by others shall be plugged with gasketed mechanical plugs or non-shrink seals as directed by the Engineer.

All sewer pipes, 24 inches or smaller in diameter, entering or leaving manholes or other structures, shall have a flexible joints within 12 inches of the exterior wall.

When cutting and/or machining the pipe is necessary, only tools and methods recommended by pipe manufacturer may be used.

When shown or approved to deflect pipe from a straight line, either in the vertical or horizontal plane, or when long-radius curves are shown, the amount of deflection allowed shall not exceed that specified or approved by the Engineer. The pipe manufacturer's recommendations will serve as a guide, but the decision of the Engineer shall be final.

#### 403.3.05B Concrete Pipe

Rubber ring gasket joints will be used.

#### 403.3.06 Installation of Service Line Sewers, Tees and Wyes

Tee and wye fittings and service line sewers will be installed as shown on the Standard Drawings. A compacted crushed aggregate base of pipe bedding material will be provided under all tees and wyes and branch fittings, extending to the springline of the fittings. Bases will be placed on undisturbed native material or compacted foundation stabilization material.

Maximum deflection permissible with any one manufactured fitting shall not exceed 45 degrees.

Service lines will extend to back of P.U.E. as shown on the Standard Drawings.

Service lines will be connected to manholes only when directed.

Ends of all service lines and fittings will be provided with approved watertight plugs, caps, or stopper, suitably braced to prevent blowoff during internal hydrostatic or air testing. Such plugs or caps shall be removable and their removal shall provide a socket

suitable for making a flexible joint lateral connection or extension.

#### 403.3.07 Markers

When the service line pipe is installed the capped or plugged end will be blocked and marker installed. Markers will be extended at least 12 inches above the ground surface. The top portion of the marker will be painted after its installation with first-quality green, quick-drying paint. After the paint has dried, black, quick-drying enamel will be used to neatly indicate the distance from the natural ground surface to the top of the service line pipe in feet and inches.

Precautions will be taken during the backfilling operation to ensure the position and location of the marker. If the marker is broken or knocked out of vertical alignment during the backfilling operation, Contractor shall reopen the trench and replace the marker. Where sanitary service lines are installed in conjunction with storm sewer lines (lot drains, etc.) the sanitary service line shall be marked with a continuous locator tape of a type approved by the Engineer. The locator tape shall be installed so that no connection can be made to the sanitary sewer without having to remove the tape.

#### 403.3.08 Concrete Closure Collars

Concrete closure collars will be used only when specified or approved. Concrete closure collars shall not be used with PVC or ABS pipe. They shall be constructed in conformance with the details provided. Pipe will be washed to remove all loose material and soil from the surface on which the concrete will be placed. Nonmetallic pipe shall be thoroughly wet prior to pouring the collars. Forms will be constructed with materials that will ensure that no concrete shall enter the line. Entire collar will be made in one pour, and collars will not be poured in water. After the collars are poured and have taken their initial set, they will be cured by covering with well-moistened earth. The trench will not be backfilled until the concrete has sufficient strength, as determined by the Engineer.

#### 403.3.09 Deep Connector Risers

Where the slope of the service line between the curb and the wye or tee on the sewer is greater than forty-five degrees, a deep connection riser will be constructed in conformance with the details shown on the Standard Drawing. The concrete foundation for supporting deep connection risers shall bear upon firm native ground. The Contractor shall avoid any concentrated load on the main sewer pipe.

Vertical pipe connections will be backfilled by compacting approved materials in six (6) inch layers with mechanical tampers.

#### 403.3.10 Disconnection and Reconnection of Existing Service Lines

Existing live service lines or lines for future use will be disconnected from existing sewers and reconnected to the new sewers. The Contractor will be responsible for locating the existing service lines prior to installing the tee or wye in the new sewer line.

#### 403.3.11 Field-Fabricated Connections

Field fabricated tees and wyes shall be of the "Fowler" or "Inserta Tee" type unless otherwise approved by the Engineer. Only those connections which are made by mechanically coring a receiver hole in the carrier pipe and to which a rubber gasketed fitting shall be inserted and properly affixed will be acceptable.

Other fabrication details may be allowed by submitting details for and obtaining approval prior to fabrication. On plastic pipe the diameter of the core drill for field fabricated tees or wyes will be no greater than 1/2 the diameter of the mainline. If this can not be attained a portion of the mainline will be removed and a manufactured tee installed.

#### 403.3.12 Manholes

##### 403.3.12A General

Manholes will be constructed as shown on the Standard Drawings. The concrete base will be densified by vibrating or working as approved and screeded to provide a level, uniform bearing for precast sections or formed wall extensions.

Sufficient preformed elastomeric joint seal will be deposited on base to assure watertight seal between base and manhole wall, or the first precast section of manhole will be placed in concrete base before concrete has set, if preferred. First section shall be properly located and plumb.

When placing precast manhole sections, ends of sections shall be cleaned of foreign material and the joint thoroughly wet with water prior to placing mortar. Mortar will be placed on groove of lower section. The next section will be set in-place. Joint will be completely filled with mortar of the proper consistency. Interior and exterior surfaces will be trowelled smooth on standard tongue and groove joints. Excess shall be wiped or otherwise cleaned from the inside of the keylock joint.

When the keylock joint is used, it is the intent that the void between the tongue and groove be completely filled with mortar and that the interior and exterior end faces of the section to be placed seat fully on the previously placed section.

Mortar will be prevented from drying out and it will be cured by applying an approved curing compound or comparable approved method. All cracked or defective mortar shall be chipped out and replaced. Preformed elastomeric joint seal meeting AASHTO M 220

(ASTM D 2628) may be used in lieu of mortar type joints. Preformed plastic gaskets shall be installed in strict accordance with the manufacturer's recommendations. Only pipe primer furnished by the gasket manufacturer will be approved. When using preformed plastic gaskets, manhole sections with chips or cracks in the jointing surfaces shall not be used. Completed manholes shall be rigid and all manholes for sanitary sewer shall pass the hydrostatic or vacuum test. Manhole inverts will be constructed in conformance with the Standard Drawings with smooth transitions to ensure an unobstructed flow through manhole. Where a full section of pipe is laid through a manhole, the top section will be cut out and the exposed edge of pipe covered completely with mortar. All mortar surfaces will be trowelled smooth.

#### 403.3.12B Standard Monolithic Manholes

Standard monolithic manholes shall conform to details on the Standard Drawings.

#### 403.3.12C Monolithic Concrete Construction

Monolithic concrete construction shall conform to details shown on the Standard Drawings and with applicable provisions herein.

All water shall be removed and kept clear from the excavation. Forms will be constructed to the dimensions and elevations required. Forms shall be tight and well-braced. All water and foreign material will be removed from the forms prior to placing the concrete. Forms shall be moistened just prior to placement. Barspllices shall be 24 diameters, but in no case less than 12 inches. All splices and intersections shall be wire-tied. Approval of the Engineer shall be obtained prior to placing any concrete. Concrete will be placed so that there is no segregation of the aggregate, and concrete will be vibrated or worked as approved to prevent rock pockets. Concrete shall not be placed when the ambient temperature is below 35 degrees F with special protection as approved. The top surface of the exposed slabs shall be screeded and troweled to a smooth finish free from marks or irregularities. Exposed edges will be finished with a steel edging tool. Concrete will be cured for 7 days in an approved manner. After removal of the forms, all rock pockets, form tie holes, and irregularities will be patched with a stiff mixture of Portland cement and sand mixed in the same proportion as the original mix. Exposed walls will be finished to produce a uniform, flat surface. Concrete will be protected from damage during the 7 day curing period.

#### 403.3.12D Drop Assemblies

Drop assemblies will be constructed at locations indicated and as shown on the Standard Drawing 4-4.

#### 403.3.13 Pipe Stubouts from Manholes

Stubouts from manholes will be installed as shown or directed. Pipe shall be grouted in precast walls or manhole base to provide watertight seal around pipes or use flexible

connectors such as "KOR-N-SEAL" or "A-LOK".

#### 403.3.14 Manhole Grade Rings

Grade rings will be installed as shown on Standard Drawings to the height directed. Grade rings will be laid in mortar with sides plumb and tops level. Joints shall be sealed with mortar as specified for manhole sections. Extensions shall be watertight.

In general, manhole grade rings will be used on all manholes in streets or roads or in other locations where a subsequent change in existing grade may be likely. Extensions will be limited to a maximum of 12 inches within a paved street area and 18 inches within an unpaved area. Finish grade for manhole covers shall conform to finished ground or street surface, unless otherwise directed.

#### 403.3.15 Manhole Frame and Covers

Frames will be set in a bed of mortar with the mortar carried over the flange of the frame as shown on the Standard Drawings. Frames will be set so tops of covers are flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.

#### 403.3.16 Concrete Encasement and Sewer Pipe

Concrete encasement for sewer pipe shall conform to the requirements shown on the Standard Drawings. Foundation stabilization, if required, shall be completed and the bottom of the trench compacted, as approved. Sides of encasement shall be formed, not poured against soil or rock, unless directed or approved by Engineer.

Pipe will be supported true to line and grade as approved before and during placement of concrete. Encasement must be placed in a single lift unless otherwise approved. If placement of the concrete in two lifts is approved, a keyway will be provided on both sides of the encased pipe. Vertical reinforcing steel shall be placed as shown or as directed. Concrete shall be placed starting at the lower end of the encasement.

After concrete encasement has been placed and taken an initial set, it will be cured by covering with well-moistened earth or backfill material for 5 days before conducting hydrostatic or air tests.

#### 403.3.17 Anchor Walls

Anchor walls shall conform to details shown on the Standard Drawings. Over-excavation will not be permitted in the areas where anchor walls are to be poured. Suitable forms that will allow the downhill wall to have a full bearing surface against undisturbed earth will be constructed. Concrete will be cured for 5 days before conducting hydrostatic or air tests.

#### 403.3.18 Cleanouts

Cleanouts shall be constructed at the locations shown on the contract documents or where indicated by the Engineer and shall conform to the Standard Drawings for cleanout construction. All cleanouts at the end of service laterals or at the terminus of a sanitary sewer main shall be fabricated of rigid pipe materials and fittings. The steel casing frame and lid shall be as specified on the Standard Drawing or as approved by the Engineer.

#### 403.3.19 Backfill

Backfill materials shall be as specified by the contract documents. All backfill materials and placement shall be in accordance with Section 405 BACKFILL: NATIVE AND IMPORTED.

#### 403.3.20 Testing Sanitary Sewers

##### 403.3.20A General

All gravity sanitary sewer lines, including service line laterals and appurtenances, shall successfully pass a hydrostatic or air test prior to acceptance and shall be free of visible leakage.

##### 403.3.20B Water and Equipment for Test

Contractor shall make all arrangements for furnishing water for testing purposes. Contractor shall perform the tests and provide personnel, hoses, tank trucks, plugs, and other necessary equipment to complete the tests at no cost to Owner. The method, equipment and personnel shall be subject to approval by Engineer.

##### 403.3.20C Cleaning Prior to Testing and Acceptance

Prior to final testing acceptance and final manhole-to-manhole inspection of the sewer system by the Engineer, all parts of the system will be cleaned and flushed. All accumulated construction debris, rocks, gravel, sand, silt and other foreign material will be removed from the sewer system at or near the closest downstream manhole. If necessary, mechanical rodding or bucket cleaning equipment will be used.

Upon the Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, Contractor shall reflush and clean the sections and portions of the lines as required.

##### 403.3.20D Testing Procedure

The tests shall be performed in a manner satisfactory to the Engineer. Any arrangement

of testing equipment which will provide observable and accurate measurements of either air or water leakage under the specified conditions will be permitted.

#### 403.3.20E Time of Test

Contractor shall make tests of sections of constructed sanitary sewer for acceptance only after all service connections, manholes, backfilling and compaction are completed between the stations to be tested. Owner may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of sections of sewer and allow connections prior to the whole system being completed.

#### 403.3.20F Repairs

Contractor shall repair or replace, in a manner approved by the Engineer, any section of pipe not meeting the air or hydrostatic test requirements, or which has visible leakage.

Infiltration of ground water following a successful hydrostatic or air test as specified, shall be considered as evidence that the original test was in error or that subsequent failure of the pipeline has occurred. Such failures occurring within the warranty period shall be corrected in a manner approved by the Engineer at no expense to the Owner.

Contractor, in contracting to do this work, agrees that the leakage allowances, as indicated herein, are fair and practical.

#### 403.3.20G Hydrostatic Testing Requirements

Pipe and joints shall sustain a maximum of 0.04 gallons per hour (GPH) per inch diameter per 100 feet when field tested by either infiltration or exfiltration methods. The hydrostatic head for test purposes shall exceed the maximum estimated ground water level in the section being tested by at least 72 inches and in no case shall be less than 72 inches above the inside top of the highest section of pipe in the test section, including service connections. In every case, the height of water table at the time of the test will be determined by exploratory holes or such other methods approved by the Engineer. The Engineer shall make the final decisions regarding test height for the water in the pipe section being tested. The length of pipe tested by exfiltration shall be limited so that the pressure on the invert of the lower end of the section shall not exceed 16 feet of water column.

An allowance of 0.2 GPH per foot of head above the manhole invert shall be made for each manhole included in a test section. If the test produces more than the allowable leakage, manholes and sewer lines will be tested separately.

All service connection footage included in the test section and subjected to the minimum

head specified shall be taken into account in computing allowable leakage.

The pipe test section may be filled 24 hours prior to the time of exfiltration testing to permit normal absorption into the pipe wall to take place.

Air test will be used when the elevations of various sections of the sewer between manholes is such that the above criteria cannot be met.

#### 403.3.20H Vacuum Testing of Manholes

Vacuum tests will be conducted in accordance with latest applicable standards, such as established procedures based on ASTM C1244-93 starting at 10" Hg of vacuum.

All adjacent surface restoration will be completed before conducting a sanitary manhole acceptance test, including finish paving and final adjustment to grade.

### 403.3.20I Hydrostatic Testing of Manholes

The test shall consist of plugging all inlets and outlets and filling the manhole to the rim with water. Leakage in each manhole shall not exceed 0.2 gallon per hour per foot of head above the invert. Duration of the testing shall be 30 minutes unless otherwise directed by Engineer. A manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into the manhole walls to take place. All manholes that do not meet the leakage test, or are unsatisfactory from visual inspection, shall be required to conform.

### 403.3.20J Air Testing

#### General

Engineer may, at any time, require a calibration check of the instrumentation used. A pressure gauge having minimum divisions of 0.10 psi and an occurrence of 0.0625 psi (one ounce per square inch) shall be used. All air used shall pass through a single control panel.

All plugs used to close the sewer for the air test must be capable of resisting the internal pressures and must be securely braced. All air testing equipment will be placed above ground and no one allowed to enter a manhole or trench where a plugged sewer is under pressure. All pressure will be released before the plugs are removed. Care will be used to avoid the flooding of the air inlet by infiltrated ground water. The air will be injected at the upper plug if possible. Only qualified personnel shall be used to conduct the test.

#### Ground Water

The presence of ground water will affect the results of the tests. The average height of ground water over the sewer will be determined immediately before starting the test; the method of checking the ground water height shall be as approved.

#### Method

The Time-Pressure Drop Material shall be used for all air testing. The test procedures are described as follows:

1. Clean the sewer to be tested and remove all debris where noted.
2. Wet the sewer prior to testing, if desirable.
3. Plug all sewer outlets with suitable test plugs. Brace plug securely.
4. Check the average height of the ground water over the sewer. The test pressures

required below shall be increased 0.433 psi for each foot of average water depth over the sewer.

5. Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psi greater than the average back pressure of any ground water that may submerge the pipe.
6. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.
7. After the temperature stabilization period, disconnect the air supply.
8. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psi to 2.5 psi greater than the average back pressure of any ground water that may submerge the pipe.
9. Compare the time recorded in step 8 with the time required as determined hereinafter.

Acceptance

The sewer shall be considered acceptable when tested as described hereinbefore if the section under test does not lose air at a rate greater than (1) 0.003 cfm per square foot of internal sewer surface, or (2) 2 cfm, whichever is greater.

If the sewer fails to meet these requirements, the reason for leakage will be determined and all defective materials or workmanship will be replaced, all at no expense to Owner. The completed sewer shall meet the requirements of this test before being considered acceptable.

This specification shall also be considered as satisfied if the time as measured by the preceding described method is not less than the time as computed according to the following procedure:

1. Record the diameter in inches and the length in feet of all pipe in the section to be tested, including the house branches, in a table similar to the one shown below:

Diameter	Length	K=	C=
Inches	Feet	0.011d <sup>2</sup> L	0.0003882dL
Total			

Time required by Specification = Seconds.

Actual time as determined by test = Seconds.

2. Using the nomograph supplied by Engineer, place a straight edge from the 'D' column (diameter in inches) to the 'L' column (length in feet). Read the corresponding 'K' and 'C' values and record them in the table.
3. Add all values of 'K' and all values of 'C' for the section being tested.
4. If the total of all the 'C' values is less than one, the time required by the specifications shall be the total of the 'K' values.
5. If the total of all the 'C' values is more than one, the time required by the specifications shall be found by dividing the total of all the 'K' values by the totals of all the 'C' values. The quotient is the time that is required by the Specifications. To make this division with the nomograph, use the scales 'C' and 'K' and read the quotient (time) from the 'tq' scale.
6. In the event that the 'D' and 'L' values for a particular section of sewer do not fall within the limits of the nomograph, the values of 'K' and 'C' may be computed from the following equations:  $K = 0.011d^2L$ ;  $C = 0.0003882dL$ . Use tables and nomographs supplied by Engineer.

#### 403.3.20K Testing Pressure Lines (Sanitary)

Pressure lines shall be filled with water and allowed to stand under a light pressure for 24 hours. The pressure shall then be raised to 100 percent of the designed working pressure as called for in the Special Provisions, and that pressure maintained for 5 hours. No leakage will be allowed in pressurized sewer lines.

#### 403.3.20L Deflection Test for PVC and ABS Pipe

In addition to hydrostatic or air testing, a deflection test shall be performed on all sanitary sewers constructed of PVC or ABS pipe at the time of t.v. testing. The test shall be conducted by pulling an approved solid pointed mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the pipe diameter unless otherwise specified by Engineer. Testing will be conducted on a manhole-to-manhole basis and only after the line has been completely flushed out with water. Any sections failing to pass the test will be located, repaired and retested, at no expense to Owner.

#### 403.3.20M Television Inspection of Sewers

Upon completion of all sewer construction, sewer repairs, required tests, final compaction testing of base rock, and prior to any finish surfacing or paving being done, Contractor

will make a full t.v. inspection of all installed lines. This inspection shall be conducted by an approved technical service which is equipped to make a color audio-visual tape recording of the conducted televised inspection. The audio-visual recording shall be compatible for replay on existing City of Springfield viewing equipment. The replay of the recorded video information, when reviewed on a monitor receiver, shall be free of electrical interference and provide a clear, stable image.

A written record shall also be made at the time of the television inspection. The written report will include a sketch with manhole numbers, flow direction, street names, tee locations, and any defects. This written report shall be made on the 'Television Report Form' supplied by the City of Springfield. A supply of this form and instructions shall be obtained from the Engineer.

The technician will insure that a clear and usable record shall be made of all possible defects and that the recording equipment is functioning properly. The equipment used for recording shall be equipped with a footage meter for visual record on the tape. A voice accounting of suspected deficiencies shall be made on the sound track.

The color video tape recording and the written report shall be submitted to the Engineer for his examination. Contractor will correct all deficiencies revealed by televiewing and will notify the Engineer that the work required has been done.

The contractor shall locate and repair any sections failing to pass the required tests and inspections and shall then repeat the specified tests and inspections on those sections at no expense to the owner.

#### 403.4.00 MEASUREMENT AND PAYMENT

##### 403.4.01 Sewer Pipe

Measurement and payment for sanitary sewer pipe in place, including pressure line sewers and pipe stubouts from manholes, shall be made on a linear foot basis for the sizes of pipe listed in the contract documents. All pipe, except service line pipe, will be measured horizontally from center-to-center of manholes or to the ends of the pipe, whichever is applicable. No deductions will be made for fittings or for structures.

Measurement and payment for service line pipe will be made on a linear foot basis for the size of pipe installed as shown in the contract documents. Length will be measured as total length of pipe installed, commencing at the point of connection to the tee, wye, manhole or pipe, as applicable, and terminating at the end of the pipe bell, including all fittings measured along the pipe centerline.

Payment shall constitute full compensation for the pipe in-place, including testing, plugs

and the markers for service line pipe.

Measurement and payment for disconnecting and reconnecting existing service lines will be made on the same basis as payment for service line pipe, and the footage required will be included in the total footage for service line pipe as shown in the contract documents.

Payment for new tees, wyes or field taps, permanent seals, and concrete closure collars, if required, will be made separately under the respective items shown in the contract documents.

#### 403.4.02 Tee and Wye Fittings

Measurement and payment for service tees and wyes installed in the sewer lines will be made at the unit price for each size as shown in the contract documents and actually installed. Since no deduction will be made under the payment item for pipe for the length of the tee or wye, the unit price for tee and wye fittings shall include only the additional cost of furnishing and installing the tee or wye fitting, over the cost of furnishing and installing an equivalent straight run of pipe. Payment will include full compensation for pipe plugs, stoppers or caps installed.

#### 403.4.03 Concrete Closure Collars

Payment for concrete closure collars shall be considered incidental to the cost of pipe in-place, unless otherwise specified.

#### 403.4.04 Deep Connection Risers

Measurement and payment for deep connection risers will be made on a linear foot basis. Measurement will be made from the bottom of the concrete foundation to the top of the highest pipe of the deep connection riser which is encased or partially encased in concrete. Payment shall include full compensation for the encased pipe including all fittings complete in-place.

#### 403.4.05 Field-Fabricated Connections

Measurement and payment for field fabricated connections will be made at the unit price each for the type and size as shown in the contract documents. Payment shall include full compensation for all materials, equipment and labor necessary to complete the work.

#### 403.4.06 Manholes

Measurement and payment for manholes, including standard precast concrete or monolithic concrete manholes, will be made on a unit price basis for each type shown in

the contract documents for manholes 8 feet deep, plus the unit price per foot shown in the contract documents for extra depth of manholes over 8 feet. No deduction will be made for depths less than 8 feet. Measurement of manhole depth will be from the top of the manhole frame and cover to the manhole invert at the center of the manhole to the nearest one-tenth of a foot. Payment shall include full compensation for excavation, foundation stabilization and/or base rock when required, backfill and constructing the manhole complete in-place.

#### 403.4.07 Drop Assemblies

Measurement and payment for drop assemblies, regardless of size, will be made on a unit price basis for drop assemblies 0-8 feet in depth, plus the unit price per foot shown in the contract documents for extra depth over 8 feet. No deduction will be made for depths less than 8 feet. Drop assemblies will be vertically measured from the invert of the pipe at the top of the assembly to the invert of the pipe into the manhole base at the bottom of the assembly to the nearest one-tenth of a foot. Payment shall include full compensation for all materials, labor and equipment required to construct the work complete in-place.

#### 403.4.08 Tamperproof and Watertight Manhole Frame and Covers

Measurement and payment for tamperproof and watertight manhole frame and covers will be made on a unit price basis for each type installed. Since payment for furnishing and installing standard frame and covers is already included in the bid price for manholes, this unit price will include only the additional compensation for providing the watertight or tamperproof frame and cover complete in place.

#### 403.4.09 Cleanouts

Measurement and payment for cleanouts shall be on a unit price basis for each size and type as shown in the contract documents, measured from the laying flowline to the surface of the finish grade. Payment shall include full compensation for all materials, labor and equipment required to install the completed cleanout, all to the satisfaction of Engineer.

#### 403.4.10 Concrete Encasement

Measurement and payment for concrete encasement will be made on a linear foot basis as shown in the contract documents for the size pipe to be encased. Length shall be measured along the centerline of the pipe and shall be the total length of encasement actually constructed. Payment shall include full compensation for all materials, equipment and labor required to construct the work complete in-place.

#### 403.4.11 Anchor Walls

Measurement and payment for anchor walls will be made on a unit price basis for each unit installed. Payment shall include full compensation for all materials, equipment and labor required to construct the work complete in-place.

#### 403.4.12 Hydrostatic, Vacuum, or Pneumatic Testing

Payment for hydrostatic, vacuum, or pneumatic testing of sanitary sewer pipe, appurtenances and manholes shall be incidental to the respective item bid. No further compensation will be allowed.

#### 403.4.13 T.V. Inspection

Measurement and payment for t.v. inspection shall be per lineal foot of sewer line inspected as directed and accepted by the Engineer.

### **404 DRAINAGE STRUCTURES-STORM SEWER PIPE AND FITTINGS**

#### 404.1.00 Description

This section covers the following work:

1. Culverts and storm conduit
2. Perforated pipe underdrains
3. Area drains
4. Manholes
5. Catch basins and inlets
6. Outfall structures

#### 404.2.00 MATERIALS

##### 404.2.01 General

Each piece of pipe shall be clearly identified as to strength, class and date of manufacture. The manufacturer or fabricator shall furnish appropriate certification based on manufacturer's routine quality control tests, that the materials in the pipe and fittings meet the requirements specified herein. Strength, permeability, hydrostatic tests and pipe joints will be used as the basis of acceptance as described under Subsection 403.2.12 PROOF TESTS. Minimum length of pipe shall be 3.5 feet.

It is not intended that materials listed herein are to be considered equal or generally interchangeable for all applications. The Engineer shall determine the materials suitable for the project and so specify.

#### 404.2.02 Concrete Pipe

All reinforced concrete pipe shall be a minimum of ASTM C 76 Class III. All non reinforced concrete pipe shall be ASTM C 14 Class III.

#### 404.2.02A Non-reinforced Concrete Pipe

Non-reinforced concrete pipe shall conform to ASTM C 14 with ASTM C 150, Type I - Type II cement.

#### 404.2.02B Reinforced Concrete Pipe

Reinforced concrete pipe shall conform to ASTM C 76 with ASTM C 655, Type I - Type II cement.

#### 404.2.02C Cast-In-Place Pipe

Cast-in-place pipe shall conform to the requirements specified.

#### 404.2.02D Perforated Concrete Pipe

Perforated concrete pipe and fittings shall conform to ASTM C444, class and end type, as specified.

#### 404.2.03 ABS Pipe

Perforated ABS pipe and fittings shall be virgin rigid ABS plastic and shall conform to ASTM D 2751, Type I and Type IV, except that the minimum heat deflection temperature [ASTM D 648] shall be 180 degrees F. Wall thickness shall be not less than 0.140 inches for 4 inch diameter and 0.200 inches for 6 inch diameter. In addition, the pipe shall be perforated with 3/8 inch holes, 3 inches on center along the pipe. Four inch pipe shall have one row on each side approximately 45 degrees above bottom centerline. Six inch pipe shall have two rows on each side approximately 45 degrees above bottom centerline.

#### 404.2.04 Polyvinyl Chloride (PVC) Pipe

PVC sewer pipe shall conform to ASTM D 3034 or AWWA C 900 and have a minimum wall stiffness of 46 psi or a Standard Dimension Ratio (SDR) of 35 or less.

Perforated PVC pipe and fittings shall conform to the requirements of ASTM 3034 and ASTM 2729. Perforations in the pipe shall be located in two rows with one row on each

side of the pipe. Each perforation shall be 0.4 inches in diameter and spaced two inches on center. Each row of perforation shall be located at 120 degrees as measured from the vertical. The number of, size and location of perforations in the pipe may vary with the addition of an approved fabric wrap around the pipe, but only with prior to installation approval by the City Engineer.

#### 404.2.05 Corrugated Polyethylene Pipe (for Non-Street Use Only)

This specification applies to high density polyethylene corrugated pipe with an integrally formed smooth interior. This specification is applicable to normal sizes 4 - 36 inch diameter. Requirements for test methods, dimensions, and markings are those found in AASHTO Designations M-252 and M-294.

Pipe and fittings shall be made of polyethylene (PE) compounds which conform with the requirements of cell class 324420C (min.), as defined and described in ASTM D3350, except that the carbon black shall not exceed 5%.

#### 404.2.06 Galvanized Corrugated Steel Pipe

##### 404.2.06A General

Galvanized corrugated steel pipe and coupling bands shall be of the gauges and type as shown or specified, and shall conform to the material, fabrication and inspection requirements of AASHTO Designation M 36 or M 167.

##### 404.2.06B Coatings

Inside and outside surfaces of corrugated steel pipe shall be completely coated with bituminous material conforming to AASHTO M 190, with a minimum thickness of 0.05 inch at the crest of the corrugations.

##### 404.2.06C Paved Inverts

When specified, inside surface of the corrugated steel pipe shall be paved for 1/4 of its circumference with bituminous material to provide a flat invert centered in the bottom of the pipe. The pavement, except where the upper edges intersect the corrugations, shall have a minimum thickness of 1/8 inch above the crests of the corrugations. The outside of the pipe will be suitably marked on both ends to clearly designate the centerline of the top of the pipe.

##### 404.2.06D Smooth Flow Paving

Corrugated steel pipe, when specified, shall be spun coated with bituminous material conforming to ASSHTO M 190 throughout its entire inner

circumference. The thickness of the coating, when measured at the crest of the corrugations, shall not be less than 1/4 inch. The valley of the corrugations shall retain enough asphalt material to fill them and shall not vary more than 1/8 inch in depth when measured by a straight edge laid on the crests of the coated pipe corrugations.

404.2.07 Galvanized Corrugated Steel Pipe -  
Exterior Polymeric Coating Polyethylene Lining

404.2.07A Base Metal Sheet

Base metal sheet shall be galvanized steel conforming to AASHTO M-218 and ASTM A-929 with the following minimum physical properties:

PHYSICAL PROPERTY	TEST METHOD	UNITS	VALUE
Yield Strength	ASTM A-525	ksi	33
Tensile Strength	ASTM A-525	ksi	45
Elongation	ASTM A-525	%	20
Zinc Coating	ASTM A-525	oz/sq ft	2

The thickness of the base material shall be 0.XXX inches (YY gauge) as shown in the drawings.

404.2.07B Exterior Polymeric Coating

Base metal sheet shall be coated on the exterior side with a minimum 10 mil thick protective polymeric coating conforming to AASHTO M-246 and ASTM A-742 (Grade 10). Polymeric coating shall consist of copolymer of ethylene and acrylic acid - "Trenchcoat" as manufactured by The Dow Chemical Company.

404.2.07C Interior Adhesive Lining

Base metal sheet shall be coated on the interior side with a minimum 10 mil thick adhesive polymeric coating conforming to AASHTO M-246 and ASTM A-742 (Grade 10), except that special additives shall be added to enhance the bond with the extruded polyethylene liner. The special adhesive layer shall be manufactured by The Dow Chemical Company.

404.2.07D Polyethylene Lining

Base metal sheet shall be lined on the interior side with a minimum 65 mil thick (75 mil thick with adhesive layer) predominately ethylene octene copolymer lining. The polyethylene lining shall consist of a resin with the following properties:

PHYSICAL PROPERTY	TEST METHOD	UNITS	VALUE
Melt Index	ASTM D-1238	g/10 min	$I_2 = 7.5 (+/- 1.5)$
Flow Rate Ratio	ASTM D-1238		$I_{10}/I_2 = 7-8$
Density	ASTM D-792	g/cc	0.902 (+/- 0.002)
Hardness	ASTM D-2240	Shore D	45 (+/- 5)
Ash Content	ASTM D-5630	%	< 1.0

#### 404.2.08 Corrugated Aluminum Alloy Pipe

Corrugated aluminum alloy pipe and coupling band shall be of the gauges and types as shown or specified, and shall conform to the material, fabrication and inspection requirements of AASHTO Designations M 196, M 197, M 211 and M 219. Aluminum pipe that comes in contact with concrete shall be coated.

#### 404.2.09 Flared End Sections

Precast concrete flared end sections shall conform to the requirements for reinforced concrete pipe herein specified. The area of steel reinforcement per linear foot of flared end section shall be at least equal to the minimum steel requirements for circular reinforcement in circular pipe for the internal diameter of the circular portion of the flared end section. All details of construction shall be approved by the Engineer.

Prefabricated steel flared end sections shall conform to AASHTO M 218, and prefabricated aluminum flared end sections shall conform to AASHTO M 196.

#### 404.2.10 Jointing Materials (Storm Sewer)

Pipe sections shall be securely fastened together with couplings, fittings or bands as specified by the manufacturer for the type of pipe used.

#### 404.2.10A Concrete Pipe

When required Rubber gaskets for bell and spigot shall conform to ASTM C 443. Captive gasket will be used in groove design for pipe 24 inches in diameter and larger. When required mortar for tongue and groove pipe shall conform to ASTM C 387.

#### 404.2.10B ABS Pipe

Gasketing material for ABS shall conform to current ASTM standards.

#### 404.2.10C PVC Pipe

Rubber gaskets for PVC shall conform to ASTM D 1869.

#### 404.2.11 Proof Testing

Proof tests shall be required as outlined in Section 403.2.12 PROOF TESTS, when watertight jointing is required in the contract documents, or when directed by the Engineer.

#### 404.2.12 Fittings

##### 404.2.12A General

Applicable requirements of Section 403 FITTINGS shall also pertain to storm sewer pipe.

##### 404.2.12B Couplings, Bands and Fittings for Corrugated Metal Pipe

Couplings, bands and fittings, as specified by the pipe manufacturer and approved by the Engineer, shall be used.

Slotting of metal bands may be required to allow for infiltration of ground water.

##### 404.2.12C Drainage Geotextile Fabric

Methods of application shall conform to Section 308 GEOTEXTILE INSTALLATION.

### 404.3.00 Construction

#### 404.3.01 Line and Grade of Storm Sewers

Contractor shall not deviate from line or grade, as established by the Engineer, more than 1/2 inch for line and 1/4 inch for grade, provided that such variation does not result in a level or reverse sloping invert. Grade will be measured at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness. Line and grade for pipe shall be established by the use of approved lasers or by transferring the cut from the offset stakes to batter boards at maximum intervals of 25 feet. If batter boards prove impractical because of trench conditions, other methods of grade and alignment control will be submitted for approval.

#### 404.3.02 Excavation

Excavation for storm sewers shall be in accordance with Section 401 Trenching. Dewatering of the trench shall conform with Subsection 401.3.04 DEWATERING. plans for dewatering shall be pre-approved by the Engineer.

### 404.3.03 Pipe Laying

#### 404.3.03A General

Storm sewer pipe shall be installed with spigot or tongue ends pointing in the direction of flow. Pipe will be placed so that the entire bottom surface of the pipe is in total contact with the bedding material, including the joints. The pipe shall be properly aligned and the joints kept as tightly together as possible. When sealed joints are specified, Contractor will follow the applicable requirements of Section 403 SANITARY SEWER PIPE-FITTINGS-APPURTENANCES.

Flexible joints shall not be required for storm sewers exiting manholes, unless otherwise specified. When shown or approved to deflect pipe from a straight line, either vertical or horizontal, or when long radius curves are shown, the amount of deflection shall not exceed that specified by the manufacturer and/or approved by the Engineer. Pipe bedding and pipe zone backfill materials shall be required for the installation of all rigid and flexible storm sewer pipe. Bedding and pipe zone materials shall be in accordance with Subsection 403.2.11 PIPE BEDDING AND PIPE ZONE MATERIAL and 403.3.04 PIPE BEDDING AND PIPE ZONE. Backfill shall be as specified and shall conform to the requirements of Section 405 BACKFILL: NATIVE AND IMPORTED.

#### 404.3.03B Concrete Pipe

All field joints made in the joining of sections of pipe to form culverts and sewers, and to connect structures and special sections, shall be closely fitted, tight, and shall provide a smooth and uniform interior surface. The joints shall secure and hold adjoining sections to each other and shall fasten securely to adjoining structures and special sections. When mortared joints are specified, the entire joint for the full circumference of the pipe shall be completely filled with mortar. The surfaces of the pipe shall be brushed clean prior to mortaring. The exterior of the joint will be filled with mortar.

#### 404.3.03C Corrugated Metal Pipe

Contractor shall repair all damaged areas of the protective coating with material similar to the original as approved and permit to dry or solidify before backfilling.

### 404.3.04 Perforated Pipe Underdrains

#### 404.3.04A Trench Excavation

Trench excavation shall be in accordance with Section 401 TRENCHING as applicable.

#### 404.3.04B Pipe Bedding

A minimum 4 inch bedding of special filter materials shall be provided under perforated drain pipe, or as shown. The bedding shall be handgraded to proper grade ahead of pipe laying. A firm, unyielding support shall be provided along the entire pipe length.

#### 404.3.04C Backfill at the Pipe Zone

The pipe zone shall be backfilled with special filter material, hand-placed simultaneously on both sides of the pipe for the full trench width and hand-tamped with approved tamping sticks supplemented by "walking in" and slicing with a shovel.

#### 404.3.04D Backfill Above the Pipe Zone

Special filter material for backfill shall be used above the pipe zone, unless otherwise specified.

#### 404.3.04E Laying and Jointing Perforated Pipe

Perforated pipe shall be securely fastened together with couplings, fittings, or bands, as specified by the manufacturer for the type of pipe used. Upstream ends of all subsurface drain pipe shall be closed with approved plugs to prevent entry of soil materials.

Pipe laying will normally begin at the outlet end of the pipe line. The lower segment of pipe shall be in contact with the shaped bedding throughout its full length. Bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe shall be placed facing the upgrade end.

Perforated pipe shall be installed with perforations facing down, unless otherwise specified or directed.

All pipe will be inspected prior to lowering into the trench and, if necessary. Contractor shall have available the proper tools, labor and equipment for efficient execution of the work. All pipe and fittings shall be carefully lowered into the trench to avoid any contamination of the filter bedding material.

#### 404.3.05 Flared End Sections

Flared end sections shall be constructed in accordance with the details and dimensions shown, except that minor variations may be accepted to permit the use of the manufacturer's standard prefabricated sections and methods of fabrication. Excavation, bedding and backfill shall conform to applicable requirements herein for the adjacent pipe or drain to be joined.

#### 404.3.06 Concrete Closure Collars

Concrete closure collars shall be used only when specified or approved and shall be constructed in conformance with the details provided. Pipe will be washed to remove all loose material and soil from the surface on which the concrete will be placed. Nonmetallic pipe shall be thoroughly wet prior to pouring the collars. Forms will be constructed with materials that will ensure that no concrete shall enter the line. The entire collar will be made in one hour, and no collars poured in water. After the collars are poured and have taken their initial set, they will be cured by covering with well-moistened earth. Backfill will not be placed until the concrete has sufficient strength, as determined by the Engineer.

#### 404.3.07 Testing

All gravity storm sewers and appurtenances shall successfully pass all tests required for Section 403 SANITARY SEWERS-FITTINGS-APPURTENANCES with the exception of hydrostatic or air testing. Storm sewers will be free of visible leakage only when watertight joints are required in the contract documents. The Engineer may require hydrostatic or air testing of the lines in such cases.

When required, the cost of all testing shall be borne by the Contractor. Methods, equipment and personnel shall be subject to approval by the Engineer.

#### 404.3.08 Television Inspection

Television inspection of all storm sewers will be required prior to any final surface being placed over them. Television inspections shall be carried out in the manner outlined in

## Section 403 SANITARY SEWERS-FITTINGS-APPURTENANCES

### 404.3.09 Manholes

Storm sewer manholes shall be constructed in conformance with manhole requirements listed in Section 403 SANITARY SEWERS-FITTINGS-APPURTENANCES, except no requirement for water tightness will be made unless so specified.

### 404.3.10 Precast Inlets and Catch Basins

Precast units may be used in lieu of cast-in-place units when approved by the Engineer. Details of proposed units shall be submitted for approval. Concrete risers for extensions shall be a maximum of 6 inches in height and of the same quality as the main section. Risers shall only be used where approved.

### 404.3.11 Precast Sump

Precast sump shall conform to requirements shown on the Standard Drawings.

### 404.3.12 Standard Frames and Grates for Inlets and Catch Basins

Frames and grates for catch basins and storm drain inlets shall be fabricated of steel conforming to ASTM A 7, A 36, or A 373 in accordance with the details shown on the Standard Drawings. All connections shall be welded. Welding shall conform to requirements of current code for welding in building construction of the American Welding Society. Frames and gratings shall be tested within the other and there shall be no more than 1/16 inch movement. When checked by a test jig, the bearing seat of either component shall have no more than 1/16 inch movement. Test jibs shall be furnished by the manufacturer.

### 404.3.13 Monolithic Concrete for Inlets and Catch Basins

Monolithic concrete for inlets and catch basins shall be the same as required under monolithic concrete construction in Section 403 SANITARY SEWERS-FITTINGS-APPURTENANCES.

### 404.3.14 Concrete Encasement for Sewer Pipe

Concrete encasement shall conform to the requirements shown on the contract documents. Foundation stabilization, if required, shall be completed and the bottom of the trench compacted, as approved. Sides of encasement shall be formed, not poured against soil or rock, unless directed or approved by the Engineer.

Pipe will be supported true to line and grade as approved, before and during placement of concrete. Encasement must be placed in a single lift unless otherwise approved. If placement of the concrete in two lifts is approved, a keyway will be provided on both sides of the encased pipe. Reinforcing steel shall be placed as shown or as directed. Concrete will be placed starting at the lower end of the encasement. After concrete encasement has been placed and taken an initial set, it will be cured by covering with well-moistened earth or backfill material for 5 days before conducting hydrostatic or air tests.

#### 404.3.15 Concrete for Splash Pads, Weirs, and Outfall Structures

Special concrete for splash pads, weirs, and outfall structures shall conform to the Standard Drawings, and to the applicable provisions for monolithic concrete construction specified herein.

#### 404.3.16 Placing Precast Units

When precast units are approved, if material in bottom of trench is unsuitable for supporting unit, Contractor shall excavate as directed and backfill to required grade with foundation stabilization material in conformance with Section 401 TRENCHING and 405 BACKFILL: NATIVE AND IMPORTED. Units will be set to grade at locations shown, or as directed.

#### 404.3.17 Inlet and Catch Basin Extensions

When approved, extensions will be installed to height as directed. Risers shall be laid in mortar with sides plumb and tops to grade. Joints shall be sealed with mortar, with interior and exterior troweled smooth. Mortar will be prevented from drying out and cured by applying an approved curing compound or other approved method. Extensions shall be watertight and conform with Subsection 404.3.10 Precast Inlets and Catch Basins.

#### 404.3.18 Installation of Inlet and Catch Basin Frames and Grates

Frames and grates shall be set at elevations shown, or as directed. Frames may be cast in or shall be set in mortar. Bearing surfaces shall be clean and provide uniform contact. Anchor bolts and other fastenings shall be firmly bedded in concrete or otherwise secured as approved.

#### 404.3.19 Geotextile Fabrics

For installation of Geotextile Fabrics refer to Section 308 GEOTEXTILE INSTALLATION.

#### 404.4.00 MEASUREMENT AND PAYMENT

##### 404.4.01 Sewer Pipe

Measurement and payment for storm pipe, and pipe stubouts from manholes, will be made on a linear foot basis for the various classes and sizes of pipe listed in the contract documents and as actually installed. All pipe will be measured horizontally from center-to-center of manholes or to the ends of the pipe, whichever is applicable. No deductions will be made for fittings or for structures.

Payment shall constitute full compensation for the pipe in-place, including testing, except for t.v. inspection.

Measurement and payment for disconnecting and reconnecting existing lines will be made on the same basis as payment for line pipe, and the footage required will be included in the total footage for pipe as shown in the contract documents.

Payment for field taps and permanent seals will be made separately under the respective items shown in the contract documents.

##### 404.4.02 Perforated Pipe Underdrains

Measurement and payment for perforated drain pipe will be made on a lineal foot basis for the size of pipe installed as shown in the contract documents. Length will be measured as total length of pipe installed, including fittings, measured along the pipe centerline. Payment shall constitute full compensation for trench excavation, special filter material for pipe bedding and trench backfill, and all other work specified to complete the installation of the perforated drainage pipe complete in-place.

##### 404.4.03 Flared End Sections

Measurement and payment for flared end sections will be made on a unit price basis for each size as shown in the contract documents. Payment shall include full compensation for the flared end section complete in place including concrete cutoff walls and toe plates, when required.

##### 404.4.04 Manholes

Measurement and payment for manholes, including standard precast or monolithic concrete manholes, will be made on a unit price basis for each type shown in the contract documents for manholes 8 feet deep, plus the unit price per foot shown in the contract documents for extra depth of manholes over 8 feet. No deduction will be made for depths less than 8 feet. Measurement of manhole depth will be from the top of the manhole frame and cover to the manhole invert at the center of the manhole to the nearest

one-tenth of a foot.

Payment shall include full compensation for excavation, foundation stabilization and/or base rock when required, backfill and constructing the manhole complete in-place.

#### 404.4.05 Pipe Stubouts from Manholes

Measurement and payment for pipe stubouts from manholes shall be made on a lineal foot basis.

#### 404.4.06 Drainage Geotextile Fabrics

Geotextile fabrics will be measured and paid for on a square yard basis, to the nearest 0.1 yard, for the surface area covered in accordance with the contract documents or as required by the Engineer. No separate measurement will be made for construction of laps, seams, joints, or patches, unless the Engineer orders more than the specified lap, in which case the added lap width will be included in the measurement.

Geotextile fabric used in trench applications will be measured and paid for on a lineal foot basis, to the nearest foot, for the length of trench the fabric is used in. No separate measurement will be made for construction of laps, seams, joints, or patches, unless the Engineer orders more than the specified lap, in which case the added lap width will be included in the measurement.

#### 404.4.07 Concrete Encasement

Measurement and payment for concrete encasement will be made on a linear foot basis as shown in the contract documents for the size pipe to be encased. Length shall be measured along the centerline of the pipe and shall be the total payment for all materials, equipment and labor required to construct the work complete in-place.

#### 404.4.08 Special Concrete Structures

Measurement and payment for special concrete structures will be made on a lump sum each basis. Payment shall constitute full compensation for materials, equipment and labor required to construct the work complete in place.

#### 404.4.09 Catch Basins and Inlets

Measurement and payment for catch basins and inlets will be made on a unit price basis per each catch basin or inlet for the number and type actually constructed. Payment shall include full compensation for all materials, equipment and labor required to construct the work complete in place.

404.4.10 Television Inspection

Measurement and payment for the television inspection will be on a lineal foot basis. Payment shall include full compensation for all labor and materials complete.

## **405 BACKFILL: NATIVE AND IMPORTED**

### **405.1.00 Description**

This section covers the materials and methods that shall apply to the backfill of sewers, utilities, trenches, structures or existing ditches. Unless authorized by Engineer, native materials shall not be used for backfill within the public right-of-way, nor shall native materials be used to backfill any structure or facility in an easement when the depth of the area to be filled is greater than the distance away from any permanent structure or facility.

### **405.2.00 Materials**

#### **405.2.01 Common Backfill (Native)**

Material excavated from within the limits of the project and approved by Engineer shall be classified common backfill. Common backfill shall be free of vegetation and other deleterious material and shall contain no frozen ground. Maximum particle size shall be as shown or approved and not to exceed 1/2 cubic foot in volume.

#### **405.2.02 Granular Backfill (Imported)**

Granular backfill consists of the following approved materials: A) sand, B) bar-run and river-run gravel, C) crushed aggregate, or D) blend.

##### **405.2.02A Sand**

Sand shall consist of fine granular material, naturally produced by the disintegration of rock, or produced from crushed gravel, and reasonably free of organic material, mica, clay and other deleterious substances as approved. The maximum particle size shall be 1/4 inch, with a gradation which allows 90 percent to 100 percent by weight to pass a No. 4 sieve and not more than 5 percent to pass a No. 200 sieve.

##### **405.2.02B Bar-Run and River-Run Gravel**

Bar-run or river-run gravel shall be acquired from an approved source, free from organic material, having a maximum particle size as shown or approved, and having a reasonable gradation from coarse to fine which contain sufficient fines for adequate compaction.

The maximum particle size shall not exceed 6 inches for trench backfill.

##### **405.2.02C Crushed Aggregate**

Crushed aggregate shall consist of graded crushed gravel or crushed rock, free from organic material, with maximum size as shown or approved and conforming to requirements for aggregate base material in Section 305 AGGREGATE BASES.

405.2.02D Blend

Blend material shall consist of sand and river rock which will conform to Subsection 405.2.02A Sand with the exception that 30% of the material shall be within the 1/4" to 3/4" size, or as directed by the Engineer. Not more than 5% shall pass the No. 200 sieve.

405.2.03 Impervious Backfill

Impervious backfill material shall be composed of particles at least 95 percent of which pass a No. 200 sieve, and with a plastic index not less than 20.

405.2.04 Controlled Density Fill (CDF)

Controlled Density Fill (CDF) shall be a mixture of cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self-consolidating, free-flowing and excavatable material which will result in a hardened, dense, non-settling fill. CDF shall be used in critical areas where settlement is to be eliminated, or as directed by the Engineer.

GUIDELINES FOR CONTROLLED DENSITY FILL MIXES

NOTE: The weights shown are only an estimate of the amount to be used per cubic yard of CDF. The actual amounts may vary from those shown if approved by the Engineer. The Contractor may submit additional data to be approved by the Engineer.

EXAMPLE #1

Proportions per Cubic Yard

Maximum Compressive Strength	100	-	250	p.s.i.
Maximum Mixing Water	30	-	50	gals.
Cement	30	-	50	lbs.
Fly Ash	200	-	350	lbs.
Dry Aggregate	2700	-	3200	lbs.

(Weights may need adjusting for pumpability)

EXAMPLE #2

MIX NAME	CEMENT (lbs)	STABLE AIR (%)	FLYASH (lbs)	SAND (lbs)	WATER (gals)	28 DAY (psi)
Road Cut CDF	125-150	22	0	2600	30	75-150
General Fill	75-100	25	0	2500	32	40-100
4" Pump	50	20	250	2500	34	40-150
2" Pump	50	18	350	2400	35	40-150

405.3.00 Construction

405.3.01 Sewer Trench Backfill and Compaction

Backfill materials shall be placed and compacted in conformance with the appropriate Standard Plan. Water settling can only be allowed if approved by the Engineer. Excavated native material will be sampled by Engineer to determine its suitability for use. Contractor shall take reasonable precautions to prevent approved excavated material from becoming wet and exceeding the optimum moisture limits. Contractor will replace any materials which become unusable through negligence with approved granular material at no expense to Owner.

The trench shall be backfilled above the pipe zone to the specified grade, or as shown on the Plans, in lifts not to exceed 8 inches loose depth. The backfill shall be compacted to a minimum of 95 percent of maximum density, as determined by AASHTO T 99 with mechanical vibrating or impact tampers. Care shall be taken to prevent damaging the pipe during the backfill process. Crushed aggregate base material or topsoil as specified shall then be placed and compacted.

Native materials shall not be used as backfill for trenches in the public right-of-way, unless directed by Engineer. See Subsection 405.1.00 Description

Backfill will not be placed into the trench in such a way as to permit free fall of material until at least 2 feet of cover is provided over the top of pipe. Under no circumstances shall sharp, heavy pieces of material be allowed to drop directly onto the pipe or tamped material around the pipe. Non-native material shall not contain consolidated masses larger than 1/4 cubic foot. The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of pipeline to be designated by Engineer.

NOTE: In accordance with sections 403, SANITARY SEWER PIPE-FITTINGS-APPURTENANCES, 404, DRAINAGE STRUCTURES - STORM SEWER PIPE AND FITTINGS, and 406, WORK ON EXISTING SEWERS AND STRUCTURES, the trench pipe zone shall include a 3 inch minimum cover of pipe zone material above the pipe when a crushed rock, sand or blend material is being used as a trench backfill. A 6 inch

minimum cover of pipe zone material is required when a bar-run or native material is being used as a trench backfill.

Test pits in the backfill shall be excavated as directed by Engineer for the purpose of testing the backfill compaction. At the option of the Engineer, density tests may be taken on a lift of compacted backfill immediately before placing the next lift. All costs in connection with excavating test pits and from standby time during field density test shall be considered as incidental to backfill and shall be included in unit prices bid for the various items included.

If required compaction density has not been obtained, the backfill will be removed from trench, replaced with approved backfill, and recompact to the specified density. Then, should routine field densities show that the specified compaction is not being obtained because of changes in soil types or for any other reason, the compacting procedure will be modified. In no case will excavation and pipe laying operations be allowed to proceed until the specified compaction is attained. The Engineer shall have the right to require changes in methods to accommodate changes in soil conditions.

Controlled density fill (CDF) shall be proportioned to be flowable, non-segregating, and excavatable by hand or machine. CDF patching, mixing and placing may be started if the weather conditions are favorable, when the temperature is at 34° F and rising. At the time of placement, CDF must have a temperature of at least 40° F. Mixing and placing shall stop when the temperature is 38° F or less and falling. Each filling stage shall be as continuous an operation as is possible. The CDF shall not be placed on frozen ground. The trench section to be filled with CDF shall be contained at either end of the trench by bulkhead or earth fill, and must provide drainage so that the CDF can cure. The Contractor shall provide steel plates to span utility trenches and prevent traffic contact with the CDF for at least 24 hours after placement or until the CDF is compacted or hardened to prevent rutting by construction equipment or traffic.

Where topsoil existed prior to excavation, the native topsoil will be replaced in the top 12 inches of trench. The topsoil will be compacted and raked to match the ground surface adjacent to the trench. The surface of the backfilled trench shall be maintained level with existing grade until the end of the contract maintenance period.

In paved and graveled areas, surface of the backfilled trench shall be maintained level with the adjacent and existing grade with 3/4 inch minus crushed aggregate material, or cold mix asphalt pavement, in conformance with Section 407 RESURFACING TRENCH AREAS.

Any subsequent settlement of trench during the maintenance period shall be promptly corrected. The backfilled trench surface will be maintained until the following operations have been completed and approved by the Engineer:

1. Service connections installed, backfilled, and compacted.
2. Construction of manholes and appurtenances.
3. Hydrostatic, vacuum or air testing, and t.v. inspection.
4. Cleanup and restoration of all physical features.
5. Utilities are restored to their original condition or better.

6. All work required between manholes has been accomplished.

No final pavement replacement will be undertaken until all items outlined above have been completed and approved.

#### 405.3.02 Structural Backfill and Compaction

##### 405.3.02A Common Backfill Around Structures

Backfill shall be placed around concrete structures only after the concrete has attained 2/3 of its specified strength. Forms shall be removed and trash cleaned from the excavation prior to the placement of backfill.

Common backfill shall only be placed when shown or as directed, and only when the area to be backfilled is great enough to allow for the proper use of compaction equipment. Backfill shall be placed around piers and columns on all sides to approximately the same elevation at the same time. Backfill in front of abutments and walls shall be placed first to prevent the possibility of forward movement. Contractor shall take special precautions to prevent any wedging action against the concrete. Slopes adjacent to the excavation shall be stepped or roughened to prevent a wedging action. Material from the excavation will be deposited in lifts not exceeding 8 inches loose thickness. Each lift shall be compacted to at least 95 percent of its maximum density at optimum moisture content, as determined by the applicable method of AASHTO T-99, before placing the next lift. Jetting or puddling will not be permitted. Adequate provision for thorough drainage of all backfill shall be made.

Earth-moving equipment shall not be operated within 5 feet of walls of concrete structures unless approved. Backfill adjacent to concrete walls will be compacted with pneumatic tampers or other approved equipment that will not damage the structure.

##### 405.3.02B Common Backfill Not Around Structures

Common backfill shall be placed to lines and grades shown to produce a rough grade in areas containing no structures, paving, utilities or similar appurtenances. Material shall be deposited in lifts not exceeding 8 inches in loose thickness. Each lift shall be compacted to at least 90 percent of its maximum density at optimum moisture content, as determined by the applicable method of AASHTO T-99, before placing next lift.

##### 405.3.02C Granular Backfill Around Structures

Imported granular backfill shall be placed in lifts not exceeding an 8 inch loose thickness. Each lift shall be compacted to 95 percent of its maximum density at optimum moisture content, as determined by AASHTO T-99, method D, before placing next lift.

#### 405.3.02D Granular Backfill Under Footings and Slabs

When shown, natural ground shall be graded and prepared as approved, and crushed granular backfill placed under footings, slabs and other structures. Material shall be deposited in lifts not exceeding an 8 inch loose thickness, and compacted to 100 percent of its maximum density at optimum moisture content, as determined by AASHTO T-99, Method C.

#### 405.3.02E Granular Backfill Under Facilities

Imported granular backfill shall be placed in previously excavated areas under piping, sidewalks, and similar structures and facilities. Material shall be placed in lifts not exceeding 8 inches in loose thickness and compacted to 90 percent of its maximum density at optimum moisture content, as determined by AASHTO T-180.

#### 405.3.02F Sand Backfill

Sand backfill shall be used wherever shown or directed for drainage blanket under vapor barriers, and where such barriers are used beneath concrete slabs. Material shall be placed in lifts not exceeding 8 inches in loose thickness and compacted to the percentage of maximum density at optimum moisture content as shown or directed, as determined by ASTM D 698, Method A.

### 405.4.00 Measurement and Payment

#### 405.4.01 Measurement

##### 405.4.01A Measurement per Cubic Yard

Measurement for backfill of trenches will be based on the neat section minus the pipe zone computed as follows:

Length. Length will be the entire horizontal distance on a linear foot basis measured along the centerline of the trench, including measurement through fittings, couplings, manholes, or structures, except that the measurement through such structures will be deducted if the proposal contains a separate provision for payment of structural backfill.

Measurement will be from center to center of manholes, structures, or end of pipe, whichever is applicable.

Width. Width upon which sewer backfill will be calculated will be based on the diameter of the pipe barrel as follows:

SIZE OF PIPE

6" - 15"

18" - 36"

42" and larger

PAY WIDTH OF TRENCH

2.5 Feet

outside dia. plus 12 inches

outside dia. plus 24 inches

Trenches that exceed 10 feet in depth will be allowed one extra foot in width for shoring on that portion of the trench in excess of the 10 foot depth.

The allowances for shoring shall not be based on the average depth.

No allowance will be made for over-width trenches when in the opinion of the Engineer adequate shoring would have prevented sloughing of the trench walls beyond the designed width.

Contractor shall immediately notify Engineer when encountering unstable material that will not stand under normal shoring practices. Failure to notify Engineer will result in loss of any allowance for over-excavation or backfill.

Depth. Depth will be the vertical measurement from the top of the pipe zone material to the original ground or subgrade. Depth of trench will be measured at intervals of 25 feet along the centerline of trench between linear pay limits as specified herein, unless physical conditions necessitate a change that is mutually acceptable to both Engineer and Contractor. Trench depth will be the average depth between measuring points. Pay depth shall not exceed depth shown on the Plans unless authorized by Engineer.

405.4.01B Measurement Per Ton

Measurement will be made on a ton basis for the number of tons of backfill weighed on an approved and tested scale. Trip tickets shall normally be given to the Engineer by the end of the day that the delivery was made, but in no event shall they be given to the Engineer later than 12 noon the following calendar day (Saturday, Sunday, and legal holidays excluded). Each trip ticket shall show the date and time of delivery, address of delivery, truck number or driver's name, and net weight of material to the nearest .01 ton. The tickets will be considered as valid delivery receipts only when received within the specified time period.

405.4.02 Trench Backfill - Native or Common Material

Measurement and payment for common backfill of trenches shall be determined by the cubic yard of material in place based on the allowances computed in accordance with Subsection 405.4.01 MEASUREMENT, excluding the pipe zone material which is incidental to the pipe in place.

405.4.03 Trench Backfill - Imported, Granular Material

Measurement and payment for imported granular materials, bar-run, pit-run, crushed rock, sand, or blend shall be by the ton, in-place, fully compacted, and acceptable to the Engineer. If the excavation stays within the neat section, then the payment shall be per ton (see 405.4.01B Measurement Per Ton). If the Contractor exceeds the neat section, then the measured cubic yards within the neat section shall be converted to tons by establishing the bulk specific gravity of the backfill placed using AASHTO T-85-60 or ASTM C 127-59.

Compaction and maintenance of backfilled trenches is considered as incidental to this item of work, and payment shall be included in payment for backfill.

#### 405.4.04 Impervious Backfill

Measurement and payment for impervious backfill shall be determined by the cubic yard of material in place based on the allowances computed in accordance with Subsection 405.4.01 MEASUREMENT.

#### 405.4.05 Controlled Density Fill (CDF)

Measurement and payment for controlled density fill shall be determined by the cubic yard of material in place based on the allowances computed in accordance with Subsection 405.4.01 MEASUREMENT, excluding the pipe zone material which is incidental to the pipe in place.

#### 405.4.06 Structural Backfill

Unless shown in the Proposal, all backfill of the type specified shall be considered as incidental to and included in the pay item for the appurtenant structure.

If structural backfill is specified as a pay item and shown in the Proposal, measurement will be as specified. The horizontal limits for measurement of required backfill shall be the sides of the pit or trench except that no measurement or payment will be made for materials outside of a vertical plane one foot outside and parallel to the neat lines of the footings or bases for structures, or as shown.

The bottom limit shall be the elevation designated for the bottom of the footing or base of the structure.

The upper limits shall be the ground surface at the site prior to beginning of work, or the stream bed as it exists at the time excavation began.

### **SUMMARY PAYMENT CHART**

MATERIAL

MEASUREMENT

Native or Common

cubic yard

Imported, Granular

ton

Impervious

cubic yard

Controlled Density Fill

cubic yard

NOTE: If the material is not listed as a pay item, the backfill shall be considered as incidental with no payment unless approved by the engineer.

## **406 WORK ON EXISTING SEWERS AND STRUCTURES**

### **406.1.00 DESCRIPTION**

This section covers the work necessary for joining new work to existing sewers, abandoning of sewer lines and structures, and for adjusting the existing utility structures to finished grades, complete.

### **406.2.00 MATERIALS**

Materials used shall conform to the requirements for related work found in various sections of these Specifications. Unless otherwise specified materials shall match the existing sewers and structures.

### **406.3.00 CONSTRUCTION**

#### **406.3.01 Excavation**

All aspects of trench excavation for the installation of sanitary sewers shall be in accordance with Section 401 TRENCHING, unless otherwise directed by the Engineer.

#### **406.3.02 Manholes Over Existing Sewers**

Prior to the start of work, Contractor shall submit a plan to the Engineer for diverting sewage flow and obtain approval from the Owner. Engineer's approval for such work shall in no way relieve the Contractor of the responsibility for maintaining adequate capacity and flow at all times, and protecting new and existing work from damage.

New manholes will be constructed over existing operating sewers at the locations shown in contract documents. New manholes will be constructed in accordance with Section 403 SANITARY SEWERS and Section 404 DRAINAGE STRUCTURES.

After completion of manholes, the top of the existing pipe within the new manholes will be cut out, the edges covered with mortar and troweled smooth, as approved in Standard Drawings.

Broken material or debris will be prevented from entering sewer flow. Flow through existing sewer lines will be maintained at all times. New concrete and mortar will be protected for a period of 7 days after placing.

#### **406.3.03 Connection to Existing Manholes**

All diversion facilities and all work necessary to maintain sewage flow in existing sewers during connection to the manhole will be provided. The existing manhole base and walls will be core drilled as specified or directed. New pipe will provide a watertight seal as specified in Section 403.3.13 PIPE STUBOUTS FROM MANHOLES. A smooth flow line will be formed through existing manhole as specified in Subsection 406.3.10. RECONSTRUCT MANHOLE BASE.

#### 406.3.04 Removal of Existing Pipes, Manholes and Sewer Appurtenances

Existing pipelines, manholes and sewer appurtenances which lie in the line of and are to be replaced by the new construction shall be removed from the site and disposed of as provided for in Section 301 EARTHWORK.

#### 406.3.05 Filling Abandoned Manholes

Existing manholes shown to be abandoned shall be filled with granular material compacted to 95 percent optimum density as determined by AASHTO T 99. The manhole frame and cover will be removed and all pipes plugged with permanent plugs as specified in Subsection 406.3.08, PERMANENT PLUGS.

#### 406.3.06 Existing Manhole Frames and Covers

Manhole frames and covers removed by the Contractor and not to be reused on the project shall become the property of the Contractor.

#### 406.3.07 Manhole Adjustment Rings (Overlay)

It shall be the responsibility of Contractor to adjust all manholes located within the area of an overlay to the proposed new finish grade. Adjustment rings shall only be used when approved by the Engineer and shall be manufactured and installed in such a manner as to provide a firm seat for the existing manhole lid, free from wobble or clatter.

#### 406.3.08 Permanent Plugs

Abandoned pipes shall be capped or plugged watertight. Abandoned pipes connected to sanitary sewers shall be plugged with gasketed mechanical plugs or non-shrink grout seals as directed by the Engineer. Abandoned pipes connected to sanitary sewer manholes shall have mechanical plugs or seals installed from the inside of the manhole and channel shall be reshaped to conform to the Standard Drawings.

#### 406.3.09 Adjust Structures to Grade

Manholes, inlets, catch basins and similar structures shall be brought to the specified finished grade by methods of construction as required in Section 403 SANITARY

SEWERS and Section 404 DRAINAGE STRUCTURES as applicable to manholes, inlets, and concrete structures.

Excavation necessary for bringing structures to grade shall center about the structure and be held to the minimum area required.

#### 406.3.10 Reconstruct Manhole Base

Contractor shall conform to the requirements of Section 403 SANITARY SEWERS and Section 404 DRAINAGE STRUCTURES as applicable to manholes, inlets and concrete structures. Caution shall be exercised in chipping out existing concrete base so as to prevent cracking of manhole walls. All material will be prevented from entering the sewer flow. The new base will be poured to a minimum of six inches below the lowest projection of the pipe. New channels will be constructed to the elevations shown.

Contractor shall conform to details for channel construction in the Standard Drawings 4-1 or 4-2. Any cracks which occur as a result of work operations shall be repaired with new grout to form a watertight seal.

#### 406.3.11 Connect Pipe to Existing Inlets

Contractor shall conform to the requirements of Section 403 SANITARY SEWERS and Section 404 DRAINAGE STRUCTURES as applicable to manholes, inlets and concrete structures.

Existing inlet will be core drilled and a watertight seal grouted in between the new pipe and inlet wall. Grout will be troweled smooth inside pipe opening. Alignment, slope of pipe, and other construction details shall be as approved.

#### 406.3.12 Field-Fabricated Connections

Field fabricated tees and wyes shall be of the "Fowler" or "Inserta Tee" type unless otherwise approved by Engineer. Only those connections which are made by mechanically coring a receiver hole in the carrier pipe and to which a rubber gasketed fitting shall be inserted and properly affixed will be acceptable. Other fabrication details may be allowed by submitting details for and obtaining approval prior to fabrication. On plastic pipe the diameter of the core drill for field fabricated tees or wyes will be no greater than 1/2 the diameter of the mainline.

### 406.4.00 MEASUREMENT AND PAYMENT

#### 406.4.01 Manholes Over Existing Sewers

Measurement and payment for constructing manholes over existing sewers shall be in accordance with Subsection 404.4.04.MANHOLES

#### 406.4.02 Removal of Existing Pipe, Manholes, and Appurtenances

Payment shall be incidental for removal and disposal of existing pipe, manhole material or other structures associated with the work item.

#### 406.4.03 Connection to Existing Manholes

Measurement and payment for connection to existing manholes will be made on a unit price each basis.

#### 406.4.04 Filling Abandoned Manholes

Measurement and payment for filling abandoned manholes will be made on a unit price each basis.

#### 406.4.05 Adjust Structures to Grade

Measurement and payment for adjusting manholes, catch basins, inlets and similar structures will be made on a unit price each basis for the type and size as shown in the proposal.

#### 406.4.06 Reconstruct Manhole Base

Measurement and payment for reconstructing manhole base will be made on a unit price each basis.

#### 406.4.07 Connection to Existing Catch Basin

Measurement and payment for connecting new pipe to existing catch basins will be made on a unit price each basis.

#### 406.4.08 Tee and Wye Fittings

Measurement and payment for tees and wyes will be made on a unit price each basis.

## 407 RESURFACING TRENCH AREAS

### 407.1.00 Description

Whenever the work to be done requires the removal of a portion of the paved roadway, driveway approach or sidewalk to facilitate the installation of an underground utility, contractor shall replace the removed structure with a temporary A.C. patch.

Any settlement of either the temporary patch or the restored structure shall be immediately corrected by Contractor. The permanent restoration shall be maintained during the life of the warranty period. Upon failure to comply, Engineer shall be at liberty, without further notice to Contractor or his Surety, to have work completed and bill the Contractor for labor and administrative costs.

Cuts made to newly constructed structures are subject to a surcharge. This refers to newly surfaced streets (within three (3) years of acceptance). Charges are levied to owner of facility based on the City Code.

### 407.2.00 Materials

#### 407.2.01 Aggregates

Aggregates incorporated in the restoration and resurfacing shall conform to the requirements of Section 305 AGGREGATE BASES.

#### 407.2.02 Cold Mix Asphaltic Concrete Patch

The grading requirements for the emulsified asphalt cold mix shall be as follows.

Sieve Size Passing	Percentages (by weight)
1"	99-100
3/4"	95-100
1/2"	70-90
1/4"	15-30
#10	0-7
#200	0-2

Asphaltic oil shall be CMS-2 conforming to ODOT Standard Specifications.

Range of emulsion - 6.0 to 7.0%.

Water content of Aggregate Range - 1.3 to 2.8%

#### 407.2.03 Asphaltic Concrete

Asphaltic Concrete used for permanent roadway restoration shall be Class 'C' A.C. mix, unless otherwise specified, meeting the requirements of Section 310 ASPHALT CONCRETE PAVEMENT.

407.2.04 Portland Cement Concrete

Portland Cement concrete shall meet the specifications of Section 311 PORTLAND CEMENT CONCRETE AND CONCRETE STRUCTURES.

407.2.05 Controlled Density Fill (CDF)

Controlled Density Fill shall meet the specifications of Section 405 BACKFILL.

407.2.06 Polymerized Crack and Joint Sealant

Polymerized crack and joint sealant shall meet the specifications of Section 309 SURFACE TREATMENTS.

407.3.00 Construction

407.3.01 Temporary Patches

Temporary patching shall be done after the trench backfill material has been fully-compacted and brought to a uniform surface eighteen (18) inches below the finish grade or the bottom of the street structure whichever is greater. Contractor will then place sixteen (16) inches of 1-1/2"-0 crushed rock within two (2) inches of the finished surface. The crushed rock shall be placed in two (2) equal and fully-compacted lifts as per Section 405 BACKFILL. The remaining two (2) inches of trench depth shall then be filled with Cold Mix A.C., placed and rolled in keeping with accepted paving practices. The temporary patch should be crowned to compensate for settlement, but shall pose no hazard to the public.

If CDF is required for backfill it shall be to road surface.

Temporary patching shall be used at the end of each work day. Permanent patching shall be done within two (2) working days following temporary patching, weather permitting. Time constraints for permanent patching may be extended with the prior approval of the Engineer. Saw cuts damaged shall be re-sawed to the satisfaction of the Engineer before permanent restoration is done.

#### 407.3.02 Permanent Restoration

Permanent restoration of paving and concrete structures shall be accomplished as shown in the Standard Drawing No. 4-16, contract documents, or as directed by Engineer.

Materials and construction shall conform to requirements in Sections 311 PORTLAND CEMENT CONCRETE AND CONCRETE STRUCTURES and Section 310 ASPHALT CONCRETE PAVEMENT. Structural restoration shall be equal to or better than existing structure, but in no case less than the minimum specified in subsection 407.3.01

Temporary Patches.

Permanent restoration shall conform to the standards described in this section. Remove temporary patch and 'T' pavement structure cut 1 foot outside trench walls and replace with permanent patch with minimum of 4 inches of depth or match existing structure. For asphalt streets apply RS-1 or CSS-1 liquid asphalt tack by spraying the entire granular surface and side areas of the patch. Pave with Class "C" asphaltic mix conforming to Section 310 ASPHALT CONCRETE PAVEMENT.

The completed restoration shall deviate no more than .03 feet from the existing structure. All restoration seam, kerf and deep tool marks will be sealed with polymerized crack and joint sealant as specified in Section 309 SURFACE TREATMENTS.

For concrete structures pour 4000 psi 3/4" mix conforming to Section 311 PORTLAND CEMENT CONCRETE AND CONCRETE STRUCTURES.

All restoration failing final inspection shall be completely removed and properly reinstalled within ten (10) working days from notification of failure.

#### 407.4.00 Measurement and Payment

##### 407.4.01 Measurement

No measurement shall be made of temporary patches as they are considered incidental to the work being done. Measurement of permanent restoration shall be made of the restored area as may be defined by the Contract Document or Engineer. Measurement shall be by the square yard.

##### 407.4.02 Payment

No payment shall be made for temporary patching which is incidental to the work being done. Payment for permanent restoration shall be made at the respective unit bid price for the type of restoration specified. Payment shall be full compensation for all labor, equipment and materials needed to complete the work all to the satisfaction of Engineer.

