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*Where Values Make The Difference*

**MEMORANDUM**

**Case # 13-15**

**DATE:** May 1st, 2013  
**TO:** MAG Specifications and Details Committee Members  
**FROM:** Warren White, City of Chandler Representative  
**SUBJECT:** Proposed Revisions to MAG Sections 603, 615 and 618

Based upon MAG Working Group discussion, and proposed flexible pipe material specifications, revisions to the following MAG Sections are proposed. The intent is to create a new flexible pipe installation specification (Section 603), leaving Section 601 as the ridged pipe installation spec. Section 615 & 618 would then be updated to reflect the two base specifications for rigid and flexible pipes.

**SECTION 603 TRENCH EXCAVATION, BACKFILLING, AND COMPACTION FOR FLEXIBLE PIPE**

- All “HDPE” revised to “flexible”
  - Defining profile HDPE as “Profile HDPE (meeting ASTM F894)”
  - Reference Section 601 for Rigid Pipe Trench, Excavation, Backfilling and Compaction
- 603.2
- Add 603.2.1 language (from Section 601.2.1)
  - Updated trench widths
  - Added 603.2.3 Trench Grade from 601
  - Added 603.2.4 Fine Grading from 601
  - Added 603.2.5 Overexcavation from 601
  - Added 603.2.6 Excavation from Manholes, Valves, Inlets, Catch Basins and Other Accessories from 601
  - Added 603.2.7 Pavement and Concrete Cutting & Removal from 601
  - Added 603.2.8 Grading and Stockpiling from 601
- 603.3
- Added 603.3 Protection of Existing Utilities from 601
- 603.4
- Added 603.4.1 Foundation from 601
  - Added 603.4.3 Backfilling from 601
  - Added 603.4.4 Compaction Densities from 601; Add Table 603-2 from 601
  - Added 603.4.7 Rights-of-Way Belonging to Others from 601
  - Added 603.4.8 Test Holes from 601
  - Added 603.4.9 Foundation and Bedding for Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines from 601

603.5

- Added General language to 603.5 from 601

603.6

- Added 603.6 from 601

SECTION 615 SEWER LINE CONSTRUCTION

- Defining profile HDPE as “Profile HDPE (meeting ASTM F894)”
- Revising PVC or HDPE to flexible pipe

615.2

- Remove paragraph for PVC pipe and refer to Section 603

615.4

- Update “HDPE and PVC” to thermoplastic

SECTION 618 STORM DRAIN CONSTRUCTION

- All “HDPE” revised to “flexible”
- Define installation reference Section 601 for rigid pipe and Section 603 for flexible pipe

618.2

- Add Section 739 and 740 to pipe sections
- Call out gaskets to meet ASTM F477

618.3

- Instead of Class V pipe only for railroads – changed to pipe included in AREMA specifications

Here is an overview of related Sections:

	<b>TRENCH EXCAVATION, BACKFILLING AND COMPACTION</b>	<b>INSTALLATION</b>	<b>MATERIAL</b>
<b>Flexible Pipe</b>	Section 603 (Revised title, was Installation of HDPE)	Section 615 - Sewer	Section 738 - HDPE
		Section 618 - Storm	Section 739 - SRPE
		Section 610 - Water	Section 740 - Polypropylene
			Section 745 - PVC
<b>Rigid Pipe</b>	Section 601	Section 615 - Sewer	Section 735 - RCP
	(Current Title)	Section 618 - Storm	Section 736 - Non-RCP
		Section 610 - Water	Section 743 - VCP
			Section 750 - DIP
			Section 752 - ACP
			Section 785 - Concrete

## SECTION 603

### TRENCH EXCAVATION, BACKFILLING AND COMPACTION FOR FLEXIBLE PIPE

#### 603.1 DESCRIPTION:

The work covered by this specification consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in connection with flexible pipe installation in accordance with the plans, specifications and special provisions. Pipe materials that are considered to be flexible include thermoplastic pipes and corrugated metal pipe and arches. See Section [601](#) for rigid pipe trench excavation, backfilling and compaction.

For installation procedures of flexible pipe for sewer line construction, see Section [615](#).

For installation procedures of flexible pipe for storm drain construction, see Section [618](#).

HDPE pipe and fittings shall conform to Section [738](#). SRPE pipe and fittings shall conform to Section [739](#). Polypropylene pipe and fittings shall conform to Section [740](#). PVC pipe and fittings shall conform to Section [745](#). Corrugated metal pipe and arches shall conform to Section [760](#).

This section covers flexible pipeline installations of gravity and low-pressure storm drain and sanitary sewer construction.

For the purpose of this specification, low-pressure is defined as the test pressures of 3.5 psi of air or 4 feet of water as specified in Section [615.11](#).

For the purpose of this specification, flexible pipe shall include 8 inches through 120 inches nominal diameter.

#### 603.2 EXCAVATION:

**601.2.1 General:** The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the plans, and including excavation ordered by the Engineer of compacted backfill for the purpose of making density tests on any portion of the backfill.

**603.2.2 Trench Widths:** Trenches for flexible pipe other than profile HDPE pipe, meeting ASTM F894, shall conform to the dimensions in Table [603-1](#), unless otherwise specified in the special provisions, indicated on the plans, and/or approved by the Engineer. Trench widths for profile HDPE pipe, meeting ASTM F894, will be designed by the Engineer and included on the plans or in the special provisions.

<b>FLEXIBLE PIPE – TRENCH WIDTHS</b>		
<b>Size of Pipe (Nom. Dia.)</b>	<b>Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel</b>	<b>Minimum Width At Springline Each Side of Pipe (1)</b>
Less than 18 inches	20 inches	8 inches
18 inches to 24 inches inclusive	23 inches	9.5 inches
27 inches to 36 inches inclusive	28 inches	12 inches
42 inches to 60 inches inclusive	34 inches	14 inches
66 inches to 78 inches inclusive	44 inches	16 inches
84 inches to 96 inches inclusive	48 inches	18 inches
102 inches to 120 inches inclusive	54 inches	21 inches

(1) When the specified compaction cannot be obtained in the haunch area and/or bedding zone, the Contractor shall make necessary changes in his methods and/or equipment to obtain the desired results. In some instances, the Minimum Width at springline shall be adjusted wider to assist the Contractor in obtaining the compaction. The Engineer must be satisfied with the Contractor's compaction effort, concur with the change and approve the revised distance. There shall be no additional cost to the Agency for the extra trench width.

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For multiple pipe installations in a single trench, the Engineer shall provide details on the plans or in the Special/Technical Provisions as to the layout, pipe configuration, distances between pipes and trench walls, the type of backfill, bedding and foundation materials, etc.

The width of the trench shall not be greater than the maximum indicated in Table 603-1, at and below the level of the top of the pipe. The width of the trench above that level may be made as wide as necessary for sheeting and bracing, and for proper installation of the work.

**603.2.3 Trench Grade:** Alignment and elevation stakes shall be furnished by the Contractor at set intervals and agreed upon offsets. On water main projects, elevation stakes will be furnished only when deemed necessary by the Engineer. In all cases where elevation stakes are furnished, the Engineer will also furnish the Contractor with cut sheets.

For all pipe 12 inches or greater in diameter, the Contractor shall excavate for and provide an initial granular bedding at least 4 inches thick or 1/12 the O.D. of the pipe whichever is greater. This bedding material shall be placed at a uniform density with minimum compaction and fine graded as specified below.

Bell or coupling holes shall be dug after the trench bottom has been graded. Such holes shall be of sufficient width to provide ample room for caulking, banding, or bolting. Holes shall be excavated only as necessary to permit accurate work in the making of the joints and to insure that the pipe will rest upon the prepared bottom of the trench, and not be supported by any portion of the joint.

Depressions for joints, other than bell-and-spigot, shall be made in accordance with the recommendations of the joint manufacturer for the particular joint used.

**603.2.4 Fine Grading:** Unless otherwise specified in the plans and/or special provisions, the bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe where it is necessary to excavate for bells and for proper sealing of the pipe joints.

**603.2.5 Overexcavation:** Except at locations where excavation of rock from the bottom of the trench is required, care shall be taken not to excavate below the depth indicated.

Unauthorized excavation below the specified grade line shall be refilled at the Contractor's expense with ABC material compacted to a uniform density of not less than 95 percent of the maximum density as determined by AASHTO T-99 and T-191 or ASTM D6938. When AASHTO T-99, method A or B, and T-191 are used for density determination, ARIZ 227c will be used for rock correction.

Whenever rock is encountered in the trench bottom, it shall be overexcavated to a minimum depth of six inches below the O.D. of the pipe. This overexcavation shall be filled with granular material placed with the minimum possible compaction.

Whenever unsuitable soil incapable of supporting the pipe is encountered, the Contractor will notify the Engineer and a field determination will be made as to the depth of overexcavation and the granular fill required.

**603.2.6 Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories:** The Contractor may excavate to place the concrete structure directly against the excavated surface, provided that the faces of the excavation are firm and unyielding and are at all points outside the structure lines shown on the plans. If the native material is such that it will not stand without sloughing or if precast structures are used, the Contractor shall overexcavate to place the structure and this overexcavation shall be backfilled with the same material required for the adjoining pipe line trench and compacted per Table 603-2.

Any unnecessary excavation below the elevation indicated for the foundation of any structure shall be replaced with the same class of concrete specified for the structure or with 1 ½ sack controlled low strength material as specified in Section 728. When the replacement material is structural concrete, the material shall be placed at the same time as the structure. However, when using 1 ½ sack controlled low strength material, placement of the material shall be

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per Section 604 which will require a time lag between the material and the structural concrete. The placement of the additional material shall be at no cost to the Agency.

**603.2.7 Pavement and Concrete Cutting and Removal:** Where trenches lie within the Portland cement concrete section of streets, alleys, driveways, or sidewalks, etc., such concrete shall be sawcut to neat, vertical, true lines in such a manner that the adjoining surface will not be damaged. The minimum depth of cut shall be 1 ½ inches or 1/4 of the thickness, whichever is greater.

Asphalt pavement shall be clean-cut, with approved equipment and by approved methods in accordance with the requirements of Section 336.

No ripping or rooting will be permitted outside limits of cuts. Surfacing materials removed shall be hauled from the job site immediately, and will not be permitted in the backfill.

**603.2.8 Grading and Stockpiling:** All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

During excavation, material suitable for backfilling shall be piled in an orderly manner, a sufficient distance back from the edges of trenches, to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling, or excess material, shall be hauled from the job site and disposed of by the Contractor.

The Contractor shall, prior to final acceptance of the work, submit a letter to the Contracting Agency stating the location of each disposal site for all excess or unsuitable material and certify that he has obtained the property owner's permission for the disposal of all such materials.

Where the plans and/or special provisions provide for segregation of topsoil from underlying material for purposes of backfill, the material shall not be mixed.

**603.2.9 Shoring and Sheeting:** The Contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. The bracing, sheathing, or shoring shall not be removed in one operation but shall be done in successive stages as determined by the Engineer to prevent overloading of the pipe during backfilling operations. The cost of the bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price for the pipe.

All shoring and sheeting deemed necessary to protect the excavation and to safeguard employees, shall be installed. See Section 107.

### 603.3 PROTECTION OF EXISTING UTILITIES:

**601.3.1 Utilities:** Unless otherwise shown on the plans or stated in the specifications, all utilities, either underground or overhead, shall be maintained in continuous service throughout the entire contract period. The Contractor shall be responsible and liable for any damages to or interruption of service caused by the construction.

If the Contractor desires to simplify his operation by temporarily or permanently relocating or shutting down any utility or appurtenance, he shall make the necessary arrangements and agreements with the owner and shall be completely responsible for all costs concerned with the relocation or shutdown and reconstruction. All property shall be reconstructed in its original or new location as soon as possible and to a condition at least as good as its previous condition. This cycle of relocation or shutdown and reconstruction shall be subject to inspection and approval by both the Engineer and the owner of the utility.

The Contractor shall be entirely responsible for safeguarding and maintaining all conflicting utilities that are shown on the plans (Sections 107 and 105 apply). This includes overhead wires and cables and their supporting poles whether they are inside or outside of the open trench. If, in the course of work, a conflicting utility line that was not shown on the plans is discovered, the Contracting Agency will either negotiate with the owner for relocation, relocate the utility, change the alignment and grade of the trench or as a last resort, declare the conflict as extra work to be accomplished by the Contractor in accordance with Section 104.

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**601.3.2 Irrigation Ditches, Pipes and Structures:** The Contractor shall contact the owners of all irrigation facilities, and make arrangements for necessary construction clearances and/or dry-up periods.

All irrigation ditches, dikes, headgates, pipe, valves, checks, etc., damaged or removed by the Contractor, shall be restored to their original condition or better, by the Contractor at no additional cost to the Contracting Agency.

**601.3.3 Building, Foundations and Structures:** Where trenches are located adjacent to building, foundations, and structures, the Contractor shall take all necessary precaution against damage to them. The Contractor shall be liable for any damage caused by the construction.

Except where authorized in the special provisions or in writing by the Engineer, water settling of backfill material in trenches adjacent to structures will not be permitted.

**601.3.4 Permanent Pipe Supports:** Permanent pipe supports for the various types and sizes of sewer, water and utility lines shall conform to the Standard Details or the details shown on the plans. Such pipe supports shall be erected at the locations shown on the plans and/or at any other locations as necessary as determined by the Engineer.

**601.3.5 Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines:** These underground facilities shall be adequately supported by the Contractor. Support for plastic pipes shall be continuous along the bottom of the pipe. Support for metal pipe and electrical conduit may be continuous or nylon webbing may be used for suspension at no greater than ten-foot intervals.

The Contractor shall avoid damaging the plastic pipe, pipeways or conduits during trench backfilling and during foundation and bedding placement.

There will be no measurement or payment for this work. The Contractor will include all associated costs in the unit price for the conduit installation.

### **603.4 FOUNDATION, BEDDING, BACKFILLING AND COMPACTION:**

**601.4.1 Foundation:** The material upon which the conduit or structure is to be placed shall be accurately finished to the grade or dimensions shown on the plans or as directed by the Engineer. The bottom portion of the trench shall be brought to grade so that the conduit or structure will be continuously in contact with the material on which it is being placed. If rocky or unsuitable soil is encountered, Subsection [603.2.5](#) applies.

**603.4.2 Bedding:** Coarse aggregate shall be used for bedding of Profile HDPE pipe (meeting ASTM F894). Coarse aggregate shall be in accordance with Subsection [603.4.6](#), for size, type, and gradation. For corrugated HDPE pipe as defined under Section [738](#), SRPE pipe as defined under Section [739](#), PP pipe as defined under Section [740](#), PVC pipe as defined under Section [745](#), and corrugated metal pipe and arches as defined under Section [621](#), bedding shall meet the requirements of subsection [601.4.2](#) and Table [601-2](#) with the compaction requirements stipulated below.

Bedding material shall be carefully deposited in 8 inches or less loose lifts, thoroughly and carefully compacted around the pipe, equally around both sides of the pipe, with approved vibratory compactors or other tools or equipment when applicable, or by shovel slicing as approved by the Engineer. This shall be repeated until enough material is placed and compacted to provide a minimum of one (1) foot cover over the top of Profile HDPE pipe (meeting ASTM F894), or to the top of other flexible pipe. Compaction densities, as well as further compaction requirements shall be as stipulated in Table [603-2](#), unless shown otherwise on the plans.

**603.4.3 Backfill:** Backfill shall be sound earthen material free from broken concrete, broken pavement, wood or other deleterious material. Unless otherwise specified, this may be native material with no piece larger than 4 inches, select material or aggregate base course. Backfill under street pavement shall be constructed per Detail 200-1 with the type of replacement noted on the plans or in the special provisions. Unless otherwise noted, backfill under single curb, curb and gutter, sidewalk, driveways, valley gutters, etc. shall be the same as the adjacent street pavement.

Where water consolidation is used, backfill will be placed in lifts as required in the following table prior to settlement.

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<b>Trench Width</b>	<b>Backfill Lifts</b>
18 to 24	Not to exceed 4
25 to 36	Not to exceed 6
Over 36	Not to exceed 8

The above backfill lift limitations are not applicable when water saturation is done by the jetting method. Where mechanical compaction is used, backfill shall be placed in lifts the height of which shall not exceed that which can be effectively compacted depending on the type of material, type of equipment and methods used, and under no circumstances shall exceed 4 feet.

Backfill, around utilities that are exposed during trench excavation, shall be placed in accordance with the bedding methods.

**603.4.4 Compaction Densities:** Unless otherwise provided in the plans and/or special provisions, the trench backfill shall be thoroughly compacted to not less than the densities in Table 603-2 when tested and determined by AASHTO T-99 and T-191 or ASTM D6938. When AASHTO T-99, method A or B, and T-191 are used for density determination, ARIZ-227c will be used for rock correction. All compaction discussed within this section shall be performed within 2 percentage points of optimum moisture content unless otherwise noted in the project plans or project specifications.

The density required will depend on the Type shown on the plans and/or called for in the special provisions. Density required for each type shall comply with Table 603-2.

TABLE 603-2				
MINIMUM TRENCH COMPACTION DENSITIES				
Backfill Type	Location	From Surface to 2 feet Below Surface	From 2 feet Below Surface To 1 foot Above Top of Pipe	From 1 foot Above Top of Pipe to Bottom of Trench
I	Under any existing or proposed pavement, curb, gutter, sidewalk, or such construction included in the contract, or when any part of trench excavation is within 2-feet of the above.	100% for granular 95% for non-granular	90%	90%
II	On any utility easement street, road or alley right-of-way outside limits of (I).	85%	85%	90%
III	Around any structures or exposed utilities.	95% in all cases		

Note: The type required will generally be shown on the plans and the plans will govern. Where no type is shown on the plans, the type shall comply with Table 603-2.

A consideration in determining the backfill Types as shown on the plans, is based on the trench widths as shown in the Contract Documents. If these trench widths increase beyond those widths referred to above and fall within the 2-foot limit of paved surfaces and other improvements due to construction exigencies, the backfill designation for that portion within the 2-foot limit of such improvements shall be Type I even though Type II backfill is shown on the plans.

**603.4.5 Compaction Methods:** For flexible pipe installations where the backfill and bedding material is coarse aggregate, mechanical compaction shall be the only method for consolidating backfill and bedding. Water consolidation shall not be used as a method of compaction for coarse aggregate whether used as a foundation, bedding or backfill material.

For flexible pipe installations where the backfill material is other than coarse aggregate, consolidation shall be by mechanical means. Water consolidation may be used as a compaction method for the backfill material only when prior written approval to do so is provided by the Engineer.

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**603.4.6 Specifications for Material:** Coarse aggregate shall consist of crushed rock as defined in Section [701.2](#) with 100 percent of the specified size of aggregate having one fractured face tested in accordance with ARIZ-212, and having the gradation complying with ASTM D448, Table 1, Size Numbers 6, 67, 68, 7, 78, or 8 as recommended by the Engineer. The gradation size number to be furnished shall be shown on the plans or in the project specifications.

**603.4.7 Rights-Of-Way Belonging to Others:** Backfill and compaction for irrigation lines of the Salt River Valley Water Users' Association and Roosevelt Irrigation Districts and for trenches in State of Arizona and Maricopa County right-of-way outside the limits of the Contracting Agency shall be accomplished in accordance with their permit and/or specifications.

**603.4.8 Test Holes:** Boring logs shown on the plans do not constitute a part of the contract and are included for the Contractor's convenience only. It is not intended to imply that the character of the material is the same as that shown on the logs at any point other than that where the boring was made. The Contractor shall satisfy himself regarding the character and amount of rock, gravel, sand, silt, clay and water to be encountered in the work to be performed.

**603.4.9 Foundation and Bedding for Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines:** Foundation and bedding for these underground facilities shall be native material or sand which conforms to the grading requirement of ASTM C33 for fine aggregate. When backfill material consists of aggregate base course, crushed stone, or other material containing stones, only sand will be used for foundation, and bedding. The foundation depth shall be six inches and bedding depth shall be one foot above the top of the facility. Compaction will be in accordance with Section [603](#).

### 603.5 PREPARING AND INSTALLING FLEXIBLE PIPE:

When requested in the Special Provisions or by the Engineer prior to installation, the Contractor shall furnish to the Contracting Agency an affidavit (certification) from the pipe manufacturer (or his designee) stating that the Contractor is familiar with the manufacturer's suggested installation methods and procedures and the installation complies with those procedures and is consistent with MAG requirements.

Also, when required in the Special/Technical Provisions or requested by the Engineer, the pipe manufacturer or his designee will review the Contractor's methods and procedures for pipe installation in the field. The Contractor will make any adjustments in the installation as recommended by the manufacturer or his representative. If necessary, the Contractor may be required to reinstall or provide corrections to pipe installed prior to the field review at no cost to the Agency. Once the manufacturer or his representative has reviewed the Contractor's installation methods and the Contractor has adjusted his installation methods as recommended by the same, the manufacturer or his representative shall furnish to the Contracting Agency an affidavit (certification) that the Contractor's installation methods and procedures, at the time of the review, complied with the manufacturer's installation practices. The affidavit must provide the name of the manufacturer's representative witnessing the pipe installation.

**603.5.1 Storage and Handling:** Pipe shall be stored and handled in such a way to minimize out-of-roundness. Pipe shall be stored in shaded areas to minimize adverse effects of thermal, and ultraviolet exposure.

Pipe that is out-of-round in excess of 3% of the nominal pipe diameter as specified in Section [738](#), shall not be installed and shall be removed if installed.

**603.5.2 Strutting:** Strutting of Profile HDPE pipe (meeting ASTM F894) per Section [738](#) will be required when the diameter is 42 inches or larger. For Profile HDPE pipe (meeting ASTM F894) with diameters smaller than 42 inches, strutting may be required at the discretion of the Engineer. Strutting of corrugated metal pipe per Section [721](#), corrugated HDPE pipe per Section [738](#), SRPE pipe per Section [739](#), PP pipe per Section [740](#) and PVC pipe per Section [745](#) is not required.

Strutting consists of placing wood struts, whose length is typically 3% longer than the nominal pipe diameter, inside the pipe. A minimum of three (3) sets of struts are placed in each pipe length, oriented vertically, spaced equally throughout the length of pipe and set so as not to interfere with the jointing of the pipe. The struts shall be kept in place until the bedding material is placed and compacted around the pipe. The struts must be removed before any

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backfill or bedding is placed above the pipe. The procedure of strutting the pipe shall not damage the pipe in any way. If the pipe is out of round, the struts will be placed in the long direction of the out-of-round. If the strut cannot be held in place by the pipe, the pipe will be removed from the job site per Subsection [738.9](#).

**603.5.3 Orienting:** If the pipe is out-of-round, the pipe should be oriented so that the long axis is placed vertically when installed in the trench. When struts are used, the struts shall be oriented vertically when pipe is installed in the trench.

**603.5.4 Installing Pipe:** Flexible pipe and fittings shall be installed in accordance with ASTM D2321 (AASHTO Section 26 for corrugated metal pipe) or manufacturer's recommendation. Flexible pipe shall be handled so as not to damage the pipe. Hoisting shall be accomplished with cloth belt slings or ropes. The pipe shall be protected by wood blocking when jointing is accomplished by pipe jacking, back hoe bucket, come-along, or cable pipe puller.

### **603.6 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:**

**603.6.1 Grading:** The Contractor shall do such grading in the area adjacent to backfilled trenches and structures as may be necessary to leave the area in a neat and satisfactory condition approved by the Engineer.

**603.6.2 Restoring Surface:** All streets, alleys, driveways, sidewalks, curbs, or other surfaces, in which the surface is broken into or damaged by the installation of the new work, shall be resurfaced in kind or as specified to the satisfaction of the Engineer in accordance with Section [336](#).

**603.6.3 Cleanup:** The job site shall be left in a neat and acceptable condition. Excess soil, concrete, etc., shall be removed from the premises.

**603.6.4 Temporary Pavement:** The Contractor shall install temporary asphalt pavement or the first course of permanent pavement replacement in accordance with Section [336](#) immediately following backfilling and compaction of trenches that have been cut through existing pavement. Except as otherwise provided in Section [336](#), this preliminary pavement shall be maintained in a safe and reasonably smooth condition until required backfill compaction is obtained and final pavement replacement is ordered by the Engineer. Temporary paving removed shall be hauled from the job site and disposed of by the Contractor at no additional cost to the Contracting Agency.

### **603.7 PAYMENT:**

No pay item will be included in the proposal, nor direct payment made for trench excavation, backfilling, compaction, or placement of temporary pavement. The cost of these features of work shall be included in the unit price per bid per linear foot for furnishing and laying pipe.

*- End of Section -*

## **SECTION 615**

### **SEWER LINE CONSTRUCTION**

#### **615.1 DESCRIPTION:**

The construction or extension of sewer lines shall conform to the applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

Concrete pipe shall conform to Section 735. High density polyethylene (HDPE) pipe shall conform to Section 738. Vitrified clay pipe shall conform to Section 743. Polyvinylchloride (PVC) pipe and fittings shall conform to Section 745. Polypropylene (PP) pipe and fittings shall conform to Section 740. Steel reinforced polyethylene (SRPE) pipe and fittings shall conform to Section 739.

#### **615.2. TRENCHING:**

Excavation of trenches shall be accomplished in accordance with Section 601 for rigid pipe and 603 for flexible pipe.

The Engineer shall furnish the Contractor alignment and elevation stakes at agreed-upon intervals and offset together with cut sheets showing the difference in elevation from the top of the stakes to the flow line of the pipe.

The trench shall be dry when the fine grading of the bottom of the trench is accomplished. Before placement of pipe the fine grade shall be carefully checked by use of a string line, laser beam, or other means so that when in final position the pipe will be true to line and grade  $\pm 0.05$  feet for 8 inches through 12 inches,  $\pm 0.10$  feet for 15 inches and larger.

For rigid pipe, the width of the trench shall be per Table 601-1. For flexible pipe, the width of the trench shall be per Table 603-1.

#### **615.3 SEPARATION**

To protect water lines from contamination by sewer lines, separation and extra protection shall be in accordance with Section 610.

Sewer lines that are constructed of ductile iron pipe for extra protection shall be internally lined for sewer service.

#### **615.4 LAYING PIPE:**

Pipe shall be of the type, class and size called for on the plans. All pipe shall be protected during handling against impact shocks and free falls. No damaged or defective pipe shall be installed in the work. Pipe shall be kept clean at all times, and as the work progresses, the interior of the pipe shall be cleared of all dirt and superfluous materials of every description.

The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flowline. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

The alignment and grade of each length of pipe shall be checked after setting by measurement from the string line, laser beam target or other means approved by the Engineer.

At all times when work is not in progress, open ends of the pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no water, earth or other substance will enter the pipe or fittings.

Thermoplastic pipe and fittings shall be installed in accordance with ASTM D2321. HDPE Profile pipe (meeting ASTM F894) bedding shall comply with Subsection 603.4. Flexible pipe bedding shall be placed in two lifts. The first lift will be from the bottom of the trench to the spring line of the pipe. The second lift will be from the spring line to one foot above the top of the pipe. Separate inspections will be required on each lift. The Contractor shall place the first lift in a manner that will insure uniform support under the haunches and proper alignment of the pipe.

#### **615.5. FITTINGS:**

All fittings shall conform to the requirements of the pipe specifications and shall be located as shown on the plans, or as directed by the Engineer, in accordance with the standard details.

#### **615.6 JOINTING:**

615.1 Rubber Gasket Joints: Prior to making pipe joints, all surfaces of the portions of the pipes to be joined shall be cleaned, dried, and prepared in accordance with the manufacturer's recommendations. The joints shall then be carefully centered and completed.

Trenches shall be kept water-free during the installation of joints and couplings.

The joint and coupling materials will be as specified in the appropriate pipe sections and shall be installed in accordance with the manufacturer's recommendations. Cement mortar joints will NOT be permitted in sanitary sewer construction.

615.6.2 Water Stops: Water stops will be required when connecting flexible pipe to concrete structures, manholes, etc. The water stop shall comply with Section 738 and will be installed per manufacturer recommendations.

#### **615.7 SANITARY SEWER SERVICE TAPS:**

When the construction of sanitary sewer service taps are called for in the special provisions, they shall be constructed in accordance with standard details for sewer taps except for HDPE pipe.

To maintain structural integrity of the pipe, service taps for HDPE pipe shall be constructed in accordance with the manufacturer's recommendations.

When any damage occurs to the pipe ribs or wall, outside the tap area, the Contractor shall perform repairs, as recommended by the manufacturer at no cost to the Contracting Agency. Damage to the pipe will include but not be limited to gouging, marring, and scratching forming a clear depression in the pipe.

The locations of the service tap for each property shall be in the downstream 1/3 of the lot, or as requested by the property owner. Sewer service taps shall not be covered until they have been plugged and marked in accordance with standard details and their location has been recorded by the Engineer. Electronic markers shall be placed at no greater depth than electronic locating devices can locate them (typically 2'-4').

#### **615.8 SANITARY SEWER CLEANOUTS:**

The cleanouts shall be constructed at locations shown on the plans, in accordance with the standard details for cleanouts.

#### **615.9 MANHOLES:**

Manholes shall be constructed to conform with the requirements of Sections 625, Section 505 and standard details.

#### **615.10 BACKFILLING:**

Backfilling and compaction shall be done in accordance with Sections 601 for rigid pipe and 603 for flexible pipe.

## **615.11 TESTING:**

Pressure testing of force mains shall be done in accordance with Section 610.15.

Sewers and pipe lines shall be subject to acceptance testing after backfilling has been completed but prior to the placement of the finished surface material.

The Contracting Agency reserves the right to require testing of the entire installation. Cost of repairs or corrections necessary to conform to the following testing requirements will be borne by the Contractor at no additional cost to the Contracting Agency.

### **(A) Low Pressure Air Test:**

Testing will be accomplished by the means of "Low Pressure Air Testing." Tests may be conducted by the Contractor or an independent testing firm. However, acceptance tests shall be made only in the presence of the Engineer.

#### **Test Procedure:**

- (1) Before testing, the pipe shall be thoroughly cleaned.
- (2) The Contractor shall seal off the section of pipe to be tested at each manhole connection. Test plugs must be securely braced within the manholes.
- (3) A minimum of two connecting hoses to link the air inlet test plug with an above ground test monitoring panel must be provided.
  - (a) One hose is to induce air through the test plug and into the test chamber.
  - (b) The second hose is for the purpose of monitoring the test pressure from within the enclosed pipe.
- (4) **UNDER NO CIRCUMSTANCES ARE WORKERS TO BE ALLOWED IN THE CONNECTING MANHOLES WHILE A PRESSURE TEST IS BEING CONDUCTED.**
- (5) Add air slowly into the test section. After an internal pressure of 4.0 psi is obtained, allow internal air temperature to stabilize.
- (6) After stabilization period, adjust the internal air pressure to 3.5 psi, disconnect the air supply and begin timing the test.
- (7) Refer to Table 615-1 to determine the length of time (minutes) the section under test must sustain while not losing in excess of 1 psi as monitored by the test gauge. If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.
- (8) Sections so determined to have lost 1 psi or less during the test period will have passed the leakage test. Those sections losing in excess of 1 psi during the test period will have failed the leakage test.
- (9) Appropriate repairs must then be completed and the line retested for acceptance.

TABLE 615-1			
SANITARY SEWER AIR TEST			
Minimum Test Time for Various Pipe Sizes*			
Nominal Pipe Size, in	T (time), min/100 ft	Nominal Pipe Sizes, in.	T (time), min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

\*The time has been established using the formulas contained in ASTM C828, Appendix.

(B) Hydrostatic Test

Exfiltration Testing (water):

Sanitary sewer testing by means of exfiltration should only be considered when low pressure air testing cannot be used and only with approval of the Engineer.

Testing Procedure:

- (1) The Contractor shall furnish all equipment for testing.
- (2) Seal off the downstream end of the line and fill with water to a minimum head of 4 feet in a stand at the high end.
- (3) A period of at least one hour will be allowed for absorption time before making the test.
- (4) A suitable meter or method of measuring the quantity of water used in necessary.
- (5) The allowable water loss for sanitary sewers shall not exceed 0.158 gallons per hour per 100 feet of pipe per inch of diameter of pipe under a minimum test head of 4 feet above the top of the pipe at the upper end.

(C) Deflection Test for flexible Pipe:

In addition to the tests prescribed above, the Contractor shall perform a deflection test on the system as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the published inside diameter shall be corrected.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long term deflection of the sewer. If the Contracting Agency determines that the deflection has exceeded 7.5% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

(D) Closed Circuit T.V. Inspection:

The Contracting Agency reserves the right to visually inspect the interior of the sewer line using a television camera. Any defects in the pipe or construction methods revealed shall be corrected by the Contractor at no additional cost to the Contracting Agency.

The Contracting Agency will pay for the initial T.V. inspection. Any additional inspection(s) required, due to failure of the initial inspection, shall be paid for by the Contractor.

**615.12 PAVEMENT AND SURFACING REPLACEMENT:**

Pavement and surfacing replacement shall be done in accordance with Section 336.

### **615.13 CLEAN UP:**

The Engineer has the right to close down forward trenching and pipe laying where testing, backfill, compaction and cleanup does not follow in an orderly manner.

### **615.14 MEASUREMENT AND PAYMENT:**

(A) Sewer Pipe and Fittings: (Vitrified clay, cast iron and other approved types of pipe.)

Measurement will be made horizontally through manholes and fittings and from centerline to centerline of structures, for the various types and sizes of pipe called for on the plans and in the proposal.

Payment for the various sizes and types of pipe will be made at the unit price bid per linear foot, and shall be compensation in full for furnishing and installing the pipe and fittings complete in place, as specified, including excavation, removal of obstructions, backfilling, water settling, compaction, sheeting and bracing, testing, and all incidental work not specifically covered in other pay items.

(B) Sanitary Sewer Service Taps:

Measurement will be the number of taps installed.

Payment will be made at the unit price bid and shall be compensation in full for furnishing and installing pipe and fittings complete in place, as specified and called for on the plans and standard details, including all cost of excavation, removal of obstructions, shoring and bracing, backfilling, compaction, pavement replacement, maintenance of traffic, and all work incidental thereto.

(C) Sanitary Sewer Cleanouts:

Measurement will be the number of cleanouts installed.

Payment will be made at the unit price bid and shall be compensation in full for furnishing and installing pipe, fittings, and frame and cover as called for on the plans and in accordance with the standard details.

-End of Section-

## SECTION 618

### STORM DRAIN CONSTRUCTION

#### 618.1 DESCRIPTION:

This section covers concrete pipe line and flexible pipe line construction used for the conveyance of irrigation water and storm drainage in streets, easements, and alley right of ways, under low hydrostatic heads.

Installation of pipe in laterals of Salt River Valley Water Users' Association or other irrigation districts shall conform to the specifications and permit of the respective irrigation district.

Installation of pipe in State Highways shall conform to the specifications and permit of the Arizona Department of Transportation.

#### 618.2 MATERIALS:

The concrete pipe and flexible pipe, specials, joints, gaskets, and testing shall be according to Sections 620 or 735, 736, 738, 739, and 740 except as specified below or as modified by special provisions.

(A) Specials: Pipe specials such as closure pieces, wyes, tees, bends, and manhole shafts shall be provided as indicated on the plans, and such specials shall be made equal in strength, diameter, and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing, or steel items. Drawings of specials shall be submitted to the Engineer for approval before their fabrication.

(B) Rubber Gasket Joints: When rubber gasket pipe is used, the joint shall be sealed with a continuous ring gasket made of a special composition rubber of such size and cross-section as to fill the annular space provided for it. The gasket shall be the sole element depended upon to make the joint watertight, and shall have smooth surfaces, free from pits, blisters, porosity, and other imperfections.

- (1) Rubber Gaskets for RCP shall be in accordance with ASTM C443 or AASHTO M315.
- (2) Rubber Gaskets for flexible pipe shall be in accordance with ASTM F477.

(C) Water Stops: Water stops will be required when connecting HDPE pipe to concrete structures, manholes, etc. The water stop shall comply with Section 738 and will be installed per manufacturer recommendations.

(D) Cement Mortar Joints for RCP will be in accordance with Subsection 736.3.

#### 618.3 CONSTRUCTION METHODS:

Excavation, bedding, backfilling, and compaction or consolidation of backfill and bedding of trenches shall be accomplished in accordance with Sections 601 for rigid pipe and 603 for flexible pipe, except as specified below, or as modified by special provisions.

The Contractor shall over-excavate the trench and fill with select materials in accordance with standard details.

Where the cover over the top of the pipe is less than 10 feet, the maximum trench width is unrestricted. The pay width, however, for pavement replacement shall remain in accordance with Section 336. For pipe, with 10 feet or more cover, the maximum trench width shall be as required by Sections 601 for rigid pipe and 603 for flexible pipe.

The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden off-sets of the flow line. Any adjustment to the line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

Variation from prescribed alignment and grade shall not exceed 0.10 foot and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet of pipe line unless otherwise approved by the Engineer. For closures and deflection angles greater than 10 degrees, joint shall be made by use of a bend, specifically manufactured fitting, or by a concrete collar, per standard details. Pipe shall be the type, class and size shown on the plans or in the special provisions.

All pipe, for permit construction, shall be reinforced concrete pipe, ASTM C76 Class III or HDPE pipe in accordance with ASTM F894, AASHTO M252 or AASHTO M294, PP pipe in accordance with AASHTO M330, ASTM F2736, or ASTM F2764, SRPE in accordance with ASTM F2562. For reinforced concrete pipe, the minimum cover from the top of the pipe to the finished grade shall be 2 feet and the maximum cover shall be 12 feet. The minimum and maximum cover for flexible pipe shall be as specified in the special provisions or the manufacturer's recommendations.

All pipes installed under railroad tracks shall be included in AREMA specifications and the minimum cover over all pipe shall be as specified in the railroad permit and/or special provisions. Bedding shall be in accordance with standard details.

The allowable water loss for irrigation lines shall not exceed 2 gallons per hour per 100 feet of pipe per inch of diameter of pipe, under a minimum test head of 1 foot above the top of the pipe at the upper end when tested in accordance with the procedures of Section 615.

#### **618.4 JACKING PIPE:**

At locations where jacking is required, the storm drain line shall be installed by jacking to the lengths indicated on the plans, in accordance with the following. The methods and equipment used in jacking reinforced concrete pipe conduit shall be optional with the Contractor, provided that the proposed method is first approved in writing by the Engineer. Such approval, however, shall in no way relieve the Contractor of the responsibility for damages of any nature which might occur as a result of the methods used.

Only workmen experienced in the operation of jacking concrete conduit shall be used.

The driving ends of the conduit shall be properly protected and the conduit shall be driven true to alignment and grade. The deviation from true line and grade at any single point within the jacked portion shall be limited to 0.5 feet horizontal deviation from line and +/- feet vertical deviation from grade.

Any section of conduit which may show signs of failure shall be removed and replaced with a new section of precast conduit or with a cast-in-place section, which in the opinion of the Engineer is adequate to carry the loads imposed upon it. In this respect it shall be understood that where pipe is specified on the drawings to be jacked into place the jacked pipe shall be reinforced concrete of the strength specified in these specifications and the design of such pipe is based upon superimposed loads and not upon loads which may be placed upon the pipe as a result of jacking operation. Any increase in pipe strength required in order to withstand jacking loads shall be the responsibility of the Contractor. The reinforcing shall be circular and of either single or double cage design.

Spacer blocks shall be placed in the inside circular space which will allow sufficient width for point mortaring when jacking is completed and to equalize pressure during jacking. Three grout holes per 8-foot section of pipe shall be made during manufacturing.

Double rubber gaskets and band type joints shall be provided for 36 inches diameter and larger pipe.

One hole shall be made on the top midway between the ends. Two additional holes, each approximately 1.5 feet from each end and approximately midway between the springline and top on opposite sides shall be made.

Where the nature of the soil, or the structure under which the conduit is being jacked is such that, there is increased danger of a cave-in or damage to said structure, the method of jacking the conduit shall be as specified below.

The leading section of conduit shall be equipped with a jacking head securely anchored thereto prevent any wobble or alignment variation during jacking operations. The length and details of the jacking head shall be subject to the written approval of the Engineer. Excavation shall be carried out entirely within the jacking head and no excavation in advance thereof will be permitted. Every effort shall be made to avoid any loss of earth outside of the jacking head. Excavated material shall be removed from the conduit as excavation progresses, and no accumulation of such material within the conduit will be permitted.

Upon completion of the jacking operations, all voids around the outside face of the conduit shall be filled by grouting through each of the previously constructed grout holes to the satisfaction of the Engineer. The grout shall be a mixture of one part cement to three parts sand and a mixture by volume.

Grouting equipment and material shall be on the job before jacking operations are started in order that grouting around the jacked conduit may be started immediately after the jacking operation. After grouting, the holes in the conduit shall be repaired to the satisfaction of the Engineer.

#### **618.5 VIDEO INSPECTION OF NEW MAINLINE STORM DRAINS:**

The Contractor shall provide the Engineer with an annotated video inspection record (either VHS or DVD format) of the new mainline storm drain pipeline. The video shall clearly show all joints, seals, connecting pipes, and manholes. This video shall be provided to the Engineer, and reviewed and approved by the Engineer prior to the Contractor being allowed to place the final pavement over the storm drain line. No separate payment will be made for this inspection; the cost of the video inspection shall be included in the cost of the pipe.

#### **618.6 MEASUREMENT:**

(A) Main Line Pipe: Shall be the number of linear feet pipe laid as measured along the pipe axis.

(B) Connecting Pipe: Shall be the number of linear feet of pipe installed, as measured along the pipe axis from a main line pipe, or a manhole, or a catch basin to a catch basin, or a plugged end, and shall include the portions of the connecting pipe embedded in the above structures.

(C) Jacked Pipe: Shall be made at the ground surface and shall be the number of linear feet of ground surface undisturbed by the cut and cover construction on either side of the jacked section.

#### **618.7 PAYMENT:**

(A) Main Line Pipe: Will be paid at the unit price bid per linear foot, to the nearest foot, for each size and type of pipe and shall be compensation in full for furnishing and installing the type of pipe as specified and as shown on the plans including removals of obstructions, excavation, bedding, backfilling, compacting, testing, joint materials, joining, collars, and field closures.

(B) Connecting Pipe: Will be paid at the unit price bid per linear foot, to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing complete in place as shown on the plans and as specified, the connecting pipe and specials including spur connections, removal of obstructions, excavations, bedding, backfilling, compacting, joint materials, joining, collars, field closures, and testing.

(C) Jacked Pipe: Will be paid the same as for main line pipe.

-End of Section-