SECTION 508
SANITARY SEWER PIPE

508-1 DESCRIPTION

The work under this section shall consist of furnishing and installing sanitary sewer pipe and all other appurtenant materials required including excavation and the furnishing, placing and compacting of backfill material, all in accordance with the details shown on the plans and the requirements of these specifications.

The contractor shall furnish and install sanitary sewer pipe, as specified on the plans at each location. Special sections, fittings, elbows, branch connections, tapered inlets, connectors, coupling, and other such items shall be of the same material and coating as the pipe to which they are attached.

508-2 MATERIALS

508-2.01 General. At each location where a pipe is to be installed, the project plans will specify the pipe-type and size and approximate length along with the requirements for each approved option at that location, such as wall thickness, coatings, lining, class and strength.

508-2.02 Sanitary Sewer Pipe. Sanitary sewer pipe materials for both gravity flow sewers and pressure sewers shall conform to the requirements of Subsection 1010-3.

508-2.03 Concrete for Pipe Encasement. Portland cement concrete for pipe encasement shall conform to the requirements found in Section 1006 for Class B concrete.

508-2.04 Controlled Low Strength Material (CLSM). Materials comprising controlled low strength material shall conform to the requirements of Section 1006. CLSM mix designs shall be in accordance with Subsection 501-2.03, Table 501-1 unless otherwise designated on the plans, in the Special Provisions or directed by the Engineer.

508-2.05 Bedding Material. Aggregate for bedding material shall conform to the gradation requirements for rigid and flexible sanitary sewer pipe found on Standard Detail WWM 104 and WWM 105 respectively.

Bedding material for all concrete or plastic pipe installations shall have a pH value between 6.0 and 12.0, inclusive. Tests for pH and resistively shall be in accordance with the requirements of Arizona Test Method 236.

508-2.06 Shading Material. Aggregate for shading material shall conform to the gradation requirements for rigid and flexible sanitary sewer pipe found on Standard Detail WMM 104 and WMM 105 respectively.
Shading shall have a pH value between 6.0 and 12.0 for all concrete or plastic pipe installations. Tests for pH and resistively shall be in accordance with the requirements of Arizona Test Method 236.

508-2.07 Trench Backfill Material. Trench backfill material for sanitary sewer pipe shall not contain organic material, rubbish, debris and other deleterious material and shall not contain solid material which exceeds 8 inches (200 millimeters) in greatest dimension and shall be soil selected from excavation or from a source selected by the contractor and approved by the Engineer.

Trench backfill material for sanitary sewer pipe within the roadway prism shall also conform to the gradation requirements of the agency in whose right-of-way the pipe is to be installed.

508-3 CONSTRUCTION DETAILS

508-3.01 Preparation of Foundations, Trenches, and Embankments. Trenches for sanitary sewer pipe installations shall be in conformance with the Standard Details unless otherwise noted on the plans or in the Special Provisions.

A trench condition is defined as a trench which has vertical slopes to a point at least 1 foot (300 millimeter) above the top of the pipe and its maximum width is as detailed on the Standard Details or project plans.

The contractor shall comply with all Occupational Safety and Health Administration (OSHA) regulations pertaining to trenching operations.

Where rock, hardpan, or other unyielding material is encountered, such material shall be removed below the vertical limits as shown on the plans. The depth to be removed shall be at least 12 inches (300 millimeters) or as designated by the Engineer. The width to be removed shall be the width of the trench, as shown on the Standard Details or project plans. This width shall be maintained throughout the additional depth. The over excavated area shall be backfilled with structure backfill material as designated in subsection 203-5.02 and compacted in layers not exceeding 6 inches (150 millimeters) in depth.

When a firm foundation is not encountered at the bottom of the vertical limits as shown on the plans due to soft, spongy, or other unstable soil, such unstable soil shall be removed for a width of at least the horizontal outside dimension of the pipe on each side of the pipe and to the depth specified by the Engineer. The unstable soil removed shall be replaced with structure backfill material as designated in Subsection 203-5.02 and compacted in layers not exceeding 8 inches (200 millimeters) in depth.
SECTION 508

The completed foundation shall be firm for its full length and width. When specified on the project plans, the foundation shall have longitudinal camber of the magnitude specified.

Unless otherwise approved, in writing, by the Engineer, the maximum length of open trench for all installations shall be 500 lineal feet (150 meters) or the contractor's daily installation length, whichever is greater.

508-3.02 Bedding.

(A) Placement of Bedding Material. All trash, forms, sheeting, bracing, and loose rock or loose earth shall be removed from the area into which bedding material is to be placed.

Bedding material shall be placed in uniform horizontal layers not exceeding 8 inches (200 millimeters) in depth before compaction.

Bedding material shall be placed under and around the pipe to the elevation at the point of maximum width of the pipe (springline), as shown on the plans or as noted on the Standard Details. At the contractor's option, bedding material may be placed above the springline of the pipe.

Bedding material shall be placed in a manner which will prevent distortion, damage to, or displacement of the pipe from its intended location. Bedding material shall also be placed so that adequate support will be provided in the haunch support areas of the pipe. Voids or loose soils which are found to occur due to improper placement or compaction of bedding materials will result in rejection of that portion of the pipe installation. Replacement of the pipe will be at the contractor's expense.

(B) Compaction of Bedding Material. Unless otherwise specified in the Standard Details, bedding material shall be compacted to at least 95 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Compaction of bedding material shall be performed without damage to the pipe and surrounding in-place material. Special care shall be taken in placing, shaping and compacting all bedding material under haunches of pipe to prevent moving the pipe or raising it from its bedding.

508-3.03 Installation of Sanitary Sewer Pipe

(A) General. Only those materials specified shall be utilized to construct public sanitary sewerage system facilities. Other materials shall be utilized only upon approval by the Engineer.

Sanitary sewer pipe and appurtenances shall be handled in such a manner as to insure delivery to the trench in sound and undamaged condition. Sanitary sewer pipe shall be unloaded opposite or near the location at which it will be installed. The sanitary sewer
SECTION 508

Pipe shall not be stored along a residential street for more than ten days or along a business street for more than three days. The interior of the pipe shall be thoroughly cleaned of foreign material before being lowered into the trench.

Repairs shall be allowed only when approved by the Engineer. Repairs shall be made in conformance with the requirements specific to the pipe material as herein noted.

Laying of sanitary sewer pipe shall be in finished trenches free from water and debris. Installation of sanitary sewer pipe shall be commenced at the lowest point of the system with the spigot ends pointing in the direction of the flow. Each pipe shall be laid true to line and grade, with uniform support under the full length of the pipe barrel.

Pipe sections shall be laid and joined in such a manner that the offset of the inside of the pipe at any joint will be held to a minimum at the invert. The maximum offset at the invert of pipe shall be one percent of the inside diameter of the pipe, or 3/8 inch (10 millimeters), whichever is smaller.

Upon installation, the meeting surfaces shall be wiped clean of dirt and foreign matter, then an approved lubricant shall be applied at the joint surfaces. The spigot shall be positioned inside the socket and the installation completed.

Any adjustment of line and grade shall be made by excavating or filling under the pipe. Wedging or blocking under the pipe ends is prohibited.

Fittings shall correspond in all respects with the requirements specified for pipe of the corresponding size.

Fittings shall be made to such lengths as will accommodate the joining system provided. Tee and wye fittings shall be furnished with spurs of the size specified, securely and completely fastened to the barrel of the fitting in the process of manufacture.

The spurs of tee fittings shall have their axes perpendicular to the longitudinal axis of the fitting. The spur of the wye fittings shall have their axes at angles of approximately 45 degrees to the longitudinal axis of the fitting, measured from the socket or bell end of the fitting. The barrel of each spur shall be of sufficient length to permit making a proper joint.

Spurs shall not project inside the inner surface of the barrel. The barrel of each spur shall be of sufficient length to permit making a proper joint with the connecting pipe.

Plugs shall be furnished and installed in all branch spurs that are left unconnected and at the upper end of each house connection sewer. The plugs shall be strong enough to sustain all applied earth and hydrostatic loads including those due to field hydrostatic tests or air tests.

280
SECTION 508

Plugs for branch pipes having flexible compression joints may be either clay discs with flexible compression joints, factory applied, that will mate with the branch joint; or a resilient material of controlled design and dimensions for mating with the branch pipe to which it is to be applied; or of other material approved by the Engineer. Plugs shall not be adversely affected when exposed to chemical and bacteriological environments. When installed and braced in place in branch spurs, plugs shall withstand a hydrostatic pressure test of 10 psi (70 kilopascals) with no leakage.

Whenever work is not in progress, open pipe ends shall be securely closed so that no water, earth or other substance will enter the pipe or fittings. If, prior to testing, any debris is found in the pipe, the pipe shall be cleaned by propelling with water a snug-fitting inflated ball through the pipe or by using other adequate methods.

(B)Vitrified Clay Pipe (VCP). Vitrified clay pipe shall conform to the requirements of Subsection 1010-3.02.

The inside diameter of vitrified clay pipe shall not vary from a true circle by more than three percent of its nominal diameter. The average inside diameter shall be determined by taking any two 90 degree opposing measurements and averaging the readings.

Vitrified clay pipe shall not deviate from a straight line by more than 1/16 inch per foot (5 millimeters per meter) of length when the offset is measured from the concave side of the pipe. Measurement shall be taken by placing a straightedge of the concave side of the pipe's full length of the barrel, being sure not to include spigot joint material or socket, and measuring the maximum distance between the straightedge along concave side of pipe.

Vitrified clay pipe of nominal inside diameters from 3 to 18 inches (75 to 450 millimeters) shall have no blister with a dimension exceeding 3 inches (75 millimeters) and no blister or pimple shall project more than 1/8 inch (3 millimeters) above the surface of the pipe. Pipe of nominal sizes over 18 inches (450 millimeters) shall have no blister exceeding 2 inches per foot (167 millimeters per meter) of internal diameter, and no blister or pimple shall project above the surface of the pipe more than 1/8 inch per foot (10 millimeters per meter) of internal diameter. The pipe shall have no broken blisters.

There shall be no fractures or cracks passing through the barrel or socket, except that a single crack at the spigot end of the pipe not exceeding 75 percent of the depth of the socket, or a single fracture in the socket not exceeding 3 inches (75 millimeters) around the circumference nor 2 inches (50 millimeters) lengthwise, may be permitted. Chips or fractures on the interior of the pipe shall not exceed 2 inches (50 millimeters) in length, 1 inch (25 millimeters) in width, and a depth of one fourth of the thickness of the barrel. A single pipe shall contain no more than two such defects.
Prior to installation, vitrified clay pipe larger than 15 inches in diameter which is structurally sound may be repaired. These repairs include the cleaning out of cracks, the preparation of chipped surfaces, and the application of repair material.

Longitudinal cracks parallel to the pipe axis and as described below may be repaired, provided they were caused by shrinkage or drying and are not more than 1/32 inch (1 millimeter) wide:

Cracks on the exterior of the spigot that do not penetrate the entire barrel thickness and do not exceed 50 percent of the depth of the socket in length.

Cracks in the socket of the pipe that do not penetrate the entire thickness, and do not exceed 75 percent of the depth of the socket in length.

Cracks in the socket of the pipe that penetrate the entire thickness of the socket and do not exceed 50 percent of the depth of the socket in length.

Cracks in the interior of the socket and in the shoulder on the exterior of the socket which do not exceed three inches in length, and do not penetrate more than 20 percent of the wall thickness.

Surface chips located on the exterior of the spigot, the interior or exterior of the socket, or on the shoulder of the socket may be repaired provided:

The length of the chip as measured along its arc does not exceed twice the barrel thickness.

The width is not greater than 50 percent of the socket depth measured parallel to the axis.

The depth is not greater than 25 percent of the wall thickness measured perpendicular to the axis.

Full-depth chips located on the socket may be repaired provided the length of the chip does not exceed twice the barrel thickness or the width does not exceed 25 percent of the socket depth.

Repairs of any type at the spigot or socket or repairs to fittings shall be in accordance with the requirements specified in Subsection 1010-3.02.

Pipe having unauthorized repairs will be rejected. The Engineer may require retesting of any repaired pipe to demonstrate its soundness. The Engineer will supervise all repairs and inspections required in accordance with Subsection 1010-3.02. The Agency shall be reimbursed for all costs incurred for inspection and testing of the repaired pipe.
Joints for VCP shall be bell and spigot or plain end, and shall meet the requirements of ASTM C 425. The bell and spigot shall not vary from a true circle more than three percent of its nominal diameter when measured in accordance with the procedure outlined in this Section. The bell shall be concentric with the barrel of the pipe. Sealing components shall resist attack by chemicals (including a 10% by weight sulfuric acid solution) or combinations of chemicals normally present in domestic and industrial sewage, and shall resist bacterial attack.

Compression couplings shall incorporate continuous and internally positioned corrosion resistant shear rings. Coupling components shall be made of stainless steel of the following type:

- Clamps: 300 Series, Type 316
- Bolts: 300 Series, Type 305
- Nuts: 300 Series, Type 305

The clamps at both ends of the couplings shall be the "field take-up" type.

Fittings and stoppers shall meet the hydrostatic pressure testing requirements of the ASTM C 700 using the testing procedures of ASTM C 301. Joints shall not leak when subjected to the deflection, shear, and displacement tests as described in ASTM C 425.

(D) Ductile Iron Pipe (DIP). Ductile iron pipe shall conform to the requirements of Subsection 1010-3.02.

The pipe manufacturer shall certify that the pipe and the lining meet the requirements of these specifications. The certification shall state specifically the following:

All ductile iron pipe and fittings shall have an internal lining comprised of either a polyethylene (PE) or a combination of polyethylene and fusion bonded epoxy (PE/FBE) or a hybrid novolac epoxy, as appropriate. The internal lining thickness shall be 40 mils (1 millimeter) nominal (35 mils (.90 millimeters) minimum) in the barrel area, 10 mils (0.25 millimeters) minimum in the bell area and 10 mils (0.25 millimeters) minimum on the exterior of the spigot end.

Each piece of pipe and each fitting have been checked for holidays utilizing a testing voltage of 7500 volts with a dry conductive probe in the barrel area and a testing voltage of 67-1/2 volts with a wet sponge in both the bell area and the exterior of the spigot end, and that no holidays were found.

The PE, PE/FBE or hybrid novolac epoxy lining shall extend from the bottom of the gasket socket in the bell to a point on the exterior of the spigot end of the pipe where the next pipe gasket would overlap the lining.
SECTION 508

All PE, PE/FBE and hybrid novolac epoxies shall comply with the requirements of Subsection 1010-3.02(A) and (B).

A maximum lining thickness of 15 mils (0.38 millimeters) has been applied to both the gasket seat groove in the bell area and the exterior of the spigot end.

The Engineer may require the use of novolac epoxy caulking or other approved material during the assembly of all ductile iron pipe when deemed appropriate. The caulking or other approved material must be applied in sufficient quantity and at the proper location so that when the spigot end of the pipe is inserted into the bell end of another pipe, an impermeable seal is developed between the spigot end of one pipe section and the barrel to bell transition point of the other pipe section.

If the contractor makes a field cut of PE, PE/FBE or hybrid novolac epoxy lined pipe, the contractor shall comply with the recommendations of both the pipe and coating manufacturer in applying a hybrid novolac epoxy coating to the pipe end and in allowing proper drying time before pipe assembly. In all cases, a minimum, a 10 mil (0.25 millimeters) coating of hybrid novolac epoxy shall be applied to the pipe end and shall overlap the PE, PE/FBE or hybrid novolac epoxy lining by 4 inches (100 millimeters) and extend around the end of the pipe and along the outside of the pipe a minimum of 10 inches (250 millimeters) and shall also be allowed to dry before pipe assembly. In addition, the overlapped surface of the PE, PE/FBE or hybrid novolac epoxy lining shall be roughened to produce a 3 to 5 mil (75 to 125 micrometer) profile over the entire surface in order to insure proper adhesion for the hybrid novolac epoxy.

Holiday testing may be required by the Agency after pipe assembly when deemed appropriate. The testing and repair requirements shall follow the procedures called for in these specifications.

Repair of damaged sections of the PE, PE/FBE or hybrid novolac epoxy lining shall be in accordance with the lining manufacturer's recommendations or as specified below so that the repaired area is equal to the undamaged lined area in all respects. All damaged lined areas and holidays shall be repaired immediately.

There are no other provisions for repair of ductile iron pipe.

The requirements of ANSI/AWWA C105/A 21.5 for materials and installation procedures for polyethylene encasement of underground installations of ductile iron pipe shall be met. Clear polyethylene wrap shall be used. The clear polyethylene wrap shall be marked in accordance with the requirements of ANSI/AWWA C105/A 21.5.

Polyethylene wrap in tube or sheet form for piping encasement shall be manufactured from virgin polyethylene material conforming to the requirements of ANSI/ASTM Standard Specification D 4976. The specified minimum thickness is 0.008 inches (8 mils).
(D) Reinforced Concrete Pipe (RCP). Reinforced concrete pipe (RCP) shall conform to the requirements of Subsection 1010-3.03.

Prior to the start of manufacture of RCP, the contractor shall submit to the Engineer detailed shop drawings of the pipe, joints, reinforcement cage assemblies, pipe specials, and the pipe-laying diagrams. The laying diagram shall show the location, length, design designation, and number designation of each pipe section.

The D-Loads specified in the plans and specifications are those to produce a 0.01 inch (0.25 millimeter) crack at least 12 inches (300 millimeters) in length at the interior pipe surface.

All pipe shall be manufactured, handled, loaded, and shipped in such a manner that it will be delivered to the job site undamaged in sound condition and conforming in all respects to these Specifications.

Reinforced concrete pipe may be rejected for any of the following:

Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.

Defects that indicate imperfect proportioning, mixing, and molding.

Surface defects indicating honeycombed or open texture.

Damaged or cracked ends where such damage would prevent the making of a satisfactory joint.

Any continuous crack having a surface width of 0.01 inches (0.25 millimeters) or more and extending for a length of 12 inches (300 millimeters) or more, regardless of position in the wall of the pipe.

Any crack showing two visible lines of separation for a continuous length of 2 feet (610 millimeters) or more, or an interrupted length of 3 feet (915 millimeters) or more inside or outside. When required by the Engineer, any crack which is 0.01 inch (0.25 millimeters) wide or wider and is not a cause for rejection, shall be filled with neat cement grout composed of cement mixed with water to a fluid consistency.

Any crack that penetrates completely through the pipe wall.

Shattering or flaking of concrete at a crack.

Bubble voids on the pipe surface exceeding 1/4 inch (6 millimeters) in depth (unless pointed with mortar).

Blisters at pipe joints involving more than 1/4 the interior surface area, and any un-repaired blister.
SECTION 508

A piece broken from the end projections of the pipe which has circumferential length exceeding 60 degrees of the circle, or extends into the gasket contact surfaces of gasketed joint pipe for a circumferential length in excess of 6 inches (150 millimeters) (measured at the midpoint of the gasket contact surface on the bell end and at the inner shoulder of the gasket groove at the spigot end). If two or more pieces are broken from an end projection, the total length of such broken pieces on any end shall not exceed 90 degrees of the circle and there shall be a distance of at least 9 inches (230 millimeters) of sound concrete between breaks. The total length of broken pieces that extends into the gasket contact surfaces of gasketed joint pipe shall not exceed a circumferential length of 6 inches (150 millimeters). If less than 9 inches (150 millimeters) of sound concrete exists between two individual breaks, the two breaks shall be considered as one continuous break. Repair of such defects not exceeding the above limitations shall be made as described below. Unsound portions of end projections shall be removed and, if the pieces removed do not exceed the above limits, the pipe may be similarly repaired.

Reinforced concrete pipe may be repaired if approved, in writing, by the Engineer.

Unsound or imperfect concrete shall be removed by chipping. The edges shall be beveled. The area to be repaired shall be kept dry. Loose material and concrete dust remaining after the chipping operation shall be removed by means of an air jet. All concrete repair work shall be trimmed or ground smooth for a neat appearance on the surface.

Epoxy resins previously approved for such use by the Engineer shall be used in the manner prescribed by the Engineer. The prepared area shall be primed with epoxy resin compound, care being taken to ensure intimate contact with the base material. No other materials used in repair of imperfections or damaged pipe are acceptable and shall be rejected regardless of place and nature of repair. An approved epoxy resin shall be equal to "Thicopy 63-Grout" as made by Grace and Company, 62 Whittemore Avenue, Cambridge, Massachusetts (Horn Products).

Joints for reinforced concrete pipe shall be rubber-gasket type. The ends of the pipe shall be so formed that, when the pipes are joined, they shall make a continuous and uniform line of pipe with a smooth and regular surface. Each joint shall contain a solid gasket of EPDM, or other material approved by the Engineer, which shall be the sole element for water tightness of the joint. The joint shall not leak when pulled one inch from normal closure for full circumference. The slope of the longitudinal gasket contact surfaces of the joint with respect to the longitudinal axis of the pipe shall not exceed 2 degrees. The rubber gaskets shall conform to the requirements of ASTM C 443. Gaskets shall be stored in a cool place and not exposed to the direct rays of the sun.
SECTION 508

Installation of liner plate, including the welding of all joints, shall be done in accordance with the manufacturer's recommendations. Nailing through the plate is not acceptable. Liner plate shall be installed with locking extensions parallel with the longitudinal axis of the sewer unless otherwise shown on the plans. Liner plate shall be held snugly in place against inner forms by means of light gauge steel wire, light steel banding straps, or other suitable means. If steel banding straps are used, they shall be applied in strap channels provided for this purpose.

Locking extensions (T-shaped) shall be integrally extruded to all lower, terminal, or longitudinal edges of liner plate as applied to concrete pipe. If banding straps are used, a steel rod 1/4 inch (6 millimeters) in diameter may be inserted in each locking extension along the longitudinal edges of each sheet of liner plate. If approved, either method for holding the lower edge of the liner plate snugly against the form may be provided.

Concrete poured against liner plate shall be compacted in a careful manner so as to protect the liner plate and to produce a dense, homogeneous concrete securely anchoring the lock extensions into the concrete. In removing forms, care shall be taken to protect liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. All holes and cut, torn, or seriously abraded areas in the liner plate shall be repaired. Patches shall be limited to those which can be made with a single weld strip. Parallel, overlapping or adjoining weld strips will not be allowed. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. Larger patches may consist of smooth liner plate applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound liner plate adjoining the damaged area.

Prior to placing the spigot into the bell of the reinforced concrete pipe previously installed, the spigot groove, the rubber gasket and the bell shall be lubricated with a soft, vegetable soap compound.

The gasket, after lubrication, shall be uniformly stretched or relieved when placing it in the spigot groove so that the rubber is distributed uniformly around the circumference.

After the joint is assembled, a thin metal feeler gauge shall be inserted between the bell and the spigot, and the position of the rubber gasket inspected for the complete circumference of the pipe. If the gasket is not in the proper position, the pipe shall be withdrawn, the gasket inspected to insure that it is not cut or damaged, the pipe reinstalled, and the gasket position again checked. All elliptical pipe shall be joined such that the "T" is at the top and the ends of the plastic liner match in a continuous straight line. Pipe not placed in this manner shall be removed and reinstalled.
SECTION 508

The contractor shall take all necessary precautions to prevent damage to installed liner plate from equipment and materials used in or taken through the work. The applied lining shall be free from bubbles due to poor workmanship. The contractor shall cut out bubbled areas and weld a similar sheet in its place unless otherwise directed by the Engineer.

Liner plate shall be set flush with the inner edge of the bell or groove end of a pipe section and shall extend to the spigot or tongue end or to approximately 3 inches (75 millimeters) beyond the tongue end, depending upon the type of liner plate to be made with the adjoining concrete pipe. Wherever liner plate protected concrete pipe joins structures not so lined; such as brick structures, concrete pipe cast-in place structures, or clay pipe; the liner plate shall be extended over and around the end of the pipe and back into the structure for not less than 4 inches (100 millimeters). Where a pipe spur not of plastic-lined concrete is installed through lined concrete pipe, the liner plate shall be returned 4 inches (100 millimeters) at the surface of contact. The seal between the liner plate and the spur shall be made using a method recommended by the manufacturer of the sheet and approved by the Engineer.

If the joint space is too wide or the joint space surface too rough to allow satisfactory sealing with this method, the joint space shall be filled with 2 inches (50 millimeters) of densely-caulked lead wool or other approved caulking material. Lined concrete pipe may be cured by standard curing methods. Care shall be exercised in handling, transporting, and placing lined pipe to prevent damage to the liner plate. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or with a suitable fork lift. Pipe with damaged lining shall not be accepted until the damage has been repaired to the satisfaction of the Engineer.

The contractor shall obtain the services of qualified personnel to weld the liner plate field joints. Qualified personnel shall mean the person doing the welding has attended a training school for welding PVC T-rib lined material, been certified by the PVC T-rib manufacturer and has worked for at least 160 hours during the past 12 months welding PVC T-rib lining material. If the individual has not worked the required hours during the previous 12 months, they must attend the training school again, and be re-certified by the PVC T-rib manufacturer. However, if the Engineer finds that, in his opinion, a welder is not providing proper welds, the welder shall be removed from the project even though he has met the training and work experience requirements noted and another qualified welder shall be brought in by the contractor to complete the welding work.
Pipe joints must be dry before the liner plate joints are made. All mortar and other foreign material shall be removed from liner plate surfaces adjacent to the pipe joint, leaving them clean and dry. No liner plate joints shall be made until the trench has been backfilled and the pipe has been tested for leaks.

Field joints in the liner plate at pipe joints shall be Type P-1.

Type P-1 joints shall be made with a separate 4 inch (100 millimeters) joint strip and two welding strips. The 4 inch (100 millimeters) strip shall be centered over the joint, secured to the liner plate by an approved method, and welded along each edge to adjacent liner plate with a 1 inch (25 millimeters) weld strip. The width of the space between adjacent liner plate sheets shall be a minimum of 1/2 inch (13 millimeters). The 4 inch (100 millimeters) joint strip shall lap over each liner plate a minimum of 1/2 inch (13 millimeters).

After the pipe is installed in the trench, all surfaces covered with liner plate shall be tested with an approved electrical Holiday or flaw detector set at a minimum of 20,000 volts. All welds shall be physically tested by a non-destructive probing method. All patches over nail and form tie holes and repairs to the liner plate shall be done in conformance with the instructions and recommendations of the liner plate manufacturer.

Factory certification is required for PVC t-rib lined reinforced concrete pipe. The certification must state that the PVC liner was checked at the factory for holidays at the voltage and testing conditions described in the special provisions and these standard specifications, and that the pipe tested holiday free before shipment.

The contractor, in the presence of and at the direction of the Engineer, shall perform random checks on deliveries of RCP pipe at the site according to the voltage and testing conditions described in the special provisions and these standard specifications.

If an average of one holiday per 1 linear foot (0.3 linear meter) in any piece of pipe are found, which average includes any holiday patches already made at the factory, the Engineer reserves the right to reject the delivery of pipe and return it to the manufacturer for replacement. Such pipe rejection is not automatic and would only occur if the Engineer exercises his right to do so.

The factory certification and onsite holiday random spot checking does not remove the requirement for the final holiday testing after the pipe is installed.

The contractor shall also provide to the Engineer a written certification or manifest from the manufacturer of the PVC weld strips and joints strips that lists the quantity, size and number of containers for both the weld strip material and the joint strip.
material supplied on the project. The contractor shall require the supplier of PVC joint and weld strip material to label the exterior of all the boxes before arrival on site so that both joint strip containers and weld strip containers can be readily distinguished.

Each transverse welding strip which extends to a lower edge of the liner plate shall be tested. The welding strips shall extend below the liner plate, providing a tab. A 10 pound (5 kilograms) pull shall be applied normal to the face of the pipe by means of a spring balance. Liner plate adjoining the welding strip shall be held against the concrete during application of the force. If a weld failure develops the 10 pound (5 kilograms) pull shall be maintained until no further separation occurs. Defective welds shall be re-tested after repairs have been made. Tabs shall be trimmed away neatly after the weld strip has passed inspection. The contractor shall provide all equipment required to test liner plate in the manner recommended by the manufacturer and as described above. The contractor shall also provide personnel qualified to perform the testing. Testing shall be performed in the presence of a representative of the Agency.

(B) Polyvinyl Chloride (PVC) Pipe (Gravity Installations).
Polyvinyl chloride (PVC) pipe shall conform to the requirements of Subsection 1010-3.05(A).

Standard laying lengths for gravity flow PVC pipe shall be 12.5 feet (3.8 meters) or 14 feet (4.3 meters). The requirements for pipe diameter and wall thickness are set forth in ASTM D 3034 for nominal pipe diameters of 4 inches through 15 inches (100 to 400 millimeters) and ASTM F 679 for nominal pipe diameters of 18 inch (450 millimeters) and larger.

Any imperfections which, in the opinion of the Engineer, may adversely affect the performance of the pipe or joints shall be cause for rejection of PVC pipe.

Polyvinyl chloride pipe shall be delivered to the job site and stored in pelletized units less than 40 inches high (1000 millimeters). Care shall be taken during the transportation of the pipe to ensure that the tie-down methods do not damage or deflect the pipe.

PVC pipe stored at the job site shall be covered with an opaque material to protect it from the ultraviolet radiation. Air circulation shall be provided under the covering. PVC pipe shall not be removed from the pallet or laid out along the ditch more than 24 hours prior to installation in the trench.

Polyvinyl chloride pipe (PVC) pipe shall be installed in accordance with ASTM 2321 as modified by the standard details or these specifications.
In addition to the requirements for pipe installation contained in these specifications, the following provisions shall pertain to gravity PVC pipe installation:

The trench shall not be wheel loaded until 3 feet (900 millimeters) of cover is placed over the top of the pipe.

A clamp gasket or approved equivalent method shall be provided at manhole entry or connection to reduce infiltration and exfiltration.

In addition to the tests at the manufacturer's plant, the Engineer may require that tests be performed on pipe specimens selected at random at the point of delivery or at the job site. The Agency shall bear the costs of such tests, which shall be in accordance with ASTM D 2412 and D 2444.

Prior to leaving the job storage area, the pipe may, at the option of the Engineer, be subjected to a deflection test using a mandrel with an outside diameter equal to 98 percent of the internal diameter of the pipe. The mandrel shall pass through the pipe without obstruction or binding.

Prior to final acceptance of the project, but not less than seven days after compaction has been completed, the PVC pipe shall be tested for vertical deflection using a mandrel. Deflections exceeding five percent of the internal diameter shall be cause for rejection of the pipe.

There are no provisions for repair of PVC.

Joints for PVC gravity pipe shall meet the minimum requirements specified in accordance with ASTM D 3212. All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made. All surfaces of the joint, upon which the gasket may bear, shall be smooth and free of any imperfection which could adversely affect sealability. Elastomeric seals (gaskets) shall meet the minimum requirements specified in accordance with ASTM F 477, the gasket shall be an integral part of the joint such that when assembled, the gasket inside the bell shall be compressed radially on the pipe spigot to form a watertight seal.

Fittings and stoppers shall meet the testing requirements for PVC pipe. Joints shall be capable of passing all tests specified in ASTM D 3212.

(F)High Density Polyethylene (HDPE) Pipe. High density polyethylene (HDPE) pipe shall conform to the requirements of Subsection 1010-3.05.
SECTION 508

Prior to the delivery of pipe to the site, the contractor shall submit shop drawings to the Engineer for review and approval. The shop drawings shall provide the following information:

Detailed procedures to be used in joining and installing the piping system including manufacturer’s recommendations.

Interface of piping system to equipment and appurtenances.

Bill of materials, indicating material composition of pipe, pressure rating, nominal size with wall dimensions, and its locations on the piping installation drawing.

Certificates of Compliance conforming to the requirements of Subsection 106-5(B) shall be submitted. Certificates shall specify conformance with the requirements of ASTM D 1248, ASTM D 3350 and that testing of the pipe material was undertaken in accordance with ASTM F 1473, for >100 hours, without failure.

HDPE pipe and fitting joints shall be heat fused by a qualified technician trained by an approved manufacturer’s representative, in accordance with the manufacturer’s recommended fusion procedures. Training shall have occurred in the previous 12 months or submittals verifying field installation experience within the previous 12 months for all technicians performing heat fusion on polyethylene pipe and fittings shall be submitted prior to the start of installation.

All necessary precautions shall be taken to prevent damage or contamination to pipe and other incidental materials during shipment and delivery. All materials shall be securely fastened to truck or rail car to prevent movement or damage during shipment. The contractor shall examine all materials before unloading.

All pipe materials shall be handled so as to prevent damage. HDPE pipe shall not be dropped, rolled or pushed off from any height on delivery storage or installation.

All pipe materials shall be stored off the ground in a dry location. Pipe shall be stored to prevent sagging or bending. Stored pipe shall be protected from exposure to ultraviolet light.

The design pressure rating of the pipe shall be defined in accordance with ASTM D 3035 and F 714. The HDPE pipe shall have a controlled outside diameter and have been manufactured to the SDR/DR rating specified by the plans or Special Provisions.

Fittings shall be manufactured using the same pressure rating as the designed piping system. The fitting shall have a controlled outside diameter and the SDR/DR rating for the pressure specified by the plans or Special Provisions. Fittings shall be specifically manufactured to standardized dimensions noted on the plans.
SECTION 508

Butt fusion fittings shall be manufactured from the same material as the extruded pipe, shall be rated for a pressure service at least equal to that of the system pipe, and shall have outlets manufactured to the same DR as the system pipe. Molded fittings shall be manufactured in accordance with ASTM D 3261 and socket fittings shall comply with ASTM D 2683.

All piping shall be inspected to assure that it is free from defects in material and workmanship. The compatibility of all pipe and fittings shall be verified.

Pipe, fittings and accessories that are cracked, damaged, not identified or in poor condition shall be rejected. Pipe sections or fittings containing significant scratches, dents or marks, that are not in conformance with the manufacturer's criteria for such blemishes, may be cause for rejection at the sole discretion of the Engineer.

The Engineer shall have free access to all joints, including test joints for determining the suitability of the joining procedure. Where construction restrictions limit inspection of joints the Engineer may direct the individual joining the pipe and/or fittings to perform a test joint in a manner that it can be clearly and easily observed. The Engineer shall select the method of testing from either visual examination, bent strap testing or ultra-sonic testing. Ultra-sonic testing shall conform to the requirement of the U.S. Department of Transportation as found in the Code of Federal Regulations 49, Part 192.285 (b) (ii) or (b) (iii).

HDPE pipe and fittings shall be heat fused together creating a homogeneous joint. Joining shall be in accordance with the manufacturer's heat fusion recommendations. Joints shall not be of the solvent weld type.

Personnel responsible for heat fusing the joints shall demonstrate proficiency by fusing trial joints and testing the trial fusion by bent strap testing or ultra-sonic testing. Trial joints shall be allowed to cool completely before testing and shall not fail at the joint. During construction, the first fusion of the day shall be a trial fusion which shall be allowed to cool, and destructively bent strap tested or ultrasonically tested. If the trial fusion fails, additional trial fusion's shall be made and tested until successful fusion's are completed. The procedure used to join the trial fusion shall be used for the balance of the day's work, provided the procedure is in compliance with that recommended by the manufacturer. The Engineer shall provide written notice to the contractor of the unacceptability of any installer whose work is deemed deficient in satisfactorily completing the heat fusion of polyethylene pipe. Any individual deemed unacceptable by the Engineer shall not be utilized by the contractor unless the individual undergoes additional training and meets the requirements specified herein.
All HDPE pipe shall be installed so as to minimize shear or tensile stresses. Pipe shall be installed in a trench as specified by the plans or Special Provisions. The minimum burial depth shall also be as specified in the plans or Special Provisions.

Pipe bedding and shading shall conform to the requirements of Standards Detail WM 105. Backfill shall comply with the provisions of Subsection 508-2.07.

508-3.04 Shading and Trench Backfill.

(A) Backfill. Sanitary sewer pipe backfill shall consist of shading material and trench backfill material.

Shading shall be placed over and around the pipe from the top of the bedding material to 1 foot (300 millimeters) above the top of the pipe. Shading shall be selected from excavation or from a source selected by the contractor. It shall not contain frozen lumps, stones larger than 3 inches (75 millimeter) in diameter, chunks of clay or other objectionable material. Shading material shall conform to the requirements of Subsection 508-2.06. At the contractor's option, shading material may be used in place of backfill material in areas outside the roadway prism.

Trench backfill shall be placed from 1 foot (300 millimeters) above the top of pipe to the subgrade elevation of the roadway or to existing ground when the installation is outside the roadway prism.

Trench backfill shall conform to the requirements of Subsection 508-2.07 with the exception that, within the roadway prism, trench backfill material shall conform to the requirements of shading material as specified in Subsection 508-2.06. However, when shading material is used for trench backfill, 100% of the material shall pass the 5 inch (150 millimeter) sieve instead of the 1 inch (25 millimeter) sieve.

(B) Placement of Shading and Trench Backfill. All trash, forms, sheeting, bracing, and loose rock or loose earth shall be removed from the areas to be backfilled before backfill material is placed.

Shading or trench backfill, compacted by pneumatic or mechanical tamping devices, shall be placed in layers not more than 8 inches (200 millimeters) in depth before compaction.

Shading, or bedding material, shall be brought up evenly on both sides of the pipe to an elevation 12 inches (300 millimeters) above the top of the pipe.
SECTION 508

(C) Compaction of Shading and Trench Backfill. Shading and trench backfill material shall be compacted to at least 95 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manuel, as directed and approved by the Engineer.

Jetting shall not be used to compact shading or trench backfill.

(D) Encasement of Pipe. When shown on the project plans, or specified in the Special Provisions, pipe shall be encased in Class B concrete conforming to the requirements of Subsection 501-2.02 or controlled low strength material (CLSM) conforming to the requirements of Subsection 501-2.03. CLSM may also be used in lieu of trench backfill material if approved by the Engineer.

508-3.05 Testing. Sanitary sewer pipelines shall be tested for leakage or infiltration following the placement of the trench backfill material and final compaction.

Gravity sanitary sewer installations shall comply with the testing requirements of Arizona Administrative Code R18-9-E301.

The contractor shall test all pipe as specified above. Pipe greater than 48 inches (1.2 meters) in diameter shall also be tested using the Joint Test method described in Subsection 508-3.05(G) when directed by the Engineer.

In the case of new sewer lines with house connections included as an integral part of the project, the test shall be performed after the house connections and stubs have been completed and backfilled. In the case of replacement sewer lines, the test shall be as specified in the Special Provisions.

(A) Air Test. Testing shall be done in accordance with either ASTM F 1417 (plastic pipe), ASTM C 924 (concrete pipe) or ASTM C 828 (vitreous clay pipe). The test procedure shall match the type of pipe material. If the material type of the pipe to be installed does not fall under one of the noted categories, the Engineer will direct which test should be conducted to verify the pipe’s water tightness. The basic test procedure is as follows:

1. Determine the test time for the section of line to be tested - see procedure noted in Subsection 508-3.05(E).

2. Plug all openings in the test section.

3. Add air until the internal pressure of the line is raised to approximately 4.0 pounds per square inch (27.5 kilopascals). After this pressure is reached, allow the pressure to stabilize. The pressure will normally drop as the air temperature stabilizes. This usually takes 2 to 5 minutes, depending on the pipe size. The pressure may be reduced to 3.5 psi (24 kilopascals) before starting the test.
SECTION 508

(4) When the pressure has stabilized and is at or above the minimum required starting test pressure of 3.5 psi (24 kilopascals), start the test. If the pressure drops more than 1.0 psi (7.0 kilopascals) during the test time, the line is presumed to have failed the test. If a 1.0 psi (7.0 kilopascals) drop does not occur within the test time, the line is considered to have passed the test.

(B) Air Test - Time Determination Procedure

(1) Table 508-1, or Table 508-2 indicates the required test time, T, in minutes/100 feet (minutes per 30 meters) or other distances for pipe of each nominal size. Test times are for a 1.0 psi (7.0 kilopascal) pressure drop from 3.5 to 2.5 psi (24 kilopascals to 17 kilopascals).

(2) 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 time to arrive at the total test time for the section.

(3) It is not necessary to hold the test for the whole period when it is clearly evident that the rate of air loss is greater than allowable.

**TABLE 508-1**

<table>
<thead>
<tr>
<th>Nominal Pipe Size, Inches (millimeters)</th>
<th>Time, Minutes/100 ft. (minutes/30 meters)</th>
<th>Nominal Pipe Size, Inches (millimeters)</th>
<th>Time, Minutes/100 ft. (minutes/30 meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (75)</td>
<td>0.2</td>
<td>24 (600)</td>
<td>3.6</td>
</tr>
<tr>
<td>4 (100)</td>
<td>0.3</td>
<td>27 (675)</td>
<td>4.2</td>
</tr>
<tr>
<td>6 (150)</td>
<td>0.7</td>
<td>30 (750)</td>
<td>4.8</td>
</tr>
<tr>
<td>8 (200)</td>
<td>1.2</td>
<td>33 (825)</td>
<td>5.4</td>
</tr>
<tr>
<td>10 (250)</td>
<td>1.5</td>
<td>36 (900)</td>
<td>6.0</td>
</tr>
<tr>
<td>12 (300)</td>
<td>1.8</td>
<td>39 (975)</td>
<td>6.6</td>
</tr>
<tr>
<td>15 (375)</td>
<td>2.1</td>
<td>42 (1050)</td>
<td>7.3</td>
</tr>
<tr>
<td>18 (450)</td>
<td>2.4</td>
<td>48 (1220)</td>
<td>8.5</td>
</tr>
<tr>
<td>21 (525)</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

296
SECTION 508

Table 508-2

Minimum Test Time for Various PVC Pipe Sizes
(Plastic Pipe)

(Time Required for a 1.0 psig Pressure Drop
for Size and Length of Pipe Indicated for Q = 0.0015)

Note 1: Refer to Uni-Bell PVC Pipe Association Standard UNI-B-6-90, "Recommended Practice for Low Pressure Testing of Installed Sewer Pipe"

Note 2: Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. diameter.

<table>
<thead>
<tr>
<th>Pipe Diameter, in. (mm)</th>
<th>Minimum Time, min. s</th>
<th>Length For Minimum Time, ft (m)</th>
<th>Time For Longer Length, s</th>
<th>Specification Time for Length (L) Shown, min. s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>100 ft (30.5m)</td>
<td>150 ft (45.7m)</td>
</tr>
<tr>
<td>4 (100)</td>
<td>3.46</td>
<td>597 (182.0)</td>
<td>0.380 L</td>
<td>3.46</td>
</tr>
<tr>
<td>6 (150)</td>
<td>5.40</td>
<td>396 (121.3)</td>
<td>0.884 L</td>
<td>5.40</td>
</tr>
<tr>
<td>8 (200)</td>
<td>7.34</td>
<td>298 (90.8)</td>
<td>1.520 L</td>
<td>7.34</td>
</tr>
<tr>
<td>10 (250)</td>
<td>9.28</td>
<td>239 (72.3)</td>
<td>2.374 L</td>
<td>9.28</td>
</tr>
<tr>
<td>12 (300)</td>
<td>11.20</td>
<td>199 (60.6)</td>
<td>3.418 L</td>
<td>11.20</td>
</tr>
<tr>
<td>15 (380)</td>
<td>14.10</td>
<td>159 (48.4)</td>
<td>5.342 L</td>
<td>14.10</td>
</tr>
<tr>
<td>18 (460)</td>
<td>17.00</td>
<td>123 (37.0)</td>
<td>7.692 L</td>
<td>17.00</td>
</tr>
<tr>
<td>21 (530)</td>
<td>19.50</td>
<td>114 (34.7)</td>
<td>10.470 L</td>
<td>19.50</td>
</tr>
<tr>
<td>24 (610)</td>
<td>22.40</td>
<td>99 (30.2)</td>
<td>13.674 L</td>
<td>22.47</td>
</tr>
<tr>
<td>27 (686)</td>
<td>25.30</td>
<td>88 (26.8)</td>
<td>17.306 L</td>
<td>28.51</td>
</tr>
<tr>
<td>30 (760)</td>
<td>28.20</td>
<td>80 (24.4)</td>
<td>21.368 L</td>
<td>35.37</td>
</tr>
<tr>
<td>33 (835)</td>
<td>31.10</td>
<td>72 (22.0)</td>
<td>25.852 L</td>
<td>43.05</td>
</tr>
<tr>
<td>36 (910)</td>
<td>34.00</td>
<td>66 (20.1)</td>
<td>30.788 L</td>
<td>51.17</td>
</tr>
</tbody>
</table>

(C) Pressure Test. All pipe for use as a force main shall be hydrostatically tested for leakage. Care shall be taken to insure that all air vents are open during filling. After the piping is completely filled, it shall be allowed to stand under a slight pressure for sufficient time, at least 48 hours, to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If any are found, they shall be repaired prior to final pressure testing. The final test shall consist of holding 150 psi (1035 kilopascals) for a period of 4 hours with leakage less than 15 gallons per inch of diameter per mile of pipe per 24 hours (1.4 liters per day per kilometer per millimeter of internal diameter of pipe).

(D) Joint Test. For pipe greater than 48 inches (1.2 meters) in diameter, the joint test method shall be used in addition to the air test previously described in this Subsection when so directed by the Engineer.
SECTION 508

(1) Equipment. The contractor shall provide all materials, labor, and equipment necessary for joint testing.

(a) Joint Tester Frame - The joint tester frame assembly is to be constructed of heavy gauge metal that can be broken down easily into small sections for ease of handling and installation/removal from sewer manholes.

(b) Bladder(s) - The joint tester shall have either single or double bladder construction.

Single Bladder Tester: The bladder shall be of a one-piece construction within an outer layer of a soft, natural rubber, between the pipe and tester.

Double Bladder Tester: The joint tester shall have two inflatable tubes (bladders) constructed of rugged heavy-duty elastomer. The bladders shall be stretched and positioned onto the joint tester frame assembly so they can be aligned over the joint to be tested. When inflated, the bladders shall create an air-tight seal against the pipe wall.

(c) Control Panel - The joint tester control panel shall provide a reliable means of controlling and monitoring bladder and center cavity pressures from a single component. The control panel shall be conveniently mounted onto the joint tester frame assembly requiring only input air from the compressor.

(d) Wheel Assemblies - Each wheel assembly shall be mounted to the inside surface of the joint tester frame assembly. The contractor will provide an easy way of transporting the Joint Tester from one joint to the next, as well as providing height adjustment and centering of the joint tester over pipe joints.

(e) Interconnect Hoses - Hoses shall be provided to route air from the control panel to the air reservoir and from the air reservoir to the center cavity chamber.

(f) Air Reservoir - An air reservoir shall be included in the joint test system. The air reservoir shall have a maximum volume of 2.5 cubic feet (0.07 cubic meters).

(2) Air Testing Procedure.

Determine test pressure. Test pressure for large diameter reinforced concrete pipe (RCP) shall be 3.5 psi (24 kilopascals).

Position the joint tester so the bladder(s) are properly located over the joint to be tested. Inflate the bladder(s) to 50 psi (345 kilopascals) or in accordance with testing equipment and manufacturer's instructions.
SECTION 508

Pressurize the center cavity with air to test pressure in Step 1 above. Allow pressure to stabilize (approximately 10-15 seconds) and turn off pressure source.

If the pressure in the cavity holds or drops less than 1 psi (7 kilopascals) in 5 seconds, the pipe joint shall be found to be acceptable. If the pressure drops over 1 psi (7 kilopascals), the joint is defective and should be repaired and retested.

When the joint test is completed, all pressure must be exhausted from center cavity to 0 psi (0 kilopascals) and then from the bladder(s) to 0 psi (0 kilopascals). The joint tester can then be transported and positioned on the next joint to be tested.

(3) Joint Sealing. The contractor may seal the joint to make sure that it is water tight if the Engineer approves this method instead of a joint test. The sealing method shall consist of:

(a) Priming the sides of the concrete joint according to the primer manufacturer’s instructions.

(b) Installing backer rod of a certain size in the bottom of the joint so as to leave a 1/2 inch (13 millimeters) to 5/8 inch (16 millimeters) depth for the flexible sealant.

(c) Installing a nonsagging, 2 component elastomeric sealant in accordance with the sealant manufacturer’s instructions.

(E) Alignment Verification. The contractor shall provide sufficient checking and verification of the grade and alignment during the progress of the construction to ensure that the installed sanitary sewer pipe is constructed within the allowable tolerances noted in this Subsection. Unless otherwise approved by the Engineer, the method of verification shall include the use of grade stakes. Grade stakes, when used, shall be placed at intervals not exceeding 50 feet (15 meters) along the entire length of the sewer line to be installed. The grade stake(s) shall indicate the offset distance to the centerline of the pipe and the cut or fill value, to specified elevations. When grade stakes are used, the contractor shall provide a grade sheet to the Engineer describing the type of stake, offset dimension or line indication, station, cut or fill value to invert or other specified elevation and any other special information. The contractor shall provide access to the trench and installed pipe to allow for periodic inspections of the alignment and grade by the Engineer.

The pipe shall be visually inspected by directing a beacon of light, from a flashlight, mirror, or other source, into the pipe. If the illuminated interior, or moon, of the pipe indicates improper alignment or any other deficiency, the condition shall be either corrected at the contractor's sole cost, or, upon approval.
SECTION 508

of the Engineer based on the degree of the deficiency, the contractor may be given the option of accepting a reduction in payment as a penalty for the Agency allowing the deficient work to remain in place.

Penalty schedules are as noted in Subsection 110-5.

The percentage of pipe illumination noted in Table 110-13 is based on the area of that portion of the full "moon" that is visible during the visual inspection.

Pipe sections installed at a reverse grade shall be removed and reinstalled to the correct grade at the contractor's sole expense.

508-4 METHOD OF MEASUREMENT

Sanitary sewer pipe less than 36 inches (900 millimeters) in diameter shall be measured by the linear foot (meter) parallel to the central axis of the pipeline, from manhole center to manhole center, and from manhole center to the end of plugged pipe; and shall include the length of all fittings and connections.

Sanitary sewer pipe 36 inches (900 millimeters) and greater in diameter shall be measured by the linear foot (meter) from inside face of wall to inside face of wall.

Tees, wyes and other branches will be measured as pipe along the central axis of the pipes to the point of intersection of said central axis. Pipe reducers will be measured as pipe of the larger diameter along the central axis.

The end of pipe in closed structures will be considered to be at the intersection of the central axis and the inside face of the wall.

Unless otherwise provided in the special provisions, no measurement shall be made for the following items of work. The cost of these items shall be included in the unit price for sanitary sewer pipe.

All testing except those tests specifically herein as being paid for by the Agency.

Shoring and sheetpiling, except that sheetpiling, directed by the Engineer to be cut off and left in place.

Dewatering.

Maintenance and operation of existing sewers during construction.
SECTION 508

508-5 BASIS OF PAYMENT

Except as hereinafter specified, no separate measurement or payment will be made for excavating trenches, dewatering compacting subgrade and for furnishing, placing and compacting bedding and backfill material as described and specified herein and on the project plans, the cost thereof being considered as included in the contract unit price per foot (meter) of sanitary sewer pipe.

Payment for the removal of rock, hard pan, other unyielding material, or soft, spongy or other unstable soil below the vertical limits as shown on the plans, and the backfilling and compaction of these overexcavated areas, as specified herein and as directed by the Engineer, will be paid for in accordance with the requirements of Subsection 104-2.

The accepted quantity of sanitary sewer pipe, measured as provided above, shall be paid for at the contract unit price complete-in-place for all pipe diameters specified.

The respective unit prices specified to be paid per linear foot (meter) of pipe shall be compensation in full for furnishing all pipe, sewer fittings and other materials required for building pipelines, for excavating and for laying, setting, and jointing of all pipes and fittings, for all testing, including leakage tests, all shoring, sheeting and bracing, de-watering by any and all methods, all backfill, excavation and recompaction of existing sub-grade, all bedding, all clean up, all labor, tools and construction equipment, and for all other work and incidental expenses. Payment includes all costs for maintaining the operation of the existing sewers during construction and for removing or abandoning existing sanitary sewers.
SECTION 509
SANITARY MANHOLES

509-1 DESCRIPTION

The work under this section shall consist of furnishing all materials and constructing or adjusting manholes or other structures comprising the sanitary sewer conveyance system including frames and covers; furnishing and installing frames and covers; or removing and resetting existing frames and covers or furnishing prefabricated adjustment rings at the locations designated on the project plans and in accordance with the details shown on the plans and the requirements of these specifications.

509-2 MATERIALS

509-2.01 Concrete. Materials furnished for portland cement concrete shall conform to the requirements of Section 1006.

Unless otherwise specified on the plans or Special Provisions, sanitary sewer manholes shall be precast units conforming to the requirements of ASTM C 478.

When specified on the plans or in the Special Provisions, sanitary sewer manholes and structures may be cast-in-place. Class S concrete, having a compressive strength after 28 days of 3,000 psi shall be required for manhole bases, inverts, channels, and bench areas. Class S concrete, having a minimum compressive strength after 28 days of 4,000 psi shall be required for manhole walls. Class B concrete shall be used for all other portions of the manhole. Portland cement shall conform to the requirements of ASTM C 150 for Type II unless the construction plans or Special Provisions state otherwise.

509-2.02 Reinforcing Steel. Materials furnished for reinforcing steel shall conform to the requirements of Section 1003.

509-2.03 Brick. Brick shall be 2-1/4 x 3-5/8 x 7-5/8 inches (57 x 90 x 190 millimeters) in size and shall conform to the requirements of ASTM C32, Grade MS.

509-2.04 Mortar. Mortar shall conform to the requirements of Subsection 503-2.03.

509-2.05 Water. Water shall conform to the requirements of Subsection 1006-2.02.

509-2.06 Frames, Covers and Prefabricated Adjustment Rings. The top surface of each sanitary sewer cover shall be cast with a studded pattern, including lettering in accordance with the standard details. Covers, with the exception of waterproof covers, shall be provided with ventilating holes conforming to the requirements of the standard details.
Frames and covers shall be manufactured in accordance with the Standard Details and shall be manufactured from gray iron, conforming to the requirements of ASTM A 48, Class 35B. Frames and covers shall be designed for H-20 loading inclusive of the proof load requirements outlined in Section 7 of the American Association of State Highway and Transportation Officials (AASHTO) Standard Specification for Drainage Structure Castings, AASHTO Designation M 306.

Frames and covers shall be cast from ferrous materials using a minimum of 75% post consumer waste. The basic design, initial sample castings and first article inspection, also known as the first proof load test, shall be pre-approved by the Agency prior to delivery. All lettering on the covers shall comply with that shown on the Standard Details.

Certificates of Compliance conforming to the requirements of Subsection 106.5(B) shall be submitted.

The bearing surfaces of the frames and covers shall be machine finished so that the covers will seat themselves firmly onto the frame. There shall be no movement of the frame from traffic. A 1/8 inch (3 millimeter) annular clearance shall be provided between frame and cover.

509-2.07 Steps. Steps for manholes and structures shall be polypropylene plastic-coated Number 3 (metric No. 10) deformed bars conforming to the requirements of ASTM C 478. Steps for pre-cast concrete manholes and for brick manholes shall conform to the Standard Details.

509-2.08 T-Lock Lining. Where indicated on the plans, the interior concrete walls and ceiling surfaces of manholes and structures shall be sealed with a protective lining installed by the Contractor or Pre-fabrication Supplier. The material used in the liner plate shall be a combination of inert, synthetic resins, pigments, and plasticizers, compounded to make permanently flexible sheets.

The liner plate shall be resistant to oxidizing agents; sulfuric, phosphoric, nitric, chromic, oleic, and stearic acids; sodium and calcium hydroxides; ammonia; sodium, calcium, magnesium and ferric chlorides; ferric sulfate; petroleum oils and greases; vegetable and animal oils; fats; greases' and soaps. The liner plate shall be impermeable to sewage gases and liquids, and shall be nonconductive to bacterial and fungus growth. All liner plates shall be factory checked with a high-voltage electrical Holiday detector set to a minimum of 20,000 volts to insure freedom from any porosity. The lining shall have good impact resistance, shall be flexible, and shall have an elongation sufficient to bridge up to a 1/8 inch (3 millimeters) setting crack without damage. Once cast into the structure, the lining shall be permanently and physically (not adhesively) attached by the T-LOCK mechanism. The lining shall withstand a 40 psi (275 kilopascals) hydrostatic back-pressure applied to the under surface of the lining without losing anchorage or without rupture or leakage.
The liner plate shall not be less than 0.065 inches (2 millimeters) in thickness. Locking extensions shall be of the same material as the liner and shall be integrally extended with the sheets. If steel bands are used to secure the liner plate to the forms transversely, strap channels shall be integrally molded into the sheet.

The liner plate shall be supplied as wall-size sheets fabricated by shop welding together the basic size sheets. Any joint straps shall be 4.0 ± 0.25 inches (100 ± 6 millimeters) in width and shall have the edges beveled at the time of manufacture.

509-2.09 Coatings.

(A) All exposed metal shall receive an SSPC-SP5 White Metal Blast Cleaning and the following coatings:

\[ \text{(SP-2000P)} \]

(1) One or more coats of HYBRID NOVOLAC EPOXY COATING, or other approved coating shall be applied in accordance with the manufacturer's recommendations. The total dry film coating thickness shall be 16 to 20 mils (400 to 500 micrometers) in dry film thickness. The color of the final coat shall be charcoal gray, white or other approved color. After all coats have been applied, the area where the HYBRID NOVOLAC EPOXY COATING or other approved coating was applied shall be checked for holidays utilizing a testing voltage of 67 1/2 volts with a wet sponge and a certification issued stating that there are none.

(B) The HYBRID NOVOLAC EPOXY COATING, or other approved coatings shall be applied by an applicator who specializes in applying coatings and is qualified to apply the coating in accordance with the manufacturer's specifications.

(1) The coating applicator must have a minimum of five (5) years experience in applying either the specified coating or an equivalent coating. The applicator shall submit a performance history for the application of either the specified coating or a similar coating in the wastewater industry or equivalent for the previous five (5) years.

(2) The coating applicator shall be an Arizona licensed contractor with an AE license or approved equivalent.

(3) The coating applicator shall submit a manufacturer's certification to apply the coating specified herein.

(4) The coating applicator shall submit three (3) references relating to the quality of workmanship performed on other projects using the same coating being proposed or an equivalent coating.
SECTION 509

(5) The coating applicator shall warrant the work for five years from the date of acceptance of the work. The warranty shall include a bond or approved equivalent for the coating in an amount that is approved by the Engineer. The warranty shall cover the coating that is applied to any part of the manhole except for the manhole cover and frame. This bond will be payable to the Agency that will own, use and maintain the manholes. No bond or warranty will be required for the coating that is to be applied to the manhole frame and cover. The bond or approved alternate shall cover both the material costs and the labor costs associated with installing the approved coating. The bond or approved alternate shall be unconditional in nature covering any type of failure in the coating and agreeing to repair or replace it at no cost to the Agency that will own, use and maintain the manhole(s), at any point during this five year period. The coating applicator shall also supply a warranty from the coating manufacturer addressed to the bonding company and the Agency that will own, use and maintain the manholes. This warranty shall state, at a minimum, that if the coating is applied in accordance with the manufacturer's recommendations, that the coating will not fail for a period of five years while the coating is immersed in either an acidic or an alkaline solution that is maintained at a temperature of 85°F (30°C). The acidic solution shall be considered a 10% by weight concentration of sulfuric acid and the alkaline solution shall be considered a 25% by weight concentration of sodium hydroxide. The definition of a coating failure is blistering, cracking, brittleness or softening of the coating.

(C) The joint between the manhole frame and the manhole walls and the joint between the manhole walls and the bench shall be caulked using an approved Hybrid Novolac Epoxy Caulk, or other approved caulking material. All applications shall be conducted in accordance with the manufacturer's recommendations.

(D) Manhole steps shall be caulked to seal any crack that exists between the manhole step and the manhole wall. Caulking shall be approved by the Engineer prior to being used by the contractor.

(E) Dry abrasive brush-off blasting and dry abrasive blasting of metal shall be conducted in the presence of the Engineer. Dry abrasive blasting shall use only copper slag.

(F) All new manhole walls, channels and bench areas that are constructed over a new or existing sewer line shall be cleaned and coated to resist corrosion. Coating of the manhole walls, channels and manhole bench areas shall be accomplished with a 3/16 inch (5 millimeter) minimum dry film thickness coating of Hybrid Novolac Epoxy Coating, or other approved coating after an approved underlayment has been used to fill all cracks or voids and to provide a smooth surface. The Hybrid Novolac Epoxy Coating, or other approved coatings and underlayments are to be applied in accordance with the manufacturer's recommendations using a trowel. The final coating applied to the bench shall not be backrolled to
SECTION 509

retain the rougher surface. The trowel marks and other minor surface irregularities shall be removed (except for the bench area) by using a short nap mohair paint roller. The short nap mohair roller should be dampened with water and the excess water shaken off prior to use. All concrete surfaces that have been cured with conventional curing compounds or could be contaminated with oils, grease, or other substances must be scarified (and if needed, chemically cleaned) to remove the contaminants prior to beginning the specified surface preparation. All new concrete on the wall, in the manhole bench area and channel shall receive a dry abrasive brush-off blasting using a minimum pressure of 90 p.s.i. (620 kilopascals) to lightly abrade the surface and open up subsurface holes and voids and etch the surface sufficiently (to approximately a 60 grit sandpaper texture) to allow the coating to bond satisfactorily. Finally, spray application of coatings will be allowed if the spray equipment complies with the coating manufacturer’s recommendations. After the Hybrid Novolac Epoxy Coating, or other approved coating has been applied to all specified areas, the areas shall be checked for holidays utilizing a minimum testing voltage of 17,000 volts with a dry conductive probe. Once the testing has been completed with no deficiencies noted, a certification shall be submitted to the Engineer to that effect.

(G) All new manholes or extensions to manholes with existing PVC t-rib lining shall have one of the previously specified coatings applied to both the concrete and the steel surfaces of the new manhole or the extension to the new manhole. For the purpose of this note, a diversion structure will be considered a manhole.

(H) All existing manholes that must be extended and do not have an existing PVC t-rib lining shall have a Hybrid Novolac Epoxy Coating or other approved coating applied to both the concrete and the steel surfaces of the extension and the existing part of the manhole.

(I) An epoxy primer/sealer coat shall be applied to all new and existing concrete surfaces before any other coating is applied. The existing concrete surfaces that shall receive the epoxy primer/sealer are those which have a difference in temperature of 15° F (8 °C) or more between the concrete surface at the top of the manhole and the concrete surface at the bottom of the manhole. The epoxy primer/sealer shall be applied in accordance with the manufacturer’s instructions.

(J) Existing manholes shall be cleaned and rehabilitated to resist corrosion by coating the manhole walls, manhole channels and manhole bench areas with a 3/16 inch (5 millimeters) minimum dry film thickness Hybrid Novolac Epoxy Coating, or other approved coating after an approved underlayment has been used to fill all cracks or voids and to provide a smooth concrete surface. The Hybrid Novolac Epoxy Coating, or other approved coatings and underlaments are to be applied in accordance with the manufacturer’s recommendations using a trowel. The final coating that will be applied to the bench shall not be backrolled to
SECTION 509

retain the rougher surface. The trowel marks and other minor surface irregularities shall be removed (except for the bench area) by using a short nap mohair paint roller. The short nap mohair roller should be dampened with water and the excess water shaken off prior to use. After the Hybrid Novolac Epoxy Coating, or other approved coating has been applied to all specified areas, the areas shall be checked for holidays utilizing a minimum testing voltage of 17,000 volts with a dry conductive probe. Once the testing has been completed with no deficiencies noted, a certification shall be submitted to the Engineer to that effect. All concrete surfaces that have been cured with conventional curing compounds or could be contaminated with oils, grease, or other substances must be scarified (and if needed, chemically cleaned) to remove the contaminants prior to beginning the surface preparation. New concrete in the manhole bench area and channel shall receive a dry abrasive brush-off blasting using a minimum pressure of 90 p.s.i. (620 kilopascals) in order to lightly abrade the surface, open up subsurface holes and voids and etch the surface sufficiently (to approximately a 60 grit sandpaper texture) to allow the coating to bond satisfactorily. All existing concrete surfaces on the walls, manhole bench area and in the channel shall first receive a wet abrasive blasting using a minimum water pressure of 5,000 p.s.i. (34.5 megapascals) until all loose and deteriorated concrete has been removed. When the wet abrasive blasting has been completed, all concrete surfaces in the area where this blasting has occurred shall be flushed with water at a minimum water pressure of 5,000 p.s.i. (34.5 megapascals) to remove any residual sand from the abrasive blasting operation. Only silica sand and water may be used in the wet abrasive brush-off blasting. Following the wet abrasive blasting, a dry abrasive blasting using only copper slag at a minimum pressure of 90 p.s.i. (620 kilopascals) shall be done to remove any remaining deteriorated concrete. The channel area of the sewer shall be covered when there is a chance of falling debris entering the sewer. The channel cover, together with any debris, shall be removed prior to acceptance of the work by the Engineer.

A spray application of the coating will also be allowed if the spray equipment being proposed complies with the coating manufacturer’s recommendations.

509-3 CONSTRUCTION DETAILS

509-3.01 General. All Hybrid Novolac Epoxy coatings used for manhole applications shall meet Pima County Wastewater Management standards current at the time of bid advertisement.

Excavation for manholes shall be in accordance with the requirements of Subsection 203-5.

All connections for lateral pipes will be considered a part of the manhole. The invert channel may be lined with split pipe.
SECTION 509

Manhole side-walls shall be constructed of cast-in-place concrete or precast concrete or brick, as shown on the project plans. The base of all manholes shall be cast-in-place concrete.

Backfilling of the completed structure shall be with satisfactory material thoroughly compacted in accordance with the requirements of Subsection 203-5.

Where frames and covers for manholes are to be set in new bituminous mix or asphaltic concrete surfaces, they shall be set after placement of the finish or surface course of asphaltic concrete. Steel plates of a size approved by the Engineer shall be placed over the manhole prior to placing courses of asphaltic concrete. After placement of all courses of asphaltic concrete are completed, the steel plates shall be removed. The asphaltic concrete shall be cut and removed in a manner such that a concentric circle is formed about the center of the manhole and the excavated face of the area removed is vertical. The frames and covers shall be set in concrete at the proper elevation so that the cover will be flush with the adjacent finish or surface course. Care shall be taken that the base and surfacing materials are not disturbed beyond the edges of the plate and that debris is kept from falling into the manhole. Concrete and reinforcing steel shall be placed around the frame as noted on the Standard Details. The concrete shall be protected during the curing period.

All castings shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength for the service intended. Castings shall be filleted boldly at angles, and the risers shall be sharp and true. Before the castings are removed from the foundry, they shall be thoroughly cleaned and the parting lines, gates and risers ground flush. No plugging or other stopping of holes will be allowed. The castings shall be thoroughly cleaned of all lumps and subject to a careful hammer test.

Prior to setting, both new and existing frames and covers shall be thoroughly cleaned of all grease, oils, asphaltic materials, portland cement concrete or other deleterious materials. Cleaning shall include obstructions to handling holes, pick holes, vent holes and bolt holes.

Frames and/or covers that are damaged by other than the contractor or that cannot be cleaned to the satisfaction of the Engineer shall be replaced. Payment for replacement frames and/or covers shall be made in accordance with Subsection 104-3.

Upon completion each manhole shall be thoroughly cleaned and kept clean until final acceptance of the work.
SECTION 509

The contractor shall observe all pertinent requirements regarding the manhole construction. Streets shall be kept open for passage of traffic and protection for the public shall be provided when the manhole excavation is exposed. The manhole construction work shall be completely and adequately covered when no work is being done. Flow management of wastewater from sanitary sewers shall be accomplished by pumping to an adjacent "live" manhole or tank truck for proper disposal.

509-3.02 Sanitary Sewer Manholes and Structures. Prior to commencing work on any sanitary sewer manhole or structure, a Construction Permit shall be secured from the Agency that owns and operates the sanitary sewer system. The contractor shall be responsible for payment of all applicable inspection fees associated with said permit.

Manholes shall be located so as to be positioned beneath the paved portions of public roads, streets, avenues, alleys and public rights-of-way, or within dedicated public sewer easements under paved private streets, to the maximum degree viable; to maximize visual access and to maximize unrestricted 24-hour maintenance vehicle access over and to the public sanitary sewerage facilities. See the standard details for more information in this regard.

(A) Construction.

(1) Manhole Base. An unreinforced manhole base may be used for sewer lines equal to or less than 21 inches (525 millimeters) in diameter which are also less than 20’ (6 meters) deep from invert to top of cover. A reinforced base shall be used for sewer lines greater than 21 inches (525 millimeters) in diameter and may be used for lines up to 36 inches (900 millimeters).

The manhole base shall be a circular slab of Class S concrete poured against undisturbed soil or approved bedding. The base, including the flow channel and connections to pipe and barrel section, shall be made in one monolithic pour.

Forms shall be checked and approved for accuracy of dimension and relative smoothness prior to pouring the base. The base shall be shaped with a wood float and receive a hand, steel-trowel finish prior to concrete setting.

If additional mortar is needed after the initial set, the surface to receive the mortar shall be primed and the mortar mixed with an approved adhesive in order to secure as chip-proof a surface as possible. The base shall be set a minimum of 72 hours before the manhole construction is continued.

A precast manhole base may be used if approved, in writing, by the Engineer.
(2) Precast Barrel and Cone Sections. Precast units shall be approved by the Engineer prior to delivery to the job site. Precast manhole sections shall be subject to rejection for any of the following deficiencies:

Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.

Defects that indicate imperfect proportioning, mixing, and molding.

Surface defects indicating honeycombed or open texture.

Damaged or cracked ends, where such damage would prevent making a satisfactory joint.

Any continuous crack having a surface width of 0.01 inch (25 micrometers) or more and extending for a length of 12 inches (300 millimeters) or more, regardless of position in the section wall.

Proper equipment shall be provided for lowering the precast sections into position. The tongue end of the section shall be placed in contact with the base structure unless otherwise directed. Not more than two holes shall be cast or drilled in the shell of each section for the purpose of handling and placing and if such holes are provided, they shall be filled and finished with mortar after placing. Immediately before joining precast sections, mortar shall be placed continuously around the circumference of the receiving section's contact surface. Any precast section damaged during handling or placing shall be repaired or replaced at the option of the Engineer and at the contractor’s expense.

Barrel and cone sections of various heights conforming to ASTM C 478 and the standard details shall be used in order to bring the top of the manhole to the designated elevation.

The precast manhole sections shall be sealed to each other with a preformed flexible gasket conforming to the following requirements:

The flexible plastic gasket shall conform to Federal Specifications SS-S-00210, “Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.”

The plastic sealing compound shall be packaged in an extruded pre-formed rope-like shape of proper size to completely fill the joint when fully compressed. The material shall be protected by a suitable, removable wrapper. The sealing compound shall be impermeable to water, have high immediate bonding strength to the primed concrete surface and shall maintain permanent plasticity, resistance to water, acids, and alkalies.
SECTION 509

All surfaces of the tongue and groove joint of the manhole barrel shall be clean prior to the installation of the sealing compound. The application of the sealing compound shall be accomplished in strict conformance with the manufacturer's instructions as to the method of application, quantity of material, the grade of the materials, and the application temperatures.

All lifting holes shall be sealed with the plastic sealing compound on the exterior side of the hole and hydraulic cement a minimum of 1/2 inch (13 millimeters) deep on the interior side of the hole.

(3) Brick Manholes. Brick work shall not be laid upon a concrete foundation less than 24 hours after such foundation has been poured. No brick work shall be laid in water, nor, except as prescribed for curing, shall water be allowed to stand or run on any brickwork until the mortar has thoroughly set. Where new work is joined to existing unfinished work, the contact surfaces of the latter shall be thoroughly cleaned and moistened.

Bricks shall be thoroughly moistened prior to placing and shall be laid in full cement mortar beds. The horizontal cross section of the manhole shall be circular unless otherwise called for on the plans or standard details. An oval or egg-shaped section will not be permitted. A double row-lock of brick in the manhole wall shall be arched over the top half of the circumference of all inlet and outlet pipes.

Brick manholes shall be plastered outside with 1/2 inch (13 millimeters) of cement mortar as shown on the standard details. The plaster coat shall be cured with a liquid membrane-forming compound immediately after plaster has been placed and finished. Inside, the brick wall shall be neatly pointed.

(4) Cast-In-Place Manholes. Cast-in-place concrete shall be placed in accordance with the requirements of Section 601.

The location of concrete placement shall conform to the requirements of the plans and these specifications and be approved by the Engineer before placement of concrete may begin.

All absorptive surfaces against which concrete is to be placed shall be moistened sufficiently to minimize moisture loss from the freshly-placed concrete.

The trench or excavated area must be free of water, dirt, mud, and debris before the concrete is placed.

Floor slabs in the area of their juncture with walls shall be washed free of sawdust, chips, and other debris after wall forms are built and immediately before the concrete placement. Should the form work confine sawdust, chips, and other loose matter in such a manner that it is impossible to remove them by

311
flushing with water, a vacuum cleaner shall be used for their removal, after which the cleaned surfaces shall be flushed with water.

Before placing concrete, the forms shall be coated with a non-staining lubricant to prevent adherence of concrete. All forms and form lumber, once used, shall be thoroughly cleaned and contact surfaces re-coated before being used again.

Forms may be either metal or wood, and shall be built true to shape, line and grade, mortar-tight, and sufficiently rigid to prevent displacement or sagging between supports. No form shall be used which is not clean. Deformed, broken, or defective forms shall be removed from the job site.

Contact surfaces for exposed concrete surfaces shall be of plywood, metal, or non-warping fiberboard. The pieces used shall be as large as the form layout permits. Small pieces shall not be patched together.

For unexposed surfaces and rough work, square-edge lumber may be used for forms. Unexposed surfaces mean any concrete surface not exposed to view on completion of the project.

All form work shall be provided with adequate cleanout openings to permit inspection and easy cleaning after all reinforcement has been placed.

Form ties shall be such that when the forms are removed, no metal remains within 3/4 inch (19 millimeters) of the surface of the concrete nor shall there be any holes larger than 7/8 inch (22 millimeters) in the surface of the concrete. Wire ties will not be permitted.

All external angles of beams, columns, edges of concrete structures and sides of walls shall be given a 3/4 inch (19 millimeters) chamfer unless otherwise indicated on the plans.

(5) Manhole Lining. If the plans call for a protective lining, the lining material shall comply with the requirements of Subsection 509-2.08 or Subsection 509-2.09. The protective lining shall be white if it is PVC.

The installation of PVC liner plate, including the welding of all joints, lap strips, flaps, etc., shall be done in accordance with the manufacturer’s recommendations. Nailing through the plate shall not be allowed. Liner plate shall be held snugly in-place against inner forms by means of light gauge steel wire, light steel banding straps, or other suitable means. If steel banding straps are used, they shall be applied in strap channels provided for this purpose.

Locking extensions (T-Shaped) shall be integrally extruded to all lower, terminal, or longitudinal edges of the PVC liner plate as applied to the wall. If banding straps are used, a steel rod 1/4 inch (6 millimeters) in diameter may be inserted
SECTION 509

in each locking extension along the longitudinal edges of each sheet of liner plate. If approved, either method for holding the lower edge of the liner plate snugly against the form may be provided.

Concrete poured against the PVC liner plate shall be consolidated in a careful manner so as to protect the liner plate and to produce a dense, homogeneous concrete securely anchoring the lock extensions into the concrete. In removing forms, care shall be taken to protect liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. All holes and cut, torn or seriously abraded areas in the liner plate shall be repaired. Patches shall be limited to those which can be made with a single weld strip. Parallel, overlapping or adjoining weld strips shall not be allowed. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. Larger patches may consist of smooth liner place applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound liner plate adjoining and damaged area.

The contractor shall take all necessary precautions to prevent damage to installed PVC liner plate from equipment and materials used in or taken through the work. The applied lining shall be free from bubbles due to poor workmanship. The contractor shall cut out bubbled areas and weld a similar sheet in its place unless otherwise directed by the Engineer.

The contractor shall obtain the services of qualified personnel to weld the PVC liner plate field joints. Refer to Subsection 508-3.03(D) for information regarding the required qualifications. Manhole joints must be dry before the PVC liner plate joints are made. All mortar and other foreign material shall be removed from PVC liner plate surfaces adjacent to the manhole joint, leaving them clean and dry. No PVC liner plate joints shall be made until the trench has been backfilled and the manhole has been tested for leaks.

The field joint used for PVC manhole lining shall be Type C-1:

Type C-1 joints shall be made with a separate 4 inch (100 millimeters) joint strip and two welding strips. The 4 inch (100 millimeters) joint strip shall be centered over the joint, heat-sealed to the liner, then welded along each edge to adjacent liner plate with a 1 inch (25 millimeters) weld strip. The width of the space between adjacent liner plate sheets shall not exceed 2 inches (50 millimeters). The 4 inch (100 millimeters) joint strip shall lap over each liner plate a minimum of 1/2 inch (13 millimeters). It may be used at any transverse or longitudinal joint.

All welding and testing of joints are to be in strict conformance with the PVC liner plate manufacturer's specifications.
(6) Specialty Manholes.

(a) Drop Manholes. Drop manholes are not an acceptable specialty manhole.

(b) Flat Top Manholes. Flat top manholes shall conform to standard details.

(B) Existing Facilities. Raising and lowering of existing manholes shall be done in accordance with the applicable standard details.

The following procedures shall be followed when connecting a new sewer line to an existing manhole that has no stub-out or block-out:

Concrete core manhole riser to accommodate new pipe.

After the new main is laid, the opening through the wall around the new main shall be sealed off with material compatible with existing manhole wall components.

The existing bench shall be broken out to a minimum depth of 1 inch (25 millimeters) and thoroughly cleaned.

The new bench and channel shall be formed from mortar of Class S concrete with an epoxy additive to assure adequate bonding to the existing bench.

All surfaces shall be steel-troweled to a smooth, dense surface.

(C) Inverts. Invert channels shall be troweled to a smooth, dense surface and a semi-circular shape conforming to the inside diameter of adjacent sewer sections. The invert channel shall be formed of concrete, using a template if necessary. It may also be half-tile laid in concrete; or it may be constructed by laying a full section of sewer pipe through the manhole and cutting out the top half after the surrounding concrete has hardened.

A cut-out shall take place, under the inspection of the Engineer, by using a saw-cutter to remove the top portion of the pipe. Care shall be taken to prevent cuttings from entering the sewer, and the Engineer may require baling of the line if an excessive amount of cuttings have fallen into the pipe. After a cut-out, the edges of the pipe shall be filled and smoothed with mortar.

The bench of the base shall be brush or broom-finished, and shall slope toward the channels at 1 to 2 percent grade. The bench elevation shall be higher than the highest pipe crown in the manhole.

(D) Pipe Connections. Where designated as a provision for future lateral extensions, block-outs, or, if approved, stub-outs shall be built into the manhole. Flow channels shall be formed in the base for each block or stub-out. Stub-outs shall be plugged with an approved watertight stopper.
SECTION 509

Stub-outs are made by extending a section of pipe with the bell flush with the outside of the manhole base. The pipe shall be sealed with an approved, prefabricated plug or cap.

(E) Frames and Covers. The elevations at which frames and covers are to be set shall conform to the requirement set forth on the plans, but in all cases shall be governed by the Engineer in the field. Where the cover is in existing pavement or in the traveled way of the existing road shoulder, it is to be placed flush with the existing surface. Where the structure is outside the limits of the traveled shoulder or pavement, it should be placed 1/10 foot (30 millimeters) or more above the existing ground surface. Manhole frames shall be set at the required grade and shall be securely attached to the top pre-cast manhole shaft unit with a grout bed and filled as shown on the standard details. After the frames are securely set in the place provided herein, covers shall be installed and all necessary cleaning and scraping of foreign materials from the frames and covers shall be accomplished to ensure a satisfactory fit.

(F) Steps. Steps shall be placed at equal intervals of 12 to 15 inches (300 to 375 millimeters). The lower step shall not be more than 18 inches (450 millimeters) from the top of the manhole bench, and the upper step shall not be more than 24 inches (600 millimeters) below the top of the frame. Steps shall be located above a solid bench.

(G) Testing Manholes. The Engineer may require testing to verify that the manhole is watertight. Testing shall be conducted after the trench around the manhole has been backfilled. The negative air pressure test, as specified in ASTM C 1244, or a water test as specified in Arizona Administrative Code R18-9-E301 shall be used to test all manholes.

Repairs shall be made as directed by the Engineer whenever leakage exceeds the test limit.

509-3.03 Frame and Cover for Manhole or Structure. Where an existing frame and cover for a manhole or structure is unfit for further use, a new frame and cover shall be furnished and installed as specified under Subsection 509-2.06. Where necessary, existing side-walls shall be adjusted to the required grade by removing portions of, or adding to, the existing walls. Such adjustments shall conform to the details of the existing manhole unless otherwise noted on the project plans.

Unless provided by the appropriate utility, payment for replacement frames and covers shall be in accordance with Subsection 109-5.

509-3.04 Reset Frame and Cover. Existing frames and covers to be reset shall be carefully removed and reset to the required grade in accordance with the requirements of Subsection 509-3.01; however, at the contractor's option and with approval of the Engineer, adjustable extension rings, of the type which do not
SECTION 509

require the removal of the existing frame, may be used. The extension device shall provide positive locking action with the existing frame and shall permit adjustment in height to conform to the new finished pavement surface. The material for the extension device shall be compatible with the existing frame and conform to the requirements of the respective section of these specifications.

Once reset, manhole frames and covers shall be free of all dirt, mud, concrete, asphaltic paving materials and other deliturious substances and shall have all vent holes unobstructed.

Manhole frames and covers to be reset which are lost or damaged due to the contractor's operations to the extent that they are unacceptable for reuse shall be replaced at no additional cost to the Agency.

509-4 METHOD OF MEASUREMENT

New sanitary manholes and structures will be measured as a unit for each manhole or structure constructed inclusive of frame and cover.

Existing manholes or structures requiring adjustment to accommodate changes in the finished elevation of the roadway of 12 inches (300 millimeters) or less, will be measured as a unit for each manhole (300 millimeters) adjusted.

Existing manholes or structures requiring an adjustment of greater than 12 inches (300 millimeters) to accommodate changes in the finished elevation of the roadway shall be designated as a reconstruction and will be measured by the foot (millimeter), to the nearest one-half foot (150 millimeters) of elevation change between the existing rim elevation of the manhole or structure and the new rim elevation.

509-5 BASIS OF PAYMENT

The accepted quantities of new manholes or structures and manhole adjustments, measured as provided above, will be paid for at the contract unit price each, complete-in-place, including excavation, backfill, concrete, reinforcing steel, brick, frame, cover and testing.

The accepted quantities of reconstructed manholes or structures, measured as provided above, will be paid for at the contract unit price per foot (meter), including excavation, backfill, frame and cover.

The removal of unsuitable material below the required depth and the furnishing and placing of material in the voids thus created will be paid for in accordance with the provisions found in Subsection 109-4.
SECTION 1010

PIPE MATERIALS

1010-1 GENERAL REQUIREMENTS

Certificates of Compliance for all pipe materials covered by this Section shall be furnished in accordance with the requirements of Subsection 106-5(B).

1010-2 DRAINAGE PIPE

1010-2.01 Corrugated Metal Pipe. Metallic coated (zinc or aluminum) corrugated iron or steel culverts, underdrains, and spiral rib corrugated steel pipe shall conform to the requirements of AASHTO M 36/M 36M except as otherwise noted herein.

Type 1A pipe may be used if the shell thickness meets or exceeds the thickness specified on the plans for Type 1 pipe.

Polymer precoated, metallic coated (zinc or aluminum) corrugated steel culverts and underdrains shall conform to the requirements of AASHTO M 245, except as otherwise noted herein.

All helically-wound corrugated metal pipe shall have annular rerolled ends, and shall have a marking system which shall provide a quick, external visual check of diameter variations during and after the manufacturing process.

Bituminous coated corrugated metal (metallic coated steel or aluminum) culverts and underdrains shall conform to the requirements of AASHTO M 190.

Aluminum alloy corrugated metal pipe shall conform to the requirements of AASHTO M 196.

The types of bituminous coating and the type of precoated sheets to be used will be specified on the project plans. In lieu of the Type A bituminous coating, the pipe shall be coated either in the field or at the plant, on the outside surface only, in accordance with the requirements of AASHTO M 243. Either asphalt mastic or tar base material shall be used.

Coupling bands shall conform to the requirements of AASHTO M 36/M 36M, M 245/M 245M, and M 196/M 196M, except that the use of bands with projections (dimples) will be limited to end sections, to pipe laid on grades under ten percent, and to pipe requiring water resistant joints.

Bands of special design that engage factory reformed ends of corrugated metal pipe may be used.

Bolts and nuts for all types of coupling bands shall conform to the requirements of ASTM F 568.

Coupling band connection hardware consisting of nuts, bolts, rods, bars, and rivets shall be either galvanized after fabrication by the hot-dip process, in accordance with the requirements of ASTM A 153, or coated by the electroplating process, in accordance with
SECTION 1010

the requirements of ASTM B 633, Type RS or ASTM B 766, Type TS. Components of bolted assemblies shall be coated separately before assembly.

Special sections, such as elbows and prefabricated end sections, shall conform to the applicable requirements of AASHTO M 36/M 36M, M 190/M 190M, M 196/M 196M, and M 245/M 245M.

Gaskets for all water-resistant joints shall be a continuous band or strip, at least 7 inches (180 millimeters) wide and 1/2 inch (13 millimeters) thick. Rubber for the gaskets shall conform to the requirements of ASTM D 1056 for the "2A" closed cell expanded grades.

Watertight joints, when specified on the project plans, shall use "O"-ring gaskets, with appropriate diameters as specified under AASHTO M 36/M 36M, and conforming to the technical requirements of AASHTO M 198. Watertight joints may substitute or be used when water-resistant joints are required.

1010-2.02 Spiral Rib Steel Pipe. Spiral rib steel shall conform to the requirements specified under Subsection 1010-2.01(A) for corrugated metal pipe, except as identified herein:

(A) Fabrication: Ribbed steel pipe shall be fabricated with a continuous helical lock seam in accordance with AASHTO M 36/M 36M, Type 1R or corrugation in accordance with AASHTO M 196/M 196M, Type 1R. Aluminum rib pipe shall be manufactured in accordance with AASHTO M 196/M 196M, Type 1R.

Each pipe end shall be fabricated with a minimum of two annular rerolled corrugations for the purposes of joining pipes together with band couplers.

(B) Coatings: The types of coatings and the type of precoated sheets to be used shall be as specified on the project plans.

(C) Coupling Bands: Coupling bands for spiral ribbed steel pipe shall be rerolled bands manufactured from 0.064 inch (1.62 millimeters) thick metallic coated steel conforming to the requirements specified under Subsection 1010-1.02(A) and shall be two-piece for pipe greater than 48 inches (1200 millimeters) of nominal diameter.

Coupling bands shall be a minimum of 10-1/2 inches (263 millimeters) wide, formed with two corrugations that are spaced to provide nesting in the second corrugation of each pipe end and shall be drawn together by a minimum of two 1/2 inch (metric M12) diameter galvanized bolts through the use of a bar and strap suitably welded to the band. Bands may be drawn together by other means, such as angles, as approved by the Engineer.

(D) Fittings: Fittings for ribbed steel pipe shall conform to the requirements for corrugated steel pipe fittings specified in Subsection 1010-2.01, except the material shall be ribbed steel.

867
**SECTION 1010**

(E) Miscellaneous: All spiral rib manhole risers 24 inch (600 millimeters) in diameter or greater shall be reinforced with a rolled 3 inch x 3 inch x 1/4 inch (75 x 75 x 6 millimeters) angle or as approved by the Engineer.

Pipe thickness for spiral rib pipe shall be specified in the pipe summary, but shall not be less than that listed in the following tables.

**Table 1010-1**

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Minimum Thickness</th>
<th>Corrugation Rib Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 - 60 inch (460 - 1520 mm)</td>
<td>1/16 inch (1.63 mm)</td>
<td>3/4 x 3/4 x 7-1/2 inch (19 x 19 x 190 mm) or 3/4 x 1 x 11-1/2 inch (19 x 25 x 292 mm)</td>
</tr>
<tr>
<td>66 - 78 inch (1680 - 1980 mm)</td>
<td>5/64 inch (2.01 mm)</td>
<td>3/4 x 3/4 x 7-1/2 inch (19 x 19 x 190 mm) or 3/4 x 1 x 11-1/2 inch (19 x 25 x 292 mm)</td>
</tr>
<tr>
<td>84 - 102 inch (2130 - 2590 mm)</td>
<td>7/64 inch (2.77 mm)</td>
<td>3/4 x 3/4 x 7-1/2 inch (19 x 19 x 190 mm) or 3/4 x 1 x 11-1/2 inch (19 x 25 x 292 mm)</td>
</tr>
</tbody>
</table>

**Spiral Rib Aluminum Pipe**

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Minimum Thickness</th>
<th>Corrugation Rib Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 - 42 inch (460 - 1070 mm)</td>
<td>16 gage (1.52 mm)</td>
<td>3/4 x 3/4 x 7-1/2 inch (19 x 19 x 190 mm) or 3/4 x 1 x 11-1/2 inch (19 x 25 x 292 mm)</td>
</tr>
<tr>
<td>48 - 54 inch (1220 - 1370 mm)</td>
<td>14 gage (1.91 mm)</td>
<td>3/4 x 3/4 x 7-1/2 inch (19 x 19 x 190 mm) or 3/4 x 1 x 11-1/2 inch (19 x 25 x 292 mm)</td>
</tr>
<tr>
<td>60 - 72 inch (1520 - 1830 mm)</td>
<td>12 gage (2.67 mm)</td>
<td>3/4 x 3/4 x 7-1/2 inch (19 x 19 x 190 mm) or 3/4 x 1 x 11-1/2 inch (19 x 25 x 292 mm)</td>
</tr>
<tr>
<td>78 - 84 inch (1980 - 2130 mm)</td>
<td>10 gage (3.43 mm)</td>
<td>3/4 x 3/4 x 7-1/2 inch (19 x 19 x 190 mm) or 3/4 x 1 x 11-1/2 inch (19 x 25 x 292 mm)</td>
</tr>
</tbody>
</table>

1010-2.03 Concrete-lined Corrugated Metal Pipe

(A) Corrugated Metal Pipe. Corrugated metal pipe, coupling bands and fittings for concrete-lined pipe shall conform to the requirements of AASHTO M 36/M 36M for the specified sectional dimensions and metallic coatings. Aluminized coating shall conform to AASHTO M 274.
SECTION 1010

Pipe shall be full circle and shall be fabricated with helical corrugations.

Pipe thickness shall be as specified in the pipe summary, but shall not be less than that listed in the following table.

Table 1010-2

<table>
<thead>
<tr>
<th>Pipe Diameter (millimeter)</th>
<th>Minimum Thickness Inch/Gage (millimeter)</th>
<th>Corrugation Rib Size inches (millimeter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-48 (300-1220)</td>
<td>0.064/16 (1.63)</td>
<td>2-2/3 x 1/2 (68x13)</td>
</tr>
<tr>
<td>54-72 (1370-1830)</td>
<td>0.064/16 (1.63)</td>
<td>2-2/3 x 1/2 (63x13)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 x 1 (75x25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 x 1 (125x25)</td>
</tr>
<tr>
<td>78-84 (1980-2130)</td>
<td>0.138/10 (3.50)</td>
<td>2-2/3 x 1/2 (68x13)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 x 1 (75x25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 x 1 (125x25)</td>
</tr>
<tr>
<td>90-102 (2290-2590)</td>
<td>0.109/12 (2.77)</td>
<td>2-2/3 x 1/2 (68x13)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 x 1 (75x25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 x 1 (125x25)</td>
</tr>
<tr>
<td>108-120 (2740-3050)</td>
<td>0.138/10 (3.50)</td>
<td>3 x 1 (75x25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 x 1 (125x25)</td>
</tr>
</tbody>
</table>

Each pipe end shall be fabricated with a minimum of two annular rerolled corrugations for purpose of joining pipes together with band couplers.

Pipe shall be joined with rerolled bands made from the same material as the pipe. The bands shall be a minimum of 16 gage/.064 inch (1.63 millimeters). Bands shall be two piece for pipe greater than 48 inches (1200 millimeters) in diameter.

Coupling bands shall be a minimum of 10-1/2 inches (263 millimeters) wide, formed with two corrugations that are spaced to provide nesting in the second corrugation of each pipe end and shall be drawn together by a minimum of two 1/2 inch (metric M 12) diameter galvanized bolts through the use of a bar and strap suitably welded to the band. Bands may be drawn together by other means, such as angles, as approved by the Engineer.

When watertight joints are specified, "O" ring gaskets will be required. "O" ring gaskets shall be per ASTM C 361 Section 5.9 and shall be placed in the first corrugation of each pipe end and shall be compressed by tightening the coupling band, in accordance with the manufacturers installation instructions.
SECTION 1010

(B) Concrete Lining:

(1) Composition. Concrete for the lining shall be composed of cement, fine aggregate and water that are well mixed and of such consistency as to produce a dense, homogeneous, non-segregating lining.

(2) Cement. Portland Cement shall be in accordance with Subsection 1006-2.01.

(3) Aggregate. Aggregates shall conform to AASHTO M 6, except that the requirements for gradation and uniformity of gradation shall not apply.

(4) Mixture. The aggregates shall be sized, graded, proportioned and thoroughly mixed with such proportions of cement and water as will produce a homogeneous concrete mixture of such quality that the pipe will conform to the design requirements of this specification. In no case, however, shall the proportions of Portland Cement plus Pozzolanic admixture be less than 470 pounds per cubic yard (280 kilogram per cubic meter) of concrete.

(5) Lining. The lining shall have a minimum thickness of 3/8 inch (10 millimeters) above the rest of the corrugations and shall be applied by a machine traveling through a stationary pipe. The rate of travel of the machine and the rate of concrete placement shall be mechanically regulated so as to produce a homogeneous non-segregated lining throughout. The lining shall be applied in a two course application, and shall be mechanically troweled by the lining machine as the unit moves through the pipe. The trowel attachment shall be such that the pressure applied to the lining will be uniform and shall produce a lining that has a uniform thickness and a consistent troweled finish. The vertical diameter anywhere inside the pipe must be 95% of the nominal diameter less acceptable tolerances as stated in AASHTO M 36. Pipe not meeting these tolerances will be rejected.

(C) Experience. The manufacturer shall certify in writing that he has successfully manufactured and furnished corrugated steel pipe with a concrete lining per these specifications on a minimum of fifteen (15) previous projects of a storm sewer nature.

1010-2.04 Slotted Pipe. Slotted pipe shall conform to the applicable requirements of AASHTO M 36/M 36M. It shall be the grate slot or angle slot type. Pipe shall be helically or annular corrugated.

Grate assemblies shall be fabricated from steel conforming to the requirements of either ASTM A 36 or ASTM A 576 and shall be galvanized in accordance with the requirements of ASTM A 123. The method of manufacture shall relieve all strain and prevent distortion of the pipe.
SECTION 1010

When a lockseam joint is used, slotted drain pipe shall be placed in a clamping device and cut the entire length prior to placement of grate. The grate must be continuous and full depth. The grate shall be welded continuously to the pipe with a 3/16 inch (5 millimeter) fillet weld from end to end on both sides.

Bolts and nuts shall be steel, conforming to the requirements of ASTM F 568, and shall be galvanized in accordance with the requirements of ASTM A 123.

The butyl rubber joint sealant shall be an extruded strip or bead, compounded from a nondrying, nontoxic, synthetic resin base with butyl rubber and inorganic extenders, and shall be 100 percent solid material with no shrinkage. The sealant material shall have sufficient adhesion so that the strip or bead will adhere to galvanized steel and be soft enough to allow cold flow when compressed during connection of the pipe sections. The sealant material shall not flow or sag at temperatures up to 180° F (82 °C) nor become brittle, crack or lose adhesion at temperatures as low as -30° F (-34 °C) and shall contain no migrating components that could leach out or produce any chemical reaction with galvanized steel. The sealant material shall be furnished in 5/8 x 1 inch (16 x 25 millimeter) strips or in 1 inch (25 millimeter) diameter beads on 1 inch (25 millimeter) wide release paper and wound into rolls.

An alternative joint sealant or sealing method that will provide a watertight joint may be used if approved by the Engineer.

Materials used for grout shall conform to the requirements of Section 1006. The grout shall be composed, by volume, of one part portland cement, three parts fine aggregate and one-fifth part hydrated lime. Hydrated lime shall conform to the requirements of ASTM C 207, Type N. To these mixed materials sufficient water shall be added to provide a mixture that will flow readily. Grout that has been mixed more than one hour shall not be used. Retempering of grout will not be permitted.

1010-2.05 Structural Plate Pipe. Structural plate (steel) for pipe, pipe-arches and arches and the accessories for connecting the plates shall conform to the requirements of AASHTO M 167/M 167M.

Structural plate (aluminum alloy) for pipe, pipe arches and arches and the accessories for connecting the plates shall conform to the requirements of AASHTO M 219.

When specified on the project plans or in the Special Provisions, structural plates (steel) and structural plates (aluminum alloy) shall be bituminous coated in accordance with the requirements of AASHTO M 243. Unless otherwise specified, the coating shall be applied to the outside only.

Concrete for footings, bottom slabs on paved inverts, and rings on struts shall conform to the requirements of Section 1006 for the strength and class specified on the project plans.

871
SECTION 1010

Steel bars, wire, wire fabric, anchor bolts, and structural steel shall conform to the requirements of Section 1003 or Section 1004, as applicable.

1010-2.06 Nestable Steel Pipe. Nestable corrugated steel pipe shall conform to the requirements of AASHTO M 36/M 36M, except that the pipe shall be fabricated in two separate semi-circular sections. The two sections shall be firmly joined together in accordance with the requirements of Military Specification MIL-P-236. At the option of the contractor, the longitudinal joint of the nestable pipe sections shall be either Type I, flanged, or Type II, notched, as specified in MIL-P-236.

1010-2.07 Reinforced Concrete Pipe. Reinforced concrete pipe (circular) shall conform to the requirements of AASHTO M 242/M 242M for the D-load specified.

Reinforced concrete pipe (circular) shall conform to the requirements of AASHTO M 170/M 170M for the class of pipe specified.

Reinforced concrete pipe (elliptical) shall conform to the requirements of AASHTO M 207/M 207M for the class of pipe specified.

Reinforced concrete pipe (arch) shall conform to the requirements of AASHTO M 206/M 206M for the class of pipe specified.

The contractor shall furnish the Engineer a copy of the pipe design when the standard AASHTO tables are exceeded.

Precast, reinforced concrete flared end sections shall conform to the requirements of the previously cited specifications to the extent to which they apply. The area of steel reinforcement, per linear foot (meter) of the flared end section, shall be at least equal to the minimum steel requirement for reinforcement in that portion of the flared end section which abuts the pipe.

Gaskets for reinforced concrete pipe (circular) shall conform to the requirements of AASHTO M 198.

Mortar used to join reinforced concrete pipe shall be composed by volume of one part portland cement, two parts fine aggregate, one-fifth part hydrated lime and sufficient water to provide a plastic mixture. Cement and water shall conform to the requirements of Section 1006. Fine aggregate shall conform to the grading requirements of ASTM C 144. Hydrated lime shall conform to the requirements of ASTM C 207, Type N. The lime shall be considered as an addition to and not as replacing any cement.

1010-2.08 Nonreinforced Concrete Pipe. Nonreinforced concrete pipe shall conform to the requirements of AASHTO M 86/M 86M for the class of pipe specified.

Gaskets and mortar used to join nonreinforced concrete pipe shall conform to the requirements hereinbefore specified under Subsection 1010-2.07.
SECTION 1010

1010-2.09 Corrugated High Density Polyethylene Pipe. Corrugated high density polyethylene pipe, fittings, couplings, and ends, where specified, shall conform to the requirements of AASHTO M 252 for pipe sizes less than 12 inches (300 millimeters) in diameter and AASHTO M 294 for pipe sizes 12 to inches (300 millimeters) in diameter and larger.

Corrugated high density polyethylene pipe shall be watertight unless otherwise specified in the Special Provisions, indicated on the plans, and/or approved by the Engineer. When watertight pipe is used, the use of a water stop designed for corrugated high density polyethylene shall be used at all connections to concrete structures.

Water stop shall meet the physical properties of ASTM C923, and the performance requirements of Subsection 501-3.06. Expanding sealants or ASTM F477 gasket supplied with the pipe to make the bell spigot connection on pipe and fittings does not meet these requirements for corrugated high density polyethylene. Installation of water stops shall be per manufacturer recommendations.

Watertight pipe shall conform to the controlled pressure test of 10.8 psi (74.5 KiloPascals) of air or 25 feet (7.6 meters) of water as stipulated in ASTM D3212 (Lab Test). For the purpose of this specification, field testing is defined as the pressures of 3.5 psi (24.1 KiloPascals) of air or 4 feet (100 millimeters) of water as specified in Subsection 501-3.06.

Water resistant pipe shall be watertight according to the requirements of ASTM D 3212, except that the internal water pressure test shall be conducted at 2 psi (14 kPa). Water resistant pipe cannot be field tested.

Non-perforated pipe shall have either water resistant or watertight joints, as specified on the project plans. Watertight joints may substitute or be used when water resistant joints are required.

Watertight joints shall be watertight according to the requirements of ASTM D 3212.

Pipe and resin producers that manufacture AASHTO M294, and AASHTO MP7 Pipe, shall be certified according to the Plastics Pipe Institute (PPI) Third Party Certification Program. All certified corrugated high density polyethylene pipe shall contain the appropriate program mark, either an official label or permanent affixation prior to shipment.

For the latest certification listing refer to www.cppainfo.org/certification/pipe.html
SECTION 1010

Magnetic tape, which is to be placed in the trench with the polyethylene pipe as an aid in location after burial, shall have a minimum overall thickness of 5.5 mils (140 micrometers) and a minimum tensile strength of 5000 pounds per square inch (34.5 mega Pascals).

1010-3 SANITARY SEWER PIPE AND APPURTEANCES

1010-3.01 General Requirements. A Certificate of Compliance from the manufacturer shall be furnished attesting that the pipe and appurtenances (excluding linings and coatings if applied by an independent applicator) meet the requirements set forth in these Subsections. The Certificate of compliance shall conform to the requirements of Subsection 106-5(B). All pipe and appurtenances shall be clearly marked with the name or trademark of the manufacturer, the batch number, and the location of the plant.

1010-3.02 Vitrified Clay Pipe (VCP) Except as modified herein, all materials, manufacture and testing for VCP shall be in accordance with ASTM C 700.

VCP shall be new and extra strength in accordance with the requirements set forth in ASTM C 700, and meet the requirements set forth herein.

The dimensions and permissible tolerances for the laying length, squareness of ends, and variation of inside diameter of VCP shall conform to Table 2 of ASTM C 700.

VCP shall meet the crushing strength and acid resistance tests, and either the absorption or hydrostatic pressure tests using the criteria set forth in ASTM C 700 and the testing procedures set forth in ASTM C 301.

Repairs of any type at the spigot or socket shall be limited to one for each 60 degrees of circumference and a maximum of four at either end. No repairs will be permitted on pipe to be used for fabrication of fittings unless the repaired pipe is tested. However, fittings may be repaired within the scope of these specifications.

All surfaces to be repaired shall be clean and dry. All unsound material at lumps or blisters shall be ground smooth and flush with adjacent surfaces. Cracks shall be saw cut, ground or otherwise grooved 3/16 to 1/4 inch wide (0.5 to 6 millimeters) and 1/8 to 1/4 inch (3 to 6 millimeters) deep for the full length of the crack and then cleaned of all loose material. All unsound material such as chips, flakes, pits, and spalls shall be removed. Edges shall be chipped or ground 1/16 inch (2 millimeters) minimum below adjacent surfaces. There shall be no feather edges.

Materials used for repair shall be approved by the Engineer. Repair material shall be mixed, applied, and cured as recommended by the manufacturer and approved by the Engineer, and shall have a color contrasting with the color of the pipe to be repaired. If necessary to produce a contrast in color, carbon black in a small quantity may be added to the repair material.
SECTION 1010

Repair material shall be compounded to provide properties most desirable for sewerage service. Repair material shall resist bacterial attack and attack by chemicals or combinations of chemicals normally present in domestic and industrial sewerage.

The repair material shall be subject to the following tests:

1. Vitrified clay bars 1 inch (25 millimeters) square in cross section and approximately 8 inches (200 millimeters) in length, compounded of the same materials as the vitrified clay pipe and fired to clay pipe manufacturing temperature, shall be used in preparing the test specimens. The Bars shall have a modulus of rupture of not less than 1,600 psi (11 megapascals) when tested in flexure with three-point loading. The bars shall be cut through at the midpoint and then bonded with the repair material. Following a seven-day maximum cure period at ambient room temperature, the bonded bars shall be tested in flexure with three-point loading. The average modulus of rupture of five test bars bonded with the repair material shall be not less than 1,600 psi (11 megapascals).

2. Five additional test bars bonded with repair material and immersed for 60 days in water at ambient room temperature shall have an average modulus of rupture not less than 1,500 psi (10 megapascals).

Each specimen of repair material shall lose not more than 2.0 percent of its weight when immersed in the solutions listed below for a period of 30 days. Specimens shall be conditioned for seven days at 110° F (43 °C) and cooled in a desiccator for three hours prior to weighing.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Percent Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfuric Acid</td>
<td>20 *</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>5</td>
</tr>
<tr>
<td>Ammonia Hydroxide</td>
<td>5 *</td>
</tr>
<tr>
<td>Nitric Acid</td>
<td>1 *</td>
</tr>
<tr>
<td>Ferric Chloride</td>
<td>1</td>
</tr>
</tbody>
</table>

* Volumetric percentages of concentrated C.P. grade reagents.

All pipe permitted to be repaired shall be inspected after preparation and prior to repair (to determine what repairs are to be made) and after repairs have been completed.

Pipe having unauthorized repairs will be rejected. The Engineer may require retesting of any repaired pipe to demonstrate its soundness. The Engineer will supervise all repairs and inspections required by this section. The Agency shall be reimbursed for all costs incurred for inspection and testing of the repaired pipe.

1010-3.03 Ductile Iron Pipe (DIP). Except as modified herein, all materials, manufacture, and testing for DIP shall be in accordance with ASTM A 746.
SECTION 1010

Ductile Iron Pipe shall be manufactured with the material, have the dimensions, be within the tolerances, and meet the testing requirements set forth in ASTM A 746. DIP shall be manufactured in nominal 18-foot (5.5 meter) or 20-foot (6.1 meter) laying lengths and shall be lined as specified herein.

(A) Polyethylene or Polyethylene/Fusion Bonded Epoxy Lining (for 8 inch (200 millimeter) and Greater DIP and Fittings). Polyethylene lining material shall be virgin polyethylene complying with ANSI/ASTM D 1248, compounded with or without an inert filler and with sufficient carbon black or other additives to resist ultraviolet rays during aboveground storage of the pipe and fittings. The polyethylene (PE) or polyethylene combined with a fusion-bonded epoxy (PE/FBE) shall be bonded to the interior of the pipe and fittings by heat.

The polyethylene (PE) or polyethylene (PE) or polyethylene lining in combination with a fusion bonded epoxy (PE/FBE) shall cover, as a minimum, the inner surfaces of the pipe and fittings from the plain or beveled spigot end to the bottom of the gasket socket. However, the lining extending into the gasket socket area and onto the exterior of the spigot end of the pipe can be either PE, PE/FBE or a hybrid novolac epoxy.

All PE or PE/FBE lining shall be applied by the pipe manufacturer at the location of pipe manufacture or by an approved lining applicator at the lining applicator's facility. The minimum thickness of the PE or PE/FBE lining shall be 35 mils (875 micrometers) and a nominal thickness of 40 mils (1000 micrometers).

Hybrid novolac epoxy used in conjunction with the polyethylene lining shall conform to the requirements of Subsection 1010-3.02(B).

(B) Hybrid Novolac Epoxy Lining (for 4 inch (100 millimeter) and Greater DIP and Fittings). Hybrid novolac epoxy lining compound must be a two-component epoxy compound capable of at least a 40 mil (1000 micrometer) nominal (35 mil minimum (875 micrometers)) dry film thickness in an application process whereby delamination will not occur. The material must also meet the following minimum performance requirements:

- A direct impact resistance as measured in accordance with ASTM D 2794 at 35 mil (875 micrometer) dry film thickness on ductile iron panels. The material shall pass 100 inch-pounds (1.13 kilonewton) of impact.

- A maximum coating weight loss of 300 milligrams as measured in accordance with ASTM D 4060 using CS-17 wheels with a 1,000 gram load for 1,000 cycles.

- A minimum adhesion value of 2000 psi as measured in accordance with ASTM D 4541.
SECTION 1010

• A maximum weight change of 1% when a sample of the lining is completely immersed in a 50% by weight solution of sulfuric acid having a temperature of 75° F (24 °C) and being tested for 30 days. The test specimens are to be cast to a 1/8 inch (3 millimeter) thickness and allowed to cure for 7 days at 75° F (24 °C). The specimen weight is to be determined after 8 hours, 24 hours, 72 hours, 7 days and 30 days of continual exposure to the sulfuric acid. Prior to each weight measurement, the specimen is to be rinsed off and allowed to dry for one hour.

The Engineer may require additional testing to be run on a proposed lining or coating to determine its suitability on a given project. Unless a special waiver is granted by the Agency, all tests are to be performed by an independent testing laboratory approved by the Agency.

Epoxy linings shall be applied by the pipe manufacturer at the location of the manufacture of the pipe, or by a qualified applicator who would apply the lining at the applicator’s place of business. The applicator shall demonstrate, to the satisfaction of the Agency, that they are capable of successfully applying the specified lining on ductile iron or steel pipe.

(C) Application and Testing of Lining. The pipe manufacturer shall be responsible for the quality of the pipe. The lining applicator shall be responsible for the quality of the lining.

All surface areas which will be exposed to sewer liquids and gases shall be cleaned so as to remove all deleterious materials. After cleaning, the lining compound shall be applied to all surface areas which will be exposed to the sewer liquids and gases. The lining compound shall be applied so as to obtain a continuous and relatively uniform and smooth integral lining.

The lining in the barrel area shall have a nominal thickness of 40 mils (1000 micrometers) and a minimum thickness of 35 mils (875 micrometers). However, the lining in the bell area may transition from a 35 mil (875 micrometers) minimum thickness at the edge of the barrel area to a 10 mil (250 micrometer) minimum thickness at the bottom of the gasket socket. The 10 mil (250 micrometer) lining shall extend into the gasket socket area to a point where the gasket would overlap the lining when it is compressed due to pipe assembly during construction. The 10 mil (250 micrometer) lining shall also continue from inside the barrel area, around the spigot end of the pipe and along the outside of the pipe to a point where the center of the gasket of the next pipe section would contact the edge of the lining on the spigot end of the previous pipe section. This is a minimum requirement. The thickness of linings shall be determined by using a dry film thickness magnetic gauge. The maximum dry film thickness in the gasket seat area and on the exterior of the spigot end is 15 mils (375 micrometers).

Each piece of pipe shall be tested and shall have an absence of holidays (small areas of pipe devoid of lining) when tested by a suitable holiday detector. In all cases, the barrel area of the
SECTION 1010

pipe shall be tested using both a voltage of 7500 volts and a dry conductive probe. The bell area and the exterior of the spigot end, shall be tested using both a voltage of 67.5 volts and a wet sponge.

Fittings and stoppers shall meet the requirements of ANSI A 21.10. Joints shall be push on type and meet the requirements of ANSI A 21.11. EPDM gaskets shall be used for all DIP, unless the plans or Special Provisions state otherwise.

1010-3.04 Reinforced Concrete Pipe (RCP). Reinforced concrete pipe shall meet the requirements of ASTM C 76 except as modified by these specifications. The absorption test as stated in Section 11.4.2 of ASTM C 76 shall be amended to read, "The absorption of a sample from the wall of the pipe, as determined in accordance with Method C 497, shall not exceed 7% of the dry mass for Method A or 6.5% for Method B". Portland cement shall be Type II unless otherwise specified by the Engineer and conform to the requirements of ASTM C 150.

Reinforced concrete pipe used for sanitary sewer applications shall have all of its interior surfaces protected by the installation of polyvinyl chloride (PVC) liner unless an alternate method of protection is approved by the Agency.

Lined pipe shall have joints utilizing EPDM "O"-ring rubber gaskets meeting the requirements of ASTM C 443, except as modified by these specifications. The lined pipe shall also have an interior lining of plastic-liner plate meeting the requirements of ASTM C 76 except when otherwise permitted by the Engineer. No materials shall be used in the manufacture of the pipe other than water, Type II Portland cement as specified in ASTM C 150, mineral aggregate and steel conforming to ASTM C 76 and approved admixtures.

The interior area of RCP shall be sealed with a protective lining installed by the pipe manufacturer or a lining applicator approved by the Engineer. The material used in the liner plate shall be a combination of inert, synthetic resins, pigments, and plasticizers, compounded to make permanently flexible sheets.

Liner plate shall be white in color and shall be resistant to oxidizing agents; sulfuric, phosphoric, nitric, chromic, oleic, and stearic acids; sodium and calcium hydroxides; ammonia; sodium, calcium, magnesium and ferric chlorides, ferric sulfate; petroleum oils and greases; vegetable and animal oils; fats; greases; and soaps. The liner plate shall be impermeable to sewage gases and liquids, and shall be non-conducive to bacterial and fungus growth. All liner plates shall be factory checked electrically with a high-voltage holiday detector set at 20,000 volts to insure freedom from any porosity. The lining shall have good impact resistance, shall be flexible, and shall have an elongation sufficient to bridge a 1/8 inch (3 millimeter) settling crack without damage. Once cast into the pipe, the lining shall be permanently and physically (not adhesively) attached by a T-lock

878
SECTION 1010

mechanism. The lining shall withstand a 15 psi (103 kilopascal) back hydrostatic pressure applied to the under surface of the lining without losing anchorage or without rupture or leakage.

Liner plate shall be supplied as pipe-size sheets fabricated by shop welding together the basic-size sheets. Joint strips shall be 4.0 inches (100 millimeters) ± 0.25 inches (6 millimeters) in width and shall have each edge beveled prior to application.

The liner plate shall not be less than 0.065 inches (1.65 millimeters) in thickness. Locking extensions shall be of the same material as the liner and shall be integrally extended with the sheets. If steel bands are used to secure the liner plate to the forms transversely, strap channels shall be integrally molded into the sheet.

The pipe manufacturer shall certify that no calcium chloride has been used in the manufacture of the pipe. Other admixtures may be used if approved by the Agency.

The reinforcement shall be fabricated as a rigid cage of bars or wire. Transverse reinforcement shall be fabricated either as complete hoops, welded or lapped, or as a continual helix. If the transverse reinforcement is formed as a cylindrical or elliptical helix, both ends of the cage shall be finished off as a complete hoop.

Splices shall be either welded or lapped and tightly wired. Either lap or butt welds may be used, but the weld must develop the full strength of the bar. The lap of un-welded splices shall extend 30 diameters when bars or rods are used for reinforcement, and 40 diameters when wire is used.

The placement of reinforcement steel shall not vary from the position in the pipe wall shown on the drawings by more than 1/4 inch (6 millimeters). In no case shall the cover over reinforcement be less than 3/4 inch (19 millimeters).

Suitable devices shall be used to hold the cage of reinforcement in its elliptical or circular shape and to maintain the cage in place within the forms during the placing and consolidation of the concrete. Supports between the reinforcement and the forms that are to be exposed in the finished pipe shall be made of plastic or plastic coated steel.

When two reinforcement cages are used, the longitudinal reinforcement shall be divided approximately equally between the two cages, and only the longitudinal reinforcement on the outer cage need extend into the bell. The end hoops of the transverse reinforcement will be nominally 1 inch (25 millimeters) from the extreme and concrete faces of the pipe. For pipe with a wall thickness of 2-1/2 inches (64 millimeters) or less, the transverse reinforcement shall be located in accordance with ASTM C 76. The cover over longitudinal reinforcement shall be not less than 3/8 inch (10 millimeters).
SECTION 1010

Reinforced concrete pipe shall have a nominal laying length of 8 to 20 feet (2.4 to 6.1 meters) unless otherwise specified. The internal diameter of 27 inch (685 millimeters) and larger pipe shall not vary more than one percent, but in no case shall the variance exceed 3/8 inch (10 millimeters) from the nominal diameter. The pipe wall may be thicker than the design thickness, but cannot be less than the design by more than five percent or 3/16 inch (5 millimeters) whichever is less. Variation in laying lengths of two opposite sides of pipe shall not be more than either 1/8 inch per foot (10.5 millimeters per meter) of diameter or 5/8 inch (16 millimeter) total whichever is less. The underrun in length of a section of pipe shall not be more than 1/8 inch per foot (10.5 millimeters per meter) with a maximum of 1/2 inch (13 millimeters) in any length of pipe.

Each Gay's run shall be marked and stored in the manufacturer's yard so that the pipe made on any particular day may be easily identified. The date of manufacture, size and D-load, lot number, manufacturer's identification mark, and, where elliptical reinforcement is used, a four-inch high "T" marking the location of the minor axis of the reinforcements, shall be legibly painted or stamped on the inside of each pipe.

Reinforced concrete pipe shall meet the physical requirements set forth in Section 11 of ASTM C 76.

All liner shall be shop tested for holes, using an approved spark detector set at a minimum of 20,000 volts. Sheets having holes shall be satisfactorily repaired in the shop and retested prior to shipping to the project.

All D-load bearing strength tests shall conform to ASTM C 497, latest edition, except as modified by these specifications.

Pipe to be D-load tested shall be randomly selected at the point of manufacture by the Engineer. One pipe will be selected for each lot, or fraction thereof, of the pipe to be furnished to the project.

For the purpose of these specifications, a lot is defined as 600 feet (180 meters), but no more than 50 sections of pipe (or a fraction thereof), of one size and class manufactured on consecutive working days. If the 600 feet (180 meters), but no more than 50 sections, of pipe are not made on consecutive working days, then only those made on consecutive working days shall be considered a lot. If an interruption in the manufacture of a lot occurs, the Engineer may permit the pipe made after the interruption to be included in the lot, provided the interruption does not last more than seven calendar days. A new lot number will be assigned if any change occurs in the size or spacing of reinforcing steel, in the concrete mix, or in the curing method.

The contractor or pipe manufacturer shall furnish the test pipe without charge and shall provide adequate equipment and facilities for conducting tests and shall bear all expense in connection therewith. Testing shall be under the supervision of the Engineer. Test equipment shall accommodate a length of pipe of
SECTION 1010

the same length as furnished for the project. All testing equipment shall be calibrated at intervals not to exceed six months by an agency approved by the Engineer.

Test pipe shall conform in all other respects to the applicable requirements specified herein. Pipe shall be tested by the three-edge bearing method as described in ASTM C 497 as modified by these specifications. Test pipe that meet the 0.01 inch (0.25 millimeter) crack load requirements shall be accepted for use.

The required strength of the pipe specimens undergoing the bearing tests will be designated in terms of D-load. Such designation indicates the actual load in pounds per linear foot (kilograms per meter) of pipe divided by the inside diameter of the pipe in feet (meters). The pipe shall withstand the required test load before a crack having a width of 0.01 inch (0.25 millimeter) measured at close intervals occurs throughout a length of 1 foot (300 millimeters) or more. The crack shall be considered 0.01 inch (0.25 millimeter) in width when the point of the measuring gauge will, without forcing, penetrate it 1/16 inch (2 millimeters) at close intervals throughout the specified distance of 1 foot (300 millimeters).

The load shall be applied at a uniform rate not to exceed 2,000 pounds per minute per foot (907 kilograms per minute per 300 millimeters) of length of pipe for the first 80 percent of the required load, and then at a uniform rate not to exceed 500 pounds per minute per foot (225 kilograms per minute per 300 millimeters) of length of pipe for the remainder of the test.

The length on which the test load is computed shall be determined by measuring the inside length of the barrel of the pipe from the bottom of the socket to the end of the spigot. The length of a beveled pipe shall be the average length of the inside of the barrel of the pipe measured from the bottom of the socket to the end of the spigot.

If the tested specimen of a designated lot passes the test, all of the pipe of that lot shall be considered as complying with these requirements.

If the tested specimen of a designated lot fails to pass the test, then two additional specimens from the same lot shall be selected for test.

If the two additional specimens pass the requirements of the test, the total number of that lot to be furnished shall be considered as complying with the requirements except that the one previous test specimen failing to meet the test requirements shall be rejected.

If any of the two additional specimens fail to meet the test requirements, the entire lot shall be rejected, or may be down-graded, except the test specimen which met the test requirements.
SECTION 1010

The contractor may test specimens of a rejected lot individually to determine whether they may comply with the requirements for acceptance.

In addition to D-load bearing strength tests described above, it is required that one short length joint for each internal diameter having a different design D-load requirement shall be bearing loaded to ultimate strength in accordance with ASTM C 497. The test specimen shall be manufactured without a lining and shall be surface-dry when tested.

1010-3.05 Polyvinyl Chloride Pipe (Gravity System Installations). Except as modified herein, all materials, manufacture and testing for PVC gravity sewer pipe shall be in accordance with ASTM D 3034 and ASTM F 679.

Gravity PVC pipe, nominal diameter size 4 inch (100 millimeters) through 15 inch (375 millimeters), shall meet the minimum wall thickness requirements of SDR-35, ASTM D 3034, and be of clean, virgin PVC having a cell classification of 12454-B, or 12264-B and meeting the requirements of ASTM D 3034 as defined in ASTM D 1784.

Gravity PVC pipe, nominal sizes 18 inch (450 millimeters) and larger, shall meet the minimum wall thickness requirements of SDR-11, ASTM F 679 and be of clean, virgin PVC having a cell classification of 12354C meeting the requirement of ASTM F 679 as defined in ASTM D 1784.

Rubber gaskets shall conform with the low-head requirements of ASTM F 477 and shall also be made of EPDM.

PVC gravity pipe shall be tested in accordance with ASTM D 3034 for nominal pipe diameters of 4 inch (100 millimeters) through 15 inch (375 millimeters) and ASTM F 679 for nominal pipe diameter of 18 inch (450 millimeters) and larger. The minimum pipe stiffness at 5 percent deflection shall be 46 psi (317 kilopascals) for all sizes when tested in accordance with ASTM D 2412.

1010-3.06 High Density Polyethylene (HDPE) Pipe (Force Main System Installations). High density polyethylene (HDPE) pipe shall conform to the requirements of ASTM D 1248, ASTM D 2122, ASTM D 3035, and ASTM C 3350, except as otherwise noted herein.

HDPE pipe, nominal diameter size 3 inch (75 millimeters) through 63 inch (1.6 meters), shall meet the minimum wall thickness requirements of SDR-PR, ASTM F 714.

The pipe manufacturer shall have a minimum of 5 years experience in producing HDPE pipe meeting the requirements specified herein. HDPE pipe and fittings shall be manufactured from the product of a single approved manufacturer.

The pipe manufacturer shall maintain a continuous quality control program.

HDPE pipe shall be manufactured from extra high molecular weight polyethylene material meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D 1248. The pipe
SECTION 1010

material shall meet the requirements of cell classification PE345464C or PE345464E of Standard PE Code Designation PE3408 as defined by ASTM D 3350. The manufacturer shall certify that the pipe material has been tested, in accordance with the provisions of ASTM F 1473, for >100 hours, without failure. The manufacturer shall also certify that the pipe has a hydrostatic design basis of 1,600 psi (11.0 MPa) at 73°F (23 °C) and 800 psi (5.5 MPa) at 140°F (60 °C) when tested in accordance with the provisions of ASTM D 2837.

The design pressure of the pipe shall be in accordance with ASTM D 3035 and ASTM F 714.

1010-4 POTABLE AND RECLAIMED WATER SYSTEM PIPE AND APPURTEINANCES

All pipe and appurtenances for potable and reclaimed water systems shall conform to those products and materials included in the water utility’s list of approved materials or to the requirements specified in the Special Provisions.

A Certificate of Compliance from the manufacturer or supplier shall be furnished attesting that the pipe and appurtenances comply with those materials or products included in the water utility’s list of approved materials or conform to the requirements specified in the Special Provisions. The Certificate of Compliance shall conform to the requirements of Subsection 106-5(B). All pipe and appurtenances shall be clearly marked with the name or trademark of the manufacturer, the batch number, and the location of the plant.