

## **SEALING OF DRAINAGE STRUCTURES.**

**(REV 3-9-18) (7-21)**

The following new Section is added after Section 425:

### **SECTION 427**

#### **SEALING OF DRAINAGE STRUCTURES**

##### **427-1 Description.**

Seal inlets, manholes, and junction boxes, including the structure's base, walls, top slab, riser, cone, and inlet tops.

Seal pipe joints minor cracks, and lift holes, with chemical grout.

Seal storm pipe joints of various diameters by the man-entry internal joint sealing method on pipes that are otherwise in sound physical condition.

##### **427-2 Equipment.**

Supply the necessary equipment, including chemical containers, pumps, regulators, valves, hoses and fittings for injecting the materials.

Use manufacturer recommended tools and equipment to install internal joint seal in accordance with manufacturer's instructions.

##### **427-3 Safety.**

Provide redundant storm drain plugs. Ensure all workers have means of rapid egress.

##### **427-4 Storm Water Flow Control.**

Insert temporary pipe plugs and block the flow. Do not pond water in any travel lane or divert water on private property. When necessary, divert the storm water at an approved location by the Engineer. Furnish all equipment and labor.

When the depth of flow in the storm pipe section being worked on is considered excessive, such that it would prevent successful joint seal installations, reduce the flow depth to an allowable level of 0 to 2 inches, by operation of pump stations, plugging or blocking the flow, or by pumping and bypassing the flow so that the pipe is accessible for man-entry joint seal installation in accordance with the manufacturer's procedures.

##### **427-5 Materials.**

**425-5.1 Chemical Sealing of Drainage Structures:** All materials containers must be undamaged and unopened, and show the manufacturer's original labels. Select hydrophobic polyurethane foam sealing materials that meet the specific sealing requirements of each site.

Hydrophilic gel sealing materials must meet the following requirements:

Uncured Viscosity is less than 900 cps

Cured Gel

Insoluble in water.

Elongation minimum 200% as measured per ASTM D 638

Tensile Strength minimum 25 psi as measured per ASTM D 638

Hydrophobic polyurethane foam sealing materials must meet the following requirements:

Uncured Viscosity is less than 900 cps

#### Cured Foam

Water absorption is less than 1% as measured per ASTM D-2127

Shrinkage is less than 1% as measured per ASTM D-2126

The cured polyurethane foam must adhere tightly to the pipe materials during wet and dry periods.

Use epoxy resin compounds that meet the requirements of Section 926.

To repair the structure, use a non-shrink grout product that meets the requirements of Section 934.

#### **427-5.2 Man-Entry Internal Joint Seals:**

**427-5.2.1 Flexible Seals:** Use a permanent, non-corrodible one-piece circular seal that can withstand an internal pipe pressure of 300 pounds per square inch and external head pressures in excess of 100 feet. The material must be an EPDM Rubber Membrane for use as a joint liner material. The material must be microbiological growth resistant when used in potable water, storm water, sea water or in humid aerobic conditions. The volume change of the material must not exceed 3% after immersion in water at 212°F for 70 hours. The seal must be manufactured in compliance with ASTM-D 3900, ASTM-D 3568 and must have designation M4AA7 1 0 A13B13C12Z1Z2Z3 in accordance with ASTM-D 2000. The seal must have definitive locations for the three stainless steel bands which hold it in place. The seal must have ribbed sections on each side of the joint to assist in making the fit between the seal and pipe airtight. A test air valve must be installed in the seal for conducting pressure tests. Each joint seal must be clearly numbered with the corresponding joint number in permanent manner.

**427-5.2.2 Stainless Steel Bands:** Use circular stainless steel bands to hold the seals in place. These bands may be in two or three sections to allow for passage through the manholes. The bands must be expanded against the seal and compress the seal to the pipe wall, and locked in place with wedges.

The stainless steel bands, shims and bolts for securing the rubber membrane seal across piping joints must be Type-316 and manufactured in accordance with ASTM-A 479. The bands must be rolled to the radius of the receiving pipeline.

The cleated ends of the band must be welded with T-316 alloy wire. All shims and wedges must be Type-316 material, as required for the stainless steel bands.

**427-5.2.3 Chemical Sealing Material:** Chemical sealing materials must have the following properties: react quickly to form a permanent water tight seal; be flexible and immune to the effects of wet/dry, freeze thaw cycles; non-biodegradable and immune to the effects of acids, alkalis, and organics; component packaging and mixing compatible with field conditions and worker safety; cleanup accomplished without heavy use of flammable or hazardous chemicals; extraneous sealant left inside pipe shall be readily removable.

Chemical joint sealing material must be acrylic resin type and furnished with activators, initiators, inhibitors and any other materials recommended by the manufacturer for a complete grout system.

**427-5.2.4 Liquid Joint Lubricant:** The liquid joint lubricant to assist in the installation of the seals and bands must be non-toxic, vegetable-based lubricating gel. This gel must not decompose or deteriorate for a minimum storage period of two years and must have a soft pasty consistency suitable for use in temperatures between 0°F and 120°F. The lubricant must not have any deteriorating effect on rubber gaskets, must not impart taste or odor to water, or have an objectionable odor. The lubricant must not support the growth of bacteria or contain any petroleum-based oil or grease

**427-5.2.5 Thread Sealing Compound:** Use a paste-type thread sealing compound with polytetrafluoroethylene components.

**427-5.2.6 Hydraulic Expander Unit:** Use a hydraulic expander unit for installation of expansion bands capable of hydraulic expansion pressure of 6,000 pounds per square inch.

## **427-6 Installation.**

**427-6.1 Chemical Sealing of Joints:** Clean all surfaces and remove the debris. Carefully drill a minimum of four insertion holes near the bottom of the structure's wall. Insert mechanical injection packer fittings. Inject the sealing material into the invert/bottom holes first, and then proceed to the upper injection holes. Demonstrate the mixing of materials meets the manufacturer's specifications. Allow the sealant to cure. Remove the injection ports and seal the injection holes with epoxy flush with the surface. Remove surplus material. Jetting or driving pipes from the surface, or open-cutting the pavement is not allowed.

**427-6.1.1 Pipe Culverts and Storm Drains:** Clean pipe joints. Inspect and video each joint before and after sealing. Jetting or driving pipes from the surface, or open-cutting the pavement is not allowed. Install joint sealing materials per the manufacturer's recommendations.

For hydrophobic urethane foam, drill a minimum of four equally spaced insertion holes through the pipe. Insert mechanical injection packer fittings. Inject the sealing material into the invert/bottom hole first, and then proceed to the upper injection holes. Demonstrate the mixing of materials meets the manufacturer's specifications. Allow the sealant to cure. Remove the injection ports and seal the injection holes with epoxy flush with the pipe surface. Remove surplus material.

**427-6.1.2 Man-Entry Internal Sealing of Joints:** Use flexible seals individually sealed in plastic bags and packed in a manner that will not damage or deform them.

Store seals in a cool, dry environment and not exposed to direct sunlight.

Examine each seal prior to fitting. Place particular attention on the ribbed sections of the seal. Clean the pipe joint section that will support the seals. Remove debris or deposits from the pipe walls and remove by hydraulic vacuum. Use subaqueous power tools if any hard scale or stubborn debris remains after hand brushing. Clean all joint gaps of debris before any installation is performed.

Once cleaned, fill the joint gaps with chemical sealing material as specified in 430-1.3.3. Remove any surplus grout and the surface left flush. Provide a smooth, continuous backing for the seal.

Remove any surface imperfections by grinding or scraping. Fill any deep imperfections by properly applying the approved joint filler. Provide a smooth surface for the seal.

Pre-mark the seal area to clearly define the seal position.

Check the seal for any damage and ensure the test valve is tight before fitting the seal in place. Locate the test valve in the seal at either the 9 o'clock or 3 o'clock position. Position the seal parallel and centered on the joint gap.

Before expanding the steel bands in the seal grooves, place stainless steel radius shims underneath the wedge area in the grooves.

If two or three piece bands are used, temporarily lock the bands into position by means of a special overlap locking device over the wedge area.

Use a hydraulic expander to apply pressure to the ends of the retaining bands, and a radius wedge fitting between the exposed gap and the expanded band ends. As the

hydraulic expander is positioned with the retaining band, care must be taken to ensure that the band remains in the groove of the elastic seal and does not move or become dislodged. Select a size of wedge having an interference fit between band ends. Tap the wedge (leading edge first) into position, locking in the compression seal.

Repeat the procedure on the second retaining band of the seal, allowing 30 minutes between expansions. Each joint must have three retaining bands in place.

Once the expanding procedure is complete, tighten the overlap locking device for the wedge, if required, to a torque of 1.25 foot pounds.

#### **427-7 Material Refusal Pressure.**

**427-7.1 Chemical Joint Sealing:** Sealant refusal pressure must be a minimum of 5 pounds per square inch. Do not exceed 10 pounds per square inch.

**427-7.2 Flexible Seal Testing:** There are two individual pressure tests applied to the seal before closing the pipeline. The first test is applied after each section has been completed and not before 30 minutes have elapsed after the final fitting of the seal. A pressure of 10 pounds per square inch is applied. Because of the excessive ballooning the center membrane of the seal (that will occur at this higher pressure), a restraining device called a "test band" is fitted over the seal during the test. Soap and water is used to detect any leak. In the second test, 5 pounds per square inch is introduced through the valve. This pressure is sustained while a soap and water test is applied to outer edge and entire body of the seal. The Engineer may request proper testing of structural properties of seals or related components before any installation is performed. If any of the seals are tested and found to be defective after installation, replace the defective seals, at no cost to the Department.

#### **427-8 Reconstruct Invert Benches.**

Install the sealant before grouting the structure. Remove all grease, laitance, loose bricks, mortar, unsound concrete, and debris. Water blasting, wet or dry sandblasting, acid washing, and other cleaning agents such as concrete cleaners, degreasers, or other chemicals, may be required to properly clean the surface. Expose sound concrete walls and invert material. Apply non-shrink cement grout to the structure walls. Reconstruct or repair the drainage structure invert bench according to the Standard Plans Index 430.

#### **427-9 Final Acceptance.**

Submit all warranties provided by the manufacturer for the specific products included in the Contract. Ensure that all warranties are fully transferable from the Contractor to the Department. Submit all documents associated with or describing any such warranties to the Department along with other project final acceptance documents and deemed to be a part of the required final acceptance documentation. Do not take any action or fail to act in any way which voids any such warranties. All subcontracts must contain similar provisions which require subcontractors to assign any such warranties to the Department.

#### **427-10 Method of Measurement.**

The quantity to be paid for will be the number of joints, per each, cleaned, sealed and accepted by the Engineer.

**427-11 Basis of Payment.**

Price and payment will be full compensation for all work specified under this section including all ancillary items to complete the work.

Payment will be made under the items specified in the Bid Price Proposal.