### SP-XX, CHEMICAL GROUTING OF STORM DRAINAGE PIPES AND STRUCTURES

Version Date: 07/22/2022 Revision Date: XX/XX/XXXX by XXX

**1.0 DESCRIPTION**

Provide polyurethanes (PU) for chemical grouting to seal pipe joints and structures, void filling, permeation grouting, subgrade stabilization and other applications in accordance with the contract. Use PU foams, gels and resins that are on the NCDOT Approved Products List.

**2.0 MATERIALS**

**POLYURETHANES REQUIREMENTS:**

Use PU types consistent with manufacturers specifications for each specific application. Use polyurethanes that meet the properties and characteristics listed below. Provide Type 3 material certifications in accordance with Article 106-3 of the *Standard Specifications* for polyurethanes. Do not use expired or improperly stored PU components or materials. If an expiration date is not provided by the PU Manufacturer, assume an expiration date 6 months after production. The Engineer may perform independent verification testing, if necessary. The material certifications shall not be interpreted as a basis for payment.

1. **Type 1 Polyurethane**

Type 1 polyurethane is a two component, high density, hydrophobic and hydro-insensitive PU foam mixed with a ratio of 1:1 by volume. This material is generally used for significant void filling. When injected, the components react with each other to expand and harden forming a rigid closed cell foam. Prime Flex 985 LX10 or equivalent is an acceptable product. Provide PU foams that meet the following:

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| **TYPE 1 POLYURETHANE REQUIREMENTS** | | |
| **Property** | **Requirement** | **Test Method** |
| Apparent Density  (Free Rise) | 3 – 4.5 lb/cf | ASTM D1622 |
| Compressive Strength**1**  (Free Rise) | 38 psi | ASTM D1621 |
| Retention of Density  (Hydro-Insensitivity) | 80% | NYSDOT GTP-9**2** |
| Wet Compressive Strength**1**  (Hydro-Insensitivity) | 38 psi | NYSDOT GTP-9**2** |

1. Compressive strength of at least 90% of maximum strength within 30 minutes of injection.
2. New York State Department of Transportation Geotechnical Test Procedure: Hydro-Insensitivity of High Density Polyurethane Grout – Panel Test.
3. **Type 2 Polyurethane**

Type 2 polyurethane is a single component, low or medium viscosity, hydrophobic PU resin mixed with an optional or required catalyst/accelerator per the PU Manufacturer’s instructions to initiate or speed up reactions. When injected, the PU resin reacts with moisture in the soil or voids to expand and solidify forming a rigid or flexible, watertight closed cell foam. Typically used to stop infiltration in pipe joints and drainage structures and permeation grouting. Prime Flex 920 or equivalent is an acceptable product. Provide PU rigid or flexible foams that meet the following:

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| **TYPE 2 POLYURETHANE REQUIREMENTS** | | |
| **Property** | **Requirement** | **Test Method** |
| Viscosity**1**  (Rigid Foam) | 200 centipoise | ASTM D4016 or D4878 |
| Viscosity**1**  (Flexible Foam) | 750 centipoise |
| Compressive Strength**2**  (Without Soil) | 150 psi | ASTM D1621 |
| Compressive Strength**2**  (With Sand) | 150 psi | ASTM D695 or D4219 |
| Tensile Strength**3** | 150 psi | ASTM D3574 |

1. Maximum viscosity of uncured resin.
2. Compressive strength of cured rigid foam; does not apply to flexible foam.
3. Tensile strength of cured flexible foam; does not apply to rigid foam.
4. **Type 3 Polyurethane**

Type 3 polyurethane is a single component, medium viscosity, hydrophilic PU resin mixed with optional or required water per the PU Manufacturer’s instructions to initiate reactions. An optional catalyst/accelerator as recommended by the PU Manufacturer may be approved for Type 3 PU based on the application. When injected, the PU resin reacts with water to expand and produce a flexible watertight closed cell foam/impermeable gel. Type 3 may not be a standalone use but combined with Type 1 or 2. Sealing of joints and drainage structures are typically used. Similar to Flex 900 and Hydro Gel SX or equivalent. Provide PU foams or gels that meet the following:

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| **TYPE 3 POLYURETHANE REQUIREMENTS** | | |
| **Property** | **Requirement** | **Test Method** |
| Viscosity**1** | 750 centipoise | ASTM D4016 or D4878 |
| Tensile Strength**2** | 150 psi | ASTM D3574 |

1. Maximum viscosity of uncured resin.
2. Tensile strength of cured foam; does not apply to gel.

The Contractor shall furnish type 3 material certifications from the manufacturer for each PU utilized to confirm they meet or exceed the specifications as written here in.

**Handling and Storing**

The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers for inspection by the Engineer. Material shall not be loaded into the equipment until inspected by the Engineer. Handle, store and dispose of polyurethanes per the manufacturer’s instructions. Use equipment recommended by the PU Manufacturer or equipment capable of proportioning and mixing components in accordance with the PU Manufacturer’s requirements. Utilize pumps and injection equipment that can maintain recommended pressures and temperatures.

Sufficient material to perform the entire back grouting or soil stabilization operation shall be in proper storage at the site prior to any field preparation, so that there shall be no delay in procuring the material for each day’s application.

**3.0 Submittals**

The contractor is required to provide the following items listed below 2 weeks prior to work being initiated:

* Provide documentation stating the polyurethanes meet or exceed all material property requirements listed in Section 2.0 above.
* Provide construction plans for monitoring injection of the polyurethanes, specifically identifying when to cease addition of the product into the repair.
* Provide a site specific construction plan with manufactures product recommendations for filling known voids around a pipe, culvert or drainage structure.
* Provide contractor’s qualifications.
  + Contractor and supervisor should have a minimum of at least 5 years’ experience including but not limited to chemical grouting of pipes and structures described herein.
  + A list of 5 projects, including references and contact information with similar pipe culvert or drainage structure rehabilitation.
  + The onsite supervisor’s NCDOT Level I or II certified for Erosion and Sedimentation Control.

**4.0 CONSTRUCTION METHODS**

**Weather Limitations**

Work under this contract item shall not be performed when ambient temperature is below 32°F. Contractor to verify that ambient temperatures are consistent with application guidelines provided by manufacture.

**Preparation**

The Contractor shall verify size and locations of areas to be chemical grouted as identified on construction plans. For structure and internal sealing of pipes, the Contractor’s personnel shall be properly trained to perform the work in accordance with OSHA confined entry requirements.

**Installation**

**Joint and Pipe Penetration Sealing**

Joint and penetration sealing (Type 3 PU) shall be performed by inserting jute oakum that has been saturated in the hydrophilic polyurethane resin and activated with water into the pipe joint and allowed to cure, sealing the joint completely. This process will include the following:

* Joint Sealing for 24” RCP to 30” RCP diameter will include 4 gallons of material
* Joint Sealing for 36” RCP to 48” RCP diameter will include 6 gallons of material
* Joint Sealing for 54” to 72” RCP diameter will include 8 gallons of material
* Joint Sealing for > 72” RCP diameter will include 12 gallons of material

The amount of material exceeding the above shall be paid per gallon.

**Back grouting Structure/Pipe**

Back grouting structure/pipe shall be performed by pumping the moisture-activated hydrophobic polyurethane resin (Type 2 PU) as specified by the manufacturer, ensuring voids are filled. Material shall be properly mixed with the catalyst to react based on the site conditions and approval of the Engineer.

**Soil Stabilization**

Soil stabilization shall be performed by pumping the moisture-activated hydrophobic polyurethane resin (Type 1 PU) through the steel pipes and into the underlying soils. Material shall be pumped down to elevations and in quantities as directed by the Engineer and/or PU manufacturer.

**Protection and Cleanup**

The Contractor shall be responsible for storage, clean-up, and removal from the work area all debris, waste, residual repair materials, and by-products generated by the preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

**Warranty**

Following the date of the Engineer’s final acceptance of all work under a given project, the Contractor shall provide a **one (1) year warranty** on materials and workmanship against patent and latent defects arising from faulty materials, faulty workmanship, or Contractor negligence pertaining to this contract item. All defective material and workmanship that fails to meet the requirements of this contract item during the warranty period shall be corrected by the Contractor for contract item compliance at no additional expense to the Department.

**Confined Space Entry**

The contractor and all laborers shall be certified per OSHA regulations for Confined Space Entry. All laborers shall wear full harnesses, meeting OSHA regulations with sufficient lengths of ½ -inch nylon rope tied off at entry. An outside supervisor shall be stationed at the entry during work inside pipe. Supervisor and crew shall communicate using standard-issue 2-way communication devices. The contractor is responsible for entry using a ladder or other acceptable means. Entry security is to be maintained by the contractor during the project and in coordination with the contracting officer.

**Ventilation**

A ventilation fan, stationed outside the pipe manhole entry, shall be utilized to pump clean air into the work area. The fan shall employ sufficient duct to force air into the work zone. Contractor is responsible for operation of fan. Air quality detection device with alarm shall be worn to measure exhaustible and other harmful gases, such as hydrogen sulfide.

**Dewatering**

The General Contractor will be responsible for all dewatering of conduit in preparation for sealing, back grouting and coating process if needed.

**5.0 MEASUREMENT AND PAYMENT**

The polyurethane material for joint sealing shall be paid for by the joint completed (per each), which will include furnishing and installing joint material.

The polyurethane material for back grouting and soil stabilization shall be paid for by the gallon. Both the Contractor and the Engineer shall agree on the number of gallons pumped utilizing a daily grout log.

The quantity of material to be paid for shall be the quantity actually used, based on the contract unit price shown on the bid form. Only those items shown on the bid sheet shall be paid for directly. All other labor, tool, equipment, and incidentals necessary for the completion of the project shall be considered incidental to the contract bid items.

Payment will be made under:

**JOINT SEALING (24” TO 30” DIAMETER) EA**

**JOINT SEALING (36” TO 48” DIAMETER) EA**

**JOINT SEALING (54” TO 72” DIAMETER) EA**

**JOINT SEALING (> 72” DIAMETER) EA**

**BACK GROUTING GN**

**SOIL STABILIZATION GN**