

HIGH DENSITY POLYURETHANE INJECTION

****From Hartford IM 089-1(60)**

- xx. DESCRIPTION. This work shall consist of pavement stabilization of soils performed by URETEK USA, Inc. (URETEK) using High Density Polyurethane Injection (HDPI).
- xx. GENERAL REQUIREMENTS. Use of the URETEK HDPI is for the purpose of stabilizing the subbase only; once movement of the pavement surface has been determined by laser survey methods HDPI shall cease.
- xx. PRE-INJECTION TESTING. URETEK shall conduct pre-injection Dynamic Cone Penetrometer (DCP) testing. Testing shall be completed in each lane prior to stabilizing the subbase. A minimum of seven (7) pre-injection DCP tests shall be completed, with a minimum of two (2) DCP tests to be completed in each lane. The following test pattern shall be used as a guide to conduct the pre-injection DCP testing:

Test Number	Lane	Distance from Beginning of Site
1	Travel	20 Feet
2	Passing	40 Feet
3	Travel	60 Feet
4	Passing	80 Feet
5	Transition	TBD on site
6	Inside Shoulder	30 Feet
7	Outside Shoulder	70 Feet

All tests shall be conducted in the passenger side wheel path of the indicated lane.

URETEK shall use the DCP results to confirm the depths and pattern of the injection points as specified in the Plans. If any adjustments in depths or pattern of the injection points are needed, URETEK shall supply the adjustments to VTrans for approval prior to performing HDPI. Once the adjustments have been approved HDPI may proceed. Upon completion of the HDPI, four (4) additional DCP tests shall be performed to verify the HDPI.

- xx. SOLE SOURCE. URETEK is the sole source for the below listed applications under the indicated U.S. Patents:
 - (a) Method for increasing the bearing capacity of foundation soils for built structures (Patent No. 6,634,831 B2 - expires 10/21/2020).
 - (b) Composition and method for preparing polyurethanes and polyurethane foams (Patent No. 6,521,673 - expires 2/18/2020).

- xx. MATERIALS. The injection material shall be URETEK 486 STAR; a two part, one-to-one ratio by volume, closed cell, hydro-insensitive, high density polyurethane system. The material shall be a polyurethane-forming mixture, having water insoluble diluents, which permits the formation of polyurethanes in excess water. The material shall have a minimum free rise density of 3.8 lbs/cubic foot with a maximum density of 4.2 lbs/cubic foot.

The material shall have a minimum compressive strength of 60 psi per ASTM 1621. The material shall have a minimum tensile strength of 60 psi per ASTM 1622. The material shall reach 90% compressive strength in 15 minutes such that traffic may be returned to the roadway within 15 minutes after the last injection of material.

Certification. A Type D certification shall be furnished in accordance with Subsection 700.02.

- xx. EQUIPMENT. The Contractor shall provide documentation that their flow meter has been calibrated within the last 3 months. The Contractor's calibrated flow meter shall be provided to ensure accurate documentation of the injection volume at each injection point.

xx. CONSTRUCTION REQUIREMENTS.

- (a) The Contractor shall provide a pavement profile of the treatment area(s) from laser level measurements of each area where HDPI is to be performed. Each profile shall be accepted by the Engineer prior to performing the work.
- (b) Pre-injection DCP testing is to confirm existing subgrade soil conditions. The pre-injection DCP plan will be prepared by the Contractor. The Engineer will have ten (10) working days to review the pre-injection DCP plan and provide comments. Work shall not commence until the pre-injection DCP plan is approved by the Engineer.
- (c) For soil densification and compaction of unconsolidated base soils, stabilization of asphalt, composite pavement, or concrete pavement the Contractor will submit a treatment plan detailing the number of drill holes, drill hole diameter, the grid pattern used for drilling the holes, and the depths or stages at which the polymer will be injected into the soil. The holes are to be drilled through the pavement and above the area requiring soil remediation. The Engineer will have ten (10) working days to review the treatment plan and provide comments. Work shall not commence until the treatment plan is approved by the Engineer.
- (d) The polyurethane material shall be injected through injection tubes inserted into the drilled holes to the proper depth, or depths, as required. The rate and amount of material injected to obtain proper densification of the base and subbase soils shall be determined by the Contractor. After the initial injections, the Contractor shall perform a minimum of four (4) additional DCP tests and consult with the Engineer to determine if additional injections are needed. All DCP testing, recommendations, and injection of HDPI shall be performed by URETEK.

- (e) For stabilization of pavement with a drainable base, injection tubes shall be placed approximately 24" below the bottom of the drainable base. The purpose is to ensure the material does not enter and fill the drainable base. Injection of materials will stabilize the subgrade and then move the subbase and base material up, compressing it against the bottom of the pavement, returning the pavement to near its original construction with an improved subgrade.
- (f) If any edge drains are present, injection within 4'-0" of the edge of the pavement (beginning of the edge drain), must be located a minimum of 18" below the bottom of the edge drain.
- (g) Continuous laser level or dial indicator micrometer readings shall be in place and monitored by the Contractor during injection to determine sufficient material usage and soils densification as indicated by pavement movement of 0.04" (1 mm). Upon measurement of 0.04" (1 mm) of movement, injection at that injection point shall cease.
- (h) The Contractor will be responsible for any pavement blowouts, excessive pavement lifting, or pavement damage that may occur as a result of the Contractor's work. The Contractor shall repair any subject areas to the satisfaction of the Engineer at the Contractor's expense.
- xx. WARRANTY. The Contractor will provide a two year bumper-to-bumper warranty against movement of more than ¼" of the affected pavement. In the unlikely event more than ¼" of movement in the injected area occurs, the Contractor will return to inject the affected area to restore the pavement to the proper grade at no cost to the State.
- xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Dynamic Cone Penetration Test) to be measured for payment will be the number of each test performed in the complete and accepted work, as taken from the Engineer's approved Contractor's daily field reports.
- The quantity of Special Provision (High Density Polymer Injection, URETEK 486 STAR) to be measured for payment will be the number of kilograms (pounds) of the specified material placed in the complete and accepted work, as displayed by the certified flow meter.
- The quantity of Special Provision (Injection Hole) of the size specified to be measured for payment will be the number of meters (linear feet) of hole installed in the complete and accepted work, as taken from the Engineer's approved Contractor's daily field reports.
- xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Dynamic Cone Penetration Test) will be paid for at the Contract unit price for each. Payment will be full compensation for performing the test as specified and for furnishing all material, labor, tools, equipment, and incidentals necessary to complete the work.
- The accepted quantity of Special Provision (High Density Polymer Injection, URETEK 486 STAR) will be paid for at the Contract unit price per kilogram (pound). Payment will be full compensation for furnishing the material specified, for performing HDPI, laser survey, and

profiling in accordance with the Contract Documents, and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

The accepted quantity of Special Provision (Injection Hole) of the size specified will be paid for at the Contract unit price per meter (linear foot). Payment will be full compensation for marking drill holes, drill setup, drilling the injection hole, and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.620 Special Provision (Dynamic Cone Penetration Test)	Each
900.635 Special Provision (High Density Polymer Injection, URETEK 486 STAR)	Kilogram (Pound)
900.640 Special Provision (Injection Hole)(X")	Meter (Linear Foot)