725-R-541 SLIP LINING OF EXISTING PIPE

(Revised 01-04-08)

The Standard Specifications are revised as follows:

SECTION 725, DELETE LINES 1 THROUGH 172.

SECTION 725, AFTER LINE 173 INSERT AS FOLLOWS:

SECTION 725 – SLIP LINING OF EXISTING PIPE

725.01 Description

This work shall include installing a thermoplastic liner into an existing pipe and filling the space between the liner and the existing pipe with cellular concrete grout all in accordance with 105.03.

MATERIALS

725.02 Materials

Materials shall be in accordance with the following.

Cement, Type I or Type III .....901.01(b)
Fine Aggregate.....904
Flowable Backfill 213
Foam Concentrate.....ASTM C869
Profile Wall HDPE Pipe Liner .....907.25(b)
Profile Wall PVC Pipe Liner.....907.25(c)
Solid Wall HDPE Pipe Liner .....907.25(a)
Water.....913.01

Individual liner section lengths shall be a minimum of 19 ft (5.8 m), but shall not exceed 55 ft (16.7 m) unless approved. The pipe liner shall either be chosen from those shown on the Department's list of approved Thermoplastic Pipe Liners or shall be covered by a Type A certification in accordance with 916. If the pipe liner is not on the Department's list of approved Thermoplastic Pipe Liners, then the Type A certification must be furnished and the pipe liner must be approved by the Engineer prior to installation.

Liner joints shall be bell and spigot, screw type, grooved press-on, fused, thermal welded, or other joint as recommended by the pipe liner manufacturer and shall be installed according to the manufacturer's recommended methods. Each liner joint shall be welded, fused, or joined according to the manufacturer's recommended methods. If a liner is welded, it shall be welded with a continuous weld for the circumference of the liner both inside and outside. The ends of pipe liners that are to be welded or fused shall be at the same ambient temperature ± 5° F. Welding, fusing, or joining shall be performed at all times by an installer trained and certified by either the pipe liner's manufacturer or the welding, fusing, or joining equipment manufacturer. A copy of the welder's, fuser's, or joiner's certificate shall be provided to the Engineer prior to the start of work. Destructive testing shall be done on a test section of pipe liner of the same size and material as the liner being installed. The method and frequency of destructive

and non-destructive testing shall be as directed by the Engineer. The results of the destructive testing shall be provided on a Type A certification in accordance with 916.

All joints shall have sufficient mechanical strength to withstand the liner installation and grouting operations. Joints shall not reduce the hydraulic capacity of the liner.

The cellular concrete grout shall be designed in accordance with ASTM C 796 except as herein modified.

The admixtures, retarders, and plasticizers used in the grout shall be in accordance with the foam concentrate supplier's specifications.

The grout shall be made using the preformed foam process using foam generating equipment calibrated daily by the foam manufacturer to produce a precise and predictable volume of foam. The foam concentrate shall be certified by the manufacturer to have specific liquid/foam expansion ratio at a constant dilution ratio with water.

The specific job mix shall be submitted to the Engineer by either the foam concentrate supplier or the certified or licensed grouting contractor for approval prior to use on the contract. The mix shall have a minimum 28 day compressive strength of 150 psi (1040 kPa). The mix shall be tested by a laboratory approved by the Department or shall be approved based on prior acceptable performance on Department contracts.

Grout mixed off site shall be delivered to the job site in a truck mixer in accordance with 702.09 filled to half its capacity. The foam concentrate shall then be added to the cement mix in the truck and mixed to a uniform consistency.

Grout mixed on site shall be batched in a deck mate or similar device. Small batches of approximately 1 cubic yard (1 cubic meter) shall be mixed and pumped in a continuous operation.

For each day worked or for each 100 cubic yards (100 cubic meters) placed, four test cylinders measuring 3 in. by 6 in. (75 mm by 150 mm) shall be cast at the point of placement of the grout. Sampling, molding, curing, and compressive strength testing of the cylinders shall be in accordance with ASTM C 495, except as modified herein.

Initial curing shall be at a temperature of 70° ± 10°F (21.1° ± 5.5°C) and shall be from 2 to 5 days. After the initial curing, the test specimens shall be placed in a moist closet or moist room or stored in an enclosed curing tank above the water level. All specimens shall be kept in their molds in the moist storage for the remainder of the curing period. The specimens shall be tested at 28 days. At that time the specimens shall be prepared for testing in accordance with ASTM C 495 except the bearing surface may be ground or cut with a dry saw to meet surface tolerance. The specimens shall not be capped. Specimens shall be tested in compression as rapidly as possible to minimize drying. If more than one specimen is removed from the moist storage at the same time, these specimens shall be covered with a damp cloth until time of testing. The Contractor shall provide a Type A certification with the compressive strength results in accordance with 916.

Existing circular pipe structures shall be lined with solid wall high density polyethylene, HDPE, pipe liner; profile wall HDPE pipe liner; or profile wall polyvinyl chloride, PVC, pipe liner. Existing deformed pipe structures shall be lined with solid wall HDPE pipe liner.

CONSTRUCTION REQUIREMENTS

725.03 Construction Requirements

(a) Right-of-Entry Areas

If the right-of-way does not provide sufficient room for performance of the work, rights-of-entry from all necessary adjacent property owners shall be obtained by the Contractor in accordance with 107.14. A temporary fence shall be installed as required to prevent encroachment of the public or livestock into the work area. Upon completion of the work, disturbed areas on private property shall be restored in accordance with 107.14.

(a.1) Quality Control and Quality Assurance

A signed and dated QCP shall be prepared and submitted to the Engineer for acceptance at least 15 days prior to the start of slip lining the pipe. No work may begin until written notice has been received that the QCP has been accepted by the Engineer. Acceptance of the QCP will in no way relieve the Contractor of responsibility for installation procedures and testing requirements. The QCP shall include, as a minimum, identification of the QC representative by name and documentation verifying the QC representative's experience; the Contractor's method for cleaning and preparation of the existing pipe; method for joining, welding, or fusing the pipe joints; the personnel and certification of the personnel who will be welding or fusing the pipe liners; the method and frequency of destructive and non-destructive testing on the welded or fused joints; the initial testing of the first joining, welding, or fusing at each pipe liner installation location; the corrective action that will be taken if defective or non-passing joints are found; the grouting process including the daily calibration process procedures for the foam generating equipment; the inspection of bulkheads; the specific job mix of the foam concentrate; the grouting procedure and grouting process to ensure complete filling of voids; the corrective action to be taken if the foam compressive strength does not meet specifications; and the plan if the installation of the foam causes damage or deflection to the pipe liner.

(a.2) Quality Control (QC) Representative on Site

The QC representative shall either be a manufacturer's representative or a Professional Engineer with experience inspecting slip lining of pipes. A QC representative shall be present at the jobsite at the following milestones:

- *Cleaning and preparation of the existing pipe,*
- *Initial testing of the first welding or fusing at each pipe liner installation location,*
- *Joining, welding, or fusing of the pipe liner,*
- *Inspection of bulkheads,*
- *Grouting procedure and process to ensure 100% filling of voids,*

- *Project clean-up.*

The Contractor shall provide a minimum of 24 hours notice to the QC person prior to performing any of the above milestones. The QC person does not supersede the responsibility of the Contractor.

(b) Filling of Cavities Outside the Existing Pipe

All obvious cavities outside the existing pipe shall be filled with flowable backfill in accordance with 213 prior to the liner installation or with grout placed in conjunction with the grouting operation after the liner is installed.

(c) Liner Installation

Prior to commencing the liner installation, all jagged existing pipe edges or other deformities shall be repaired. All foreign material shall be removed from the existing pipe.

The inside diameter of the liner shall be in accordance with the following:

EXISTING CIRCULAR CMP STRUCTURES	
PAY ITEM DIAMETER in. (mm)	*MINIMUM LINER INSIDE DIAMETER in. (mm)*
12 (300)	*10.0 (250)*
15 (375)	*11.7 (290)*
18 (450)	*14.3 (355)*
21 (525)	*16.8 (420)*
24 (600)	*18.5 (460)*
27 (675)	*20.7 (515)*
30 (750)	*23.5 (585)*
33 (825)	*26.1 (650)*
36 (900)	*29.5 (735)*
42 (1050)	*33.6 (840)*
48 (1200)	*39.2 (980)*
54 (1350)	*42.0 (1050)*
60 (1500)	*48.0 (1200)*
66 (1650)	*51.6 (1350)*
72 (1800)	*59.1 (1475)*
78 (1950)	*60.0 (1500)*
84 (2100)	*66.0 (1650)*
90 (2250)	*72.0 (1800)*
96 (2400)	*78.0 (1950)*
102 (2550)	*78.0 (1950)*
108 (2700)	*84.0 (2100)*
114 (2850)	*90.0 (2250)*
120 (3000)	*96.0 (2400)*
126 (3150)	*96.0 (2400)*
132 (3300)	*108.0 (2700)*
138 (3450)	*108.0 (2700)*

144 (3600)	*120.0 (3000)*

EXISTING CIRCULAR STRUCTURAL PLATE PIPE STRUCTURES	
PAY ITEM DIAMETER ft – in. (mm)	*MINIMUM LINER INSIDE DIAMETER in. (mm)*
5 – 0 (1500)	*48.0 (1200)*
5 – 6 (1655)	*51.7 (1290)*
6 – 0 (1810)	*59.1 (1475)*
6 – 6 (1965)	*59.1 (1475)*
7 – 0 (2120)	*59.1 (1475)*
7 – 6 (2275)	*72.0 (1800)*
8 – 0 (2430)	*78.0 (1950)*
8 – 6 (2585)	*84.0 (2100)*
9 – 0 (2740)	*90.0 (2250)*
9 – 6 (2895)	*96.0 (2400)*
10 – 0 (3050)	*96.0 (2400)*
10 – 6 (3205)	*96.0 (2400)*
11 – 0 (3360)	*108.0 (2700)*
11 – 6 (3515)	*108.0 (2700)*
12 – 0 (3670)	*120.0 (3000)*

EXISTING DEFORMED PIPE STRUCTURES	
PAY ITEM END AREA ft^2 (m^2)	*MINIMUM LINER INSIDE DIAMETER in. (mm)*
CORRUGATED METAL PIPE-ARCH	
2 2/3 in. x 1/2 in. (68 mm x 13 mm) Corrugations	
1.1 (0.10)	*12.0 (300)*
1.6 (0.15)	*14.9 (370)*
2.2 (0.20)	*16.8 (420)*
2.9 (0.27)	*18.5 (460)*
4.5 (0.42)	*24.0 (600)*
6.5 (0.60)	*29.5 (735)*
8.9 (0.83)	*33.6 (840)*
11.6 (1.08)	*39.2 (980)*
14.7 (1.37)	*42.0 (1050)*
18.1 (1.68)	*48.0 (1200)*
21.9 (2.03)	*51.6 (1290)*
26.0 (2.42)	*59.1 (1475)*
3 in. x 1 in. (75 mm x 25 mm) Corrugations	
15.6 (1.45)	*42.0 (1050)*
19.3 (1.79)	*48.0 (1200)*
23.2 (2.16)	*51.6 (1290)*
27.4 (2.55)	*59.1 (1475)*
32.1 (2.98)	*60.0 (1500)*
37.0 (3.44)	*66.0 (1650)*

42.4 (3.94)	*72.0 (1800)*
48.0 (4.46)	*78.0 (1950)*
59.2 (5.04)	*78.0 (1950)*
60.5 (5.62)	*84.0 (2100)*
67.4 (6.26)	*90.0 (2250)*
74.5 (6.92)	*96.0 (2400)*
STRUCTURAL PLATE STEEL PIPE-ARCH	
22 (2.0)	*48.0 (1200)*
24 (2.2)	*51.7 (1290)*
26 (2.4)	*51.7 (1290)*
28 (2.6)	*59.1 (1475)*
31 (2.9)	*59.1 (1475)*
33 (3.1)	*59.1 (1475)*
35 (3.3)	*59.1 (1475)*
38 (3.5)	*59.1 (1475)*
40 (3.7)	*59.1 (1475)*
43 (4.0)	*59.1 (1475)*
46 (4.3)	*72.0 (1800)*
49 (4.6)	*72.0 (1800)*
52 (4.8)	*78.0 (1950)*
55 (5.1)	*84.0 (2100)*
58 (5.4)	*84.0 (2100)*
61 (5.7)	*90.0 (2250)*
64 (5.9)	*90.0 (2250)*
67 (6.2)	*96.0 (2400)*
71 (6.6)	*96.0 (2400)*
74 (6.9)	*96.0 (2400)*
78 (7.2)	*96.0 (2400)*
81 (7.5)	*96.0 (2400)*
85 (7.9)	*96.0 (2400)*
97 (9.0)	*108.0 (2700)*
102 (9.5)	*108.0 (2700)*
105 (9.8)	*108.0 (2700)*
109 (10.1)	*120.0 (3000)*

Prior to commencing the liner installation operation, steps shall be taken by the Contractor to verify that a liner meeting the minimum inside diameter requirements can be successfully placed inside the existing pipe. If it is discovered prior to installation that a liner with the required inside diameter cannot fit, the inside and outside diameters of a substitute liner shall be submitted to the Engineer for approval. If this discovery is not made until after the liner installation has begun, the partially installed liner shall be removed. Inside and outside diameters for a substitute liner shall then be submitted to the Engineer for approval.

After the liner installation is complete and the liner has cooled to approximately the temperature of the existing pipe, the liner shall be cut so that each end is 8 in. (200 mm) outside the end of the existing pipe.

Grout shall be injected into the space between the existing pipe and the liner. The injection operation shall provide sufficient grout to fill all voids between the existing pipe and the liner over the entire structure length, but shall also be performed in a manner that does not distort the liner. Injection of the grout in lifts, use of spacers, or other safeguards shall be taken in order to keep the liner in position and prevent the liner from floating. The pressure developed in the space between the liner and the existing pipe shall not exceed the liner manufacturer's recommended maximum value.

All existing culverts, storm drains, underdrain pipes, drain tile, or other pipes that are directly connected to the lined structure shall be perpetuated. Grout shall not leak through the liner at these connections.

725.04 Method of Measurement

Thermoplastic liner will be measured by the linear foot (meter), complete in place. An allowance of 5 ft (1.5 m) of liner will be made for the perpetuation of an existing pipe through the liner.

No measurement will be made of liner joints or the length of joint welding or fusing, or other incidentals necessary to join sections of liner in accordance with the manufacturer's recommendations. The test section lengths of liner used for destructive testing will not be measured for payment.

No measurement will be made for a liner meeting the minimum inside diameter requirements that does not fit.

725.05 Basis of Payment

The accepted quantities of pipe liner, thermoplastic, will be paid for at the contract unit price per linear foot (meter) for the size of the existing pipe in which the liner is installed, complete in place. Perpetuating the direct connection of an existing pipe through the liner will be paid for by means of an allowance of 5 ft (1.5 m) of liner for each such connection.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
Pipe Liner, Thermoplastic, _____ in. (mm) diameter	*LFT (m)*
Pipe Liner, Thermoplastic, ____ sft (m2) area	*LFT (m)*

The cost of repairing jagged edges or deformities to existing pipe, filling cavities around the existing pipe with cellular concrete grout, acquisition and restoration of required right-of-entry areas, erection, maintenance, and removal of temporary fence, removing foreign material from the existing pipe, grouting the space between the existing pipe and the liner, and other incidentals will not be paid separately, but shall be included in the cost of the pay items in this section.

The cost of liner joints and other incidentals necessary to join sections of liner in accordance with the manufacturer's recommendations shall be included in the cost of the pay items in this section. All costs associated with having the QC representative on site shall be included in the cost of the pay items in this section.

The cost of training and certifying an installer, destructive and non-destructive testing, pipe liner, and incidentals used in destructive testing, and all costs associated with the development of an acceptable QCP shall be included in the cost of the pay items in this section.

All welded or fused joints that do not pass the destructive testing will be rejected. The non-compliant joint shall be removed, a new joint fabricated, and retested, all with no additional compensation.

In situations where the condition of the existing pipe requires that a substitute liner be utilized, there will be no reduction in payment for the installation of the substitute liner. There will be no additional payment for the additional grout required to fill the larger void between the existing pipe and the smaller liner.

There will be no payment for the installation or removal of any liner that cannot be successfully installed due to the condition of the existing pipe. There will be no payment for a liner meeting the minimum inside diameter requirements that does not fit.

If the existing pipe or any other object not designated for removal is damaged while performing this work, it shall be considered unauthorized work and repaired or replaced in accordance with 105.11.
