

725-R-599 PIPE LINING

(Revised 05-01-12)

The Standard Specifications are revised as follows:

SECTION 725, DELETE LINES 1 THRU 317.

SECTION 725, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION 725 – SLIP LINING OF EXISTING PIPE

725.01 Description

This work shall include installing a thermoplastic liner pipe into an existing pipe and filling the space between the liner pipe 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:

<i>Admixture</i>	<i>*</i>
<i>Cellular Concrete Grout</i>	<i>ASTM C 796</i>
<i>Cement, Type I or Type III</i>	<i>901.01(b)</i>
<i>Concrete, A.....</i>	<i>702</i>
<i>Fine Aggregate**.....</i>	<i>904</i>
<i>Flowable Backfill</i>	<i>213</i>
<i>Foaming Agent.....</i>	<i>912.05</i>
<i>Profile Wall HDPE Liner Pipe</i>	<i>907.25(b)</i>
<i>Profile Wall PVC Liner Pipe.....</i>	<i>907.25(c)</i>
<i>Solid Wall HDPE Liner Pipe</i>	<i>907.25(a)</i>
<i>Water</i>	<i>913.01</i>

** An admixture may be used as recommended by and in accordance with the foaming agent manufacturer’s specifications.*

*** The supplier may elect to use gradations in accordance with 904.02(h) or may propose the use of alternate gradations.*

Where circular liner pipe is shown on the plans, the pipe structure shall be lined with solid wall high density polyethylene, HDPE, liner pipe; profile wall HDPE liner pipe; or profile wall polyvinyl chloride, PVC, liner pipe. Where deformed liner pipe is shown on the plans, the pipe structure shall be lined with solid wall HDPE liner pipe or profile wall HDPE liner pipe.

The maximum number of joints and corresponding maximum length of each section of liner pipe used in each pipe structure to be lined shall be as shown on the plans. If the Contractor has obtained the necessary right-of-entry from all affected property owners and all necessary new permits or amendments to existing permits to enable work in areas accessible via Contractor-obtained right-of-entry, the Department will consider a written request by the Contractor to use liner pipe sections which exceed the maximum length shown on the plans. A corresponding reduction in the maximum

allowable number of joints shall be included with the written proposal. The Contractor shall not install longer sections of liner pipe until written approval has been received from the Engineer.

The liner pipe shall either be chosen from those shown on the Department's list of approved Plastic Pipe and Pipe Liner Sources or shall be accompanied by a type A certification in accordance with 907.25(d). If the liner pipe is not on the Department's list of approved Plastic Pipe and Pipe Liner Sources, then the type A certification must be furnished. Liner pipe must be approved by the Engineer prior to installation.

Proper care shall be taken to ensure that no damage is done to the liner pipe during the unloading process. All liner pipes shall be unloaded with straps and lifting equipment.

Liner pipe joints shall be bell and spigot, screw type, grooved press-on, butt fused, extrusion welded, or other joint as recommended by the liner pipe manufacturer and shall be installed according to the manufacturer's recommended methods.

CONSTRUCTION REQUIREMENTS

Where a deformed HDPE liner pipe is specified, the liner pipe shall be made deformed by using equipment specifically designed to take a circular liner pipe and deform it without causing damage to the liner pipe. The equipment and method used to deform the liner pipe shall be described in the QCP. Once the liner pipe has been deformed, it shall be structurally reinforced in the horizontal and vertical planes. Structural reinforcement shall be spaced at a maximum distance of 3 ft on centers. Structural reinforcement shall not be removed until the installation of the liner pipe and cellular concrete grout at that structure has been completed.

725.03 Right-of-Entry Areas

If the Contractor desires more working room than the right-of-way provides, the Contractor may elect to pursue rights-of-entry from all necessary adjacent property owners 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.

725.04 Quality Control

A QCP shall be submitted in accordance with ITM 803. No work on the pipe lining operation shall begin until written notice has been received that the QCP has been accepted by the Engineer. Acceptance of the QCP in no way relieves the Contractor of the responsibility for installation procedures and testing requirements.

A QC representative shall be present at the jobsite for the initial testing of the first welding or fusing at each liner pipe installation location and for the joining, welding, or fusing of the liner pipe at each location.

725.05 Filling of Cavities Outside of the Existing Pipe

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

725.06 Joining Liner Pipe

Each liner pipe joint shall be welded, fused, or joined according to the manufacturer's recommended methods. Welded liner pipe joints shall be welded with a continuous weld for the circumference of the liner pipe both inside and outside. Welded liner pipe joints shall have weld beads that are smooth and shall not project further than 3/8 in. into the inside of the liner pipe and shall not reduce the hydraulic capacity of the liner pipe. The ends of liner pipe that are to be welded or butt fused shall be at the same temperature $\pm 5^{\circ}$ F.

A visual inspection will be conducted for acceptance of all liner pipe joined by methods other than by welding or fusing joints. All joints that do not pass visual inspection shall be removed, shall have a new joint fabricated, and will be re-inspected.

All liner pipe joints shall have sufficient mechanical strength to withstand the liner pipe installation and cellular concrete grouting operations.

(a) Welder, Butt Fuser, or Joiner Joint Testing

Welding, butt fusing, or joining shall be performed at all times by an operator trained and certified by either the manufacturer of the liner pipe or the manufacturer of the welding, butt fusing, or joining equipment. A copy of the operator's certification shall be provided to the Engineer prior to the start of work. Prior to fabricating a production joint on a liner pipe, each operator who is performing welding, butt fusing, or joining, shall demonstrate that they can produce a joint that will withstand a destructive test prior to being allowed to join liner pipe. This test shall be repeated as many times as necessary in order to produce a joint that will pass the destructive test. One passing joint test is required per operator per contract. The method of joint testing shall be in accordance with section (b) or (c) below.

(b) Solid Wall HDPE Liner Pipe

Solid Wall HDPE liner pipe joined using butt fusion shall be in accordance with ASTM F 2620.

Solid wall HDPE liner pipe that is to have extrusion welded joints shall have destructive testing performed on a test section of liner pipe of the same material as the liner pipe being installed. The Contractor shall propose and describe in the QCP a destructive test, such as but not limited to a bend strap test, to demonstrate that an operator can produce an extrusion welded joint that will not fail. Once an extrusion welded joint is produced on a test section that passes the destructive test, each subsequent joint fabricated that same day by that operator will be visually inspected for acceptance. A destructive test in accordance with the approved QCP shall be conducted on the test section at the beginning of each day that solid wall HDPE liner pipe joining is being done.

(c) Profile Wall HDPE Liner Pipe

Profile Wall HDPE liner pipe joined using extrusion welding shall be in accordance with ASTM F 894. The Contractor shall propose and describe in the QCP a destructive test, such as but not limited to a bend strap test, to demonstrate that an operator can produce an extrusion welded joint that will not fail. Destructive testing shall be performed on 2 flat pieces of HDPE sheet stock that has been butt welded together to verify the extrusion gun is working properly and that the operator can produce an extrusion welded joint that will not fail. Once an extrusion welded joint is produced on a test section that passes the destructive test, each subsequent joint fabricated that same day by that operator will be visually inspected for acceptance. A destructive test in accordance with the approved QCP shall be conducted on the test section at the beginning of each day that profile wall HDPE liner pipe joining is being done.

725.07 Cellular Concrete Grout

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. The mix shall be tested by a laboratory approved by the Department or shall be approved based on prior acceptable performance on Department contracts.

The cellular concrete grout pump gauges shall be calibrated a minimum of once per month in the presence of the Engineer by the method described in the QCP.

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 foaming agent 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 cu yd shall be mixed and pumped in a continuous operation.

For each day worked or for each 100 cu yd placed, 4 test cylinders measuring 3 in. by 6 in. 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 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 1 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 in accordance with 916 that provides the compressive strength results.

725.08 Liner Pipe Installation

Prior to commencing the liner pipe installation, all jagged existing pipe edges or other deformities shall be repaired. All debris and foreign material shall be removed from the existing pipe. A visual walk-through inspection shall be performed after all debris and foreign material has been removed from the existing pipe in order to assess the current condition of the pipe. If visual inspection is not possible, a video inspection of the existing pipe shall be performed. A copy of the video inspection shall be provided to the Engineer. If, upon completion of the inspection of the existing pipe, the Contractor believes that they cannot proceed with the work as shown on the plans, the Engineer shall be notified.

The cross-sectional area of the liner pipe shall be as shown on the plans.

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

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

The cellular concrete grout within the annular space between the existing pipe and the liner pipe shall be contained by bulkheads. The bulkheads shall be constructed at each end of the structure. Each bulkhead shall be constructed to withstand the pressure of the grouting operation. The bulkhead shall be free from leaks and the exterior surface shall be given a smooth trowel finish. The bulkhead shall extend from the end of the existing pipe inward a minimum depth of 18 in.

Cellular concrete grout shall be injected into the annular space between the existing pipe and the liner pipe. The injection operation shall provide sufficient cellular concrete grout to fill all voids between the existing pipe and the liner pipe over the entire structure length, but shall also be performed in a manner that does not distort the liner pipe. Injection of the cellular concrete grout in lifts, use of spacers, or other safeguards

shall be taken in order to keep the liner pipe in position and prevent the liner pipe from floating. The pressure developed in the annular space between the liner pipe and the existing pipe shall not exceed the liner pipe 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. Cellular concrete grout shall not leak through the liner pipe at these connections.

725.09 Method of Measurement

All thermoplastic liner pipe will be measured by the linear foot, for the shape and cross-sectional area of the liner pipe, complete in place. Perpetuation of existing pipes through the liner pipe will be measured by the number of existing pipes perpetuated.

No measurement will be made of liner pipe joints or the length of joint welding or fusing, or other incidentals necessary to join sections of liner pipe in accordance with the manufacturer's recommendations. The liner pipe or flat sheet stock used for destructive testing will not be measured for payment. No measurement will be made of a liner pipe meeting the required opening area that does not fit.

No measurement will be made for debris removal, filling existing voids, or trimming, cutting, jacking, or other corrective measures performed on jagged edges or other deformities of the existing pipe in order to facilitate installation of the liner pipe. No measurement will be made for visual or video inspection of the existing pipe.

No measurement will be made for the bulkhead.

725.10 Basis of Payment

The accepted quantities of thermoplastic liner pipe will be paid for at the contract unit price per linear foot for the shape and cross-sectional area of the liner pipe, complete in place. Perpetuation of existing pipes through the liner pipe will be paid for by the number of existing pipes perpetuated.

Payment will be made under:

<i>Pay Item</i>	<i>Pay Unit Symbol</i>
<i>Liner Pipe, Thermoplastic, Circular, _____ sq ft.....</i>	<i>LFT</i>
<i>cross-sectional area</i>	
<i>Liner Pipe, Thermoplastic, Deformed, _____ sq ft.....</i>	<i>LFT</i>
<i>cross-sectional area</i>	
<i>Perpetuation, Existing Pipe</i>	<i>EACH</i>

The cost of repairing, trimming, or cutting jagged edges or deformities to existing pipe, filling cavities around the existing pipe with cellular concrete grout, acquisition and restoration of right-of-entry areas, acquiring all necessary new permits or amendments to existing permits to work in areas accessible via Contractor-obtained right-of-entry, erection, maintenance, and removal of temporary fence, removing debris and foreign

material from the existing pipe, visual or video inspection of the existing pipe, deforming a circular liner pipe, supplying and constructing the bulkheads, grouting the annular space between the existing pipe and the liner pipe, 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 pipe joints other incidentals necessary to join sections of liner pipe in accordance with the manufacturer's recommendations, and all test sections of liner pipe and test sections of HDPE sheet stock shall be included in the cost of the pay items in this section. All costs associated with having a QC representative on site shall be included in the cost of the pay items in this section.

The cost of training and certifying an operator, destructive and non-destructive testing, liner pipe, 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.

Any joint that does not pass the visual inspection and needs to be re-fused, re-welded, or re-joined shall be done at no additional cost to the Department.

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

There will be no payment for the installation or removal of any liner pipe that cannot be successfully installed due to the condition of the existing pipe. There will be no payment for a liner pipe meeting the required cross-sectional area 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.

SECTION 907, BEGIN LINE 312, DELETE AND INSERT AS FOLLOWS:

907.25 Thermoplastic Liner Pipe

Thermoplastic liner pipe shall be high density polyethylene or polyvinyl chloride pipe with sufficient rigidity to withstand the installation operation and shall exhibit a minimum amount of distortion. The liner pipe shall be free from visible cracks, holes, foreign inclusions, or other defects.

(a) Solid Wall HDPE Liner Pipe

Solid wall HDPE liner pipe shall be in accordance with ASTM F 714. The maximum standard dimension ratio, SDR, for the liner pipe as defined in ASTM F 412 shall be 32.5. The resin used in the manufacture of the liner pipe shall have a minimum cell classification of 345464C in accordance with ASTM D 3350 or a minimum grade of PE4710 in accordance with ASTM F 714. A 12 in. ~~(300 mm)~~ section of the liner pipe shall show no evidence of splitting, cracking, or breaking when compressed between parallel plates to 40% of its outside diameter within 2 to 5 min. Thermoplastic liner pipe

may be added to the Department's approved list by completing the requirements of ITM 806, Procedure Q.

(b) Profile Wall HDPE Liner Pipe

Profile wall HDPE liner pipe shall be in accordance with ASTM F 894. The minimum liner ring stiffness constant, RSC, shall be ~~400~~160 *for circular installations and 250 for deformed installations*. Thermoplastic liner pipe may be added to the Department's approved list by completing the requirements of ITM 806, Procedure A.

(c) Profile Wall PVC Liner Pipe

Profile wall PVC liner pipe shall be in accordance with ASTM F 949. Thermoplastic liner pipe may be added to the Department's approved list by completing the requirements of ITM 806, Procedure A.

(d) Type A Certification Forms for Liner Pipe

Type A certification for liner pipe shall be in accordance with 916.01, 916.02, and 916.02(a) with the exception that the sample form for type A certification shall not be used. The sample type A certification for liner pipe that shall be used is contained herein.

**TYPE A CERTIFICATION
FOR PROFILE WALL HDPE LINER PIPE**

This certifies the Profile Wall HDPE Liner Pipe, _____
(Product Trade Name)

of _____ nominal diameter, manufactured by _____
(size) (Manufacturer Name)

at _____
(Plant Location, City & State)

is in accordance with the Indiana Department of Transportation Standard Specifications and ASTM F 894. This material is to be used for and by the following and is substantiated by the test results included herein.

Contract Number _____ Contractor Name _____

Identifying Print Line Information _____

or Lot Number _____

Material Destination (if other than contract location) _____

Test	Method	Specification Limits	Test Results
Resin Density	ASTM D 3350	0.940, minimum	
Resin Melt Index	ASTM D 3350 Condition (190, 2.16)	0.4, maximum	
RSC*	ASTM F 894 @ 3% Deflection	160 minimum for circular installations, 250 minimum for deformed installations	
ID	ASTM F 894	**	
Wall Thickness (Pipe)	ASTM F 894	**	
Wall Thickness (Bell)	ASTM F 894	**	
Wall Thickness (Spigot)	ASTM F 894	**	
Flattening	ASTM F 894	Pass	
Length	ASTM F 894	±2 in. of specified or nominal length	

*In lieu of RSC, the PS (in accordance with ASTM F 894, X1) may be reported, provided the adjustment factor, C, in accordance with ASTM D 2412 and the mean diameter, D, are also reported.

** These values vary depending on the pipe size. Contractor shall include the appropriate value from ASTM.

Joint type (circle one): Bell/Spigot Screw Type Grooved Press-On Butt Fused Ext. Welded

Other (specify) _____

(Date)

(Signature of Manufacturer's Representative)

(Title)

**TYPE A CERTIFICATION
FOR SOLID WALL HDPE LINER PIPE**

This certifies the Solid Wall HDPE Liner Pipe, _____,
(Product Trade Name)

of _____ nominal diameter, manufactured by _____
(size) (Manufacturer Name)

at _____
(Plant Location, City & State)

is in accordance with the Indiana Department of Transportation Standard Specifications and AASHTO M 326 or ASTM F 714. This material is to be used for and by the following and is substantiated by the test results included herein.

Contract Number _____ Contractor Name _____

Identifying Print Line Information _____

or Lot Number _____

Material Destination (if other than contract location) _____

Test	Method	Specification Limits	Test Results
Resin Density	ASTM D 3350	0.940 – 0.955	
Resin Melt Index	ASTM D 3350 Condition (190, 2.16)	0.15, maximum	
Liner OD	AASHTO M 326	*	
Liner Wall Thickness or ID	AASHTO M 326	Nominal OD, in in., divided by 32.5, minimum (For 12 in. use 12.750 in. and for 13 in., use 13.375 in.) Given ID, subtract from OD provided and divide by 2 to determine wall thickness, then use spec above	
Liner DR (Actual Calculated)	AASHTO M 326	32.5, minimum	
Length	AASHTO M 326	99% specified length, minimum or 1/2" less than specified length, minimum, whichever is shorter	

* These values vary depending on the pipe size. Contractor shall include the appropriate value from AASHTO.

Joint type (circle one): Bell/Spigot Screw Type Grooved Press-On Butt Fused Ext. Welded

Other (specify) _____

(Date)

(Signature of Manufacturer's Representative)

(Title)