



*Florida Department of Transportation*

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January 16, 2019

Khoa Nguyen  
Director, Office of Technical Services  
Federal Highway Administration  
3500 Financial Plaza, Suite 400  
Tallahassee, Florida 32312

Re: State Specifications Office  
Section: **960**  
Proposed Specification: **9600202 Post-Tensioning Components.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Jacqueline Petrozzino-Roche to reflect the current and appropriate test methods and material types.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to [dan.hurtado@dot.state.fl.us](mailto:dan.hurtado@dot.state.fl.us).

If you have any questions relating to this specification change, please call me at 414-4130.

Sincerely,

Signature on file

Dan Hurtado, P.E.  
State Specifications Engineer

DH/rf

Attachment

cc: Florida Transportation Builders' Assoc.  
State Construction Engineer

**POST-TENSIONING COMPONENTS****(REV 11-107-198)**

SUBARTICLE 960-2.2.1.8 is deleted and the following substituted:

**960-2.2.1.8 Heat Shrink Sleeves:**

1. Heat shrink sleeves shall have unidirectional circumferential recovery and be sized specifically for the duct size being coupled.

2. Use sleeves with a crosslinked polymer, typically polyolefin backing for grouted applications and sleeves with a high-density polyethylene or polypropylene backing for flexible filler applications.

3. Use adhesive with the same bond value to steel and high-density polyethylene or polypropylene materials.

4. Heat shrink sleeves shall have an adhesive layer that meets the requirements of the following table:

<b>Table 2.2.1.8-1 Heat Shrink Sleeve Adhesive Layer Minimum Requirements</b>			
Property	Test Method	Minimum Requirements	
		Grouted Applications	Flexible Filler (Internal and External Applications)
Softening Point	ASTM E28	162°F	256°F
Lap Shear at 73°F	ISO 21809-3	87 psi	44 psi
Tensile Strength	ASTM D 638	2,900 psi	3,190 psi
Hardness	ASTM D2240	46 Shore D	55 Shore D
Elongation	ASTM D 638	600%	600%
Volume Resistivity	ASTM D 257	3.9 x 10 <sup>16</sup> ohm-inch	3.9 x 10 <sup>16</sup> ohm-inch
Adhesion Strength at 73°F	ISO 21809-3	5-20 lbf/inch	28 lbf/inch
Impact Resistance	ISO 21809-3	Pass	15 J
Indentation Resistance	ISO 21809-3	Pass	0.026 inch
Cathodic Disbondment @ 73°F, 28 days	ISO 21809-3	0.5 inch*radian	< 0.4 inch
Backing Thickness	-	0.025 inch	0.035 inch
Adhesive Thickness	-	0.035 inch	0.055 inch
Operating Temperature	-	122°F	212°F

5. Install heat shrink sleeves using procedures and methods specified in the manufacturer's instructions.

6. Do not use heat shrink sleeves with properties meeting the requirements for grouted applications for applications using flexible filler.

7. Do not use heat shrink sleeves with properties meeting the requirements for flexible filler applications for applications using grout.

SUBARTICLE 960-2.2.2.2 is deleted and the following substituted:

**960-2.2.2.2 Inlets, Outlets, Drains, Ports, Valves, and Plugs:**

1. Provide permanent inlets, outlets, drains, ports, valves, and threaded plugs made of nylon, high-density polyethylene or polypropylene materials, or stainless steel.

2. For unbonded post-tensioning systems using flexible filler, provide permanent inlets, outlets and drains made from steel. Provide temporary inlets, outlets, drains and valves made from brass or steel.

3. All inlets, outlets, drains and ports shall have pressure rated mechanical shut-off valves or plugs. Mechanical shut-off valves must be 1/4 turn ball valves.

4. Inlets, outlets, drains, ports, valves, and plugs shall have a minimum pressure rating of 150 psi.

5. Inlets, outlets and ports shall have a minimum inside diameter of 3/4 inches for strand and 3/8 inches for single bar tendons and four-strand ducts.

6. Drains shall have a minimum inside diameter of 3/8 inches. Locate drains, and inlets and outlets serving as drains, at the bottom of the duct cross section.

6. Dual in line mechanical shutoff valves are required for vertical PT systems.

7. Specifically designate temporary items, not part of the permanent structure, on PT system drawings.

SUBARTICLES 960-2.4.3 through 960-2.4.4 are deleted and the following substituted:

**960-2.4.3 Polypropylene:** Conform to all of the following:

1. Non-colored, unfilled polypropylene according to ASTM D4101 with a cell class range of PP0340B44541 to PP0340B67884.

2. Contains antioxidants with a minimum Oxidative-Induction Time (OIT) according to ASTM D3895 of not less than 20 minutes.

3. Contains a non-yellowing light stabilizer.

4. Remolded finished material has a minimum failure time of 100~~three~~ hours when tested for stress crack resistance using ASTM F2136 at an applied stress of 600~~348~~ psi.

**960-2.4.4 High-density Polyethylene:** Conform to all of the following:

1. Smooth pipe is to meet the requirements of ASTM D3350 with a minimum cell class of 445574C. All other HDPE components are to m~~Meets the~~ requirements of ASTM D3350 with the values of the first four digits of the cell class meeting a minimum-~~cell~~ class of 445574C, be composed of a resin listed in the Plastic Pipe Institute's Technical Report 4 for Hydrostatic design basis and have a code letter designation of "C" per ASTM D3350.

2. Contains antioxidants with a minimum Oxidative-Induction Time (OIT) according to ASTM D3895 of 40 minutes.

3. Remolded finished material has a minimum failure time of 24~~three~~ hours when tested for stress crack resistance using ASTM F2136 at an applied stress of 600~~348~~ psi.

SUBARTICLE 960-3.2.2 through 960-3.2.4 are deleted and the following substituted:

**960-3.2.2 Filler Containment Assembly Pressure Test:** In addition to the other testing specified in this Section, test all filler containment assemblies, i.e., anchorages, anchorage caps, inlets, outlets, drains, ports, valves, plugs, etc., for all system sizes as follows:

1. Assemble the anchorage and anchorage cap with all required filler injection attachments.
2. Seal the opening in the anchorage where the duct/trumpet connects.
3. Condition the assembly by maintaining a pressure of 150 psi in the system for three hours.
4. After conditioning, lock off the air supply to the assembly.
5. After lock off, the assembly must sustain 150 psi internal pressure for five minutes with no more than 15 psi, or 10%, reduction in pressure.

This test may be combined with the External Duct Systems Pressure Test for external PT systems.

**960-3.2.3 External PT Systems Pressure Test:** In addition to the other testing specified in this Section, test all sizes of external PT systems as follows:

1. Prepare a system assembly consisting of at least one of each component and connection type required to install a tendon from anchorage cap to anchorage cap using between 15 and 50 feet of duct with a straight profile.
2. Condition the assembly by maintaining a pressure of 100 psi in the system for three hours.
3. After conditioning, lock off the air supply to the assembly.
4. After lock off, the assembly must sustain 100 psi internal pressure for five minutes with no more than 10 psi reduction in pressure.

**960-3.2.4 Vacuum Test for Internal and External PT Systems with Flexible Filler:** In addition to the other testing specified in this Section, test all sizes of internal PT systems with flexible filler and all external PT as follows:

1. Prepare a system assembly consisting of at least one of each component and connection type required to install a tendon from anchorage cap to anchorage cap using between 15 and 50 feet of duct Do not cast any component into concrete.
2. Condition the assembly by maintaining a 90% vacuum in it for 1 hour.
3. After conditioning, lock off the air supply to the assembly.
4. After lock off, the assembly must sustain a 90% vacuum for 5 minutes with no more than a 10% loss of vacuum.

**POST-TENSIONING COMPONENTS****(REV 1-10-19)**

SUBARTICLE 960-2.2.1.8 is deleted and the following substituted:

**960-2.2.1.8 Heat Shrink Sleeves:**

1. Heat shrink sleeves shall have unidirectional circumferential recovery and be sized specifically for the duct size being coupled.

2. Use sleeves with a crosslinked polymer, typically polyolefin backing for grouted applications and sleeves with a high-density polyethylene or polypropylene backing for flexible filler applications.

3. Use adhesive with the same bond value to steel and high-density polyethylene or polypropylene materials.

4. Heat shrink sleeves shall have an adhesive layer that meets the requirements of the following table:

<b>Table 2.2.1.8-1 Heat Shrink Sleeve Adhesive Layer Minimum Requirements</b>			
Property	Test Method	Minimum Requirements	
		Grouted Applications	Flexible Filler (Internal and External Applications)
Softening Point	ASTM E28	162°F	256°F
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Hardness	ASTM D2240	46 Shore D	55 Shore D
Elongation	ASTM D 638	600%	600%
Volume Resistivity	ASTM D 257	3.9 x 10 <sup>16</sup> ohm-inch	3.9 x 10 <sup>16</sup> ohm-inch
Adhesion Strength at 73°F	ISO 21809-3	5-20 lbf/inch	28 lbf/inch
Impact Resistance	ISO 21809-3	Pass	15 J
Indentation Resistance	ISO 21809-3	Pass	0.026 inch
Cathodic Disbondment @ 73°F, 28 days	ISO 21809-3	0.5 inch*radian	< 0.4 inch
Backing Thickness	-	0.025 inch	0.035 inch
Adhesive Thickness	-	0.035 inch	0.055 inch
Operating Temperature	-	122°F	212°F

5. Install heat shrink sleeves using procedures and methods specified in the manufacturer's instructions.

6. Do not use heat shrink sleeves with properties meeting the requirements for grouted applications for applications using flexible filler.

7. Do not use heat shrink sleeves with properties meeting the requirements for flexible filler applications for applications using grout.

SUBARTICLE 960-2.2.2.2 is deleted and the following substituted:

**960-2.2.2.2 Inlets, Outlets, Drains, Ports, Valves, and Plugs:**

1. Provide permanent inlets, outlets, drains, ports, valves, and threaded plugs made of nylon, high-density polyethylene or polypropylene materials, or stainless steel.

2. For unbonded post-tensioning systems using flexible filler, provide permanent inlets, outlets and drains made from steel. Provide temporary inlets, outlets, drains and valves made from brass or steel.

3. All inlets, outlets, drains and ports shall have pressure rated mechanical shut-off valves or plugs. Mechanical shut-off valves must be 1/4 turn ball valves.

4. Inlets, outlets, drains, ports, valves, and plugs shall have a minimum pressure rating of 150 psi.

5. Inlets, outlets and ports shall have a minimum inside diameter of 3/4 inches for strand and 3/8 inches for single bar tendons and four-strand ducts.

6. Drains shall have a minimum inside diameter of 3/8 inches. Locate drains, and inlets and outlets serving as drains, at the bottom of the duct cross section.

7. Specifically designate temporary items, not part of the permanent structure, on PT system drawings.

SUBARTICLES 960-2.4.3 through 960-2.4.4 are deleted and the following substituted:

**960-2.4.3 Polypropylene:** Conform to all of the following:

1. Non-colored, unfilled polypropylene according to ASTM D4101 with a cell class range of PP0340B44541 to PP0340B67884.

2. Contains antioxidants with a minimum Oxidative-Induction Time (OIT) according to ASTM D3895 of not less than 20 minutes.

3. Contains a non-yellowing light stabilizer.

4. Remolded finished material has a minimum failure time of 100 hours when tested for stress crack resistance using ASTM F2136 at an applied stress of 600 psi.

**960-2.4.4 High-density Polyethylene:** Conform to all of the following:

1. Smooth pipe is to meet the requirements of ASTM D3350 with a minimum cell class of 445574C. All other HDPE components are to meet the requirements of ASTM D3350 with the values of the first four digits of the cell class meeting a minimum of 4455, be composed of a resin listed in the Plastic Pipe Institute's Technical Report 4 for Hydrostatic design basis and have a code letter designation of "C" per ASTM D3350.

2. Contains antioxidants with a minimum Oxidative-Induction Time (OIT) according to ASTM D3895 of 40 minutes.

3. Remolded finished material has a minimum failure time of 24 hours when tested for stress crack resistance using ASTM F2136 at an applied stress of 600 psi.

SUBARTICLE 960-3.2.2 through 960-3.2.4 are deleted and the following substituted:

**960-3.2.2 Filler Containment Assembly Pressure Test:** In addition to the other testing specified in this Section, test all filler containment assemblies, i.e., anchorages, anchorage caps, inlets, outlets, drains, ports, valves, plugs, etc., for all system sizes as follows:

1. Assemble the anchorage and anchorage cap with all required filler injection attachments.
2. Seal the opening in the anchorage where the duct/trumpet connects.
3. Condition the assembly by maintaining a pressure of 150 psi in the system for three hours.
4. After conditioning, lock off the air supply to the assembly.
5. After lock off, the assembly must sustain 150 psi internal pressure for five minutes with no more than 15 psi, or 10%, reduction in pressure.

This test may be combined with the External Duct Systems Pressure Test for external PT systems.

**960-3.2.3 External PT Systems Pressure Test:** In addition to the other testing specified in this Section, test all sizes of external PT systems as follows:

1. Prepare a system assembly consisting of at least one of each component and connection type required to install a tendon from anchorage cap to anchorage cap using between 15 and 50 feet of duct with a straight profile.
2. Condition the assembly by maintaining a pressure of 100 psi in the system for three hours.
3. After conditioning, lock off the air supply to the assembly.
4. After lock off, the assembly must sustain 100 psi internal pressure for five minutes with no more than 10 psi reduction in pressure.

**960-3.2.4 Vacuum Test for Internal and External PT Systems with Flexible Filler:** In addition to the other testing specified in this Section, test all sizes of internal PT systems with flexible filler and all external PT as follows:

1. Prepare a system assembly consisting of at least one of each component and connection type required to install a tendon from anchorage cap to anchorage cap using between 15 and 50 feet of duct Do not cast any component into concrete.
2. Condition the assembly by maintaining a 90% vacuum in it for 1 hour.
3. After conditioning, lock off the air supply to the assembly.
4. After lock off, the assembly must sustain a 90% vacuum for 5 minutes with no more than a 10% loss of vacuum.