9600000 POST-TENSIONING COMPONENTS
COMMENTS FROM INTERNAL/INDUSTRY REVIEW

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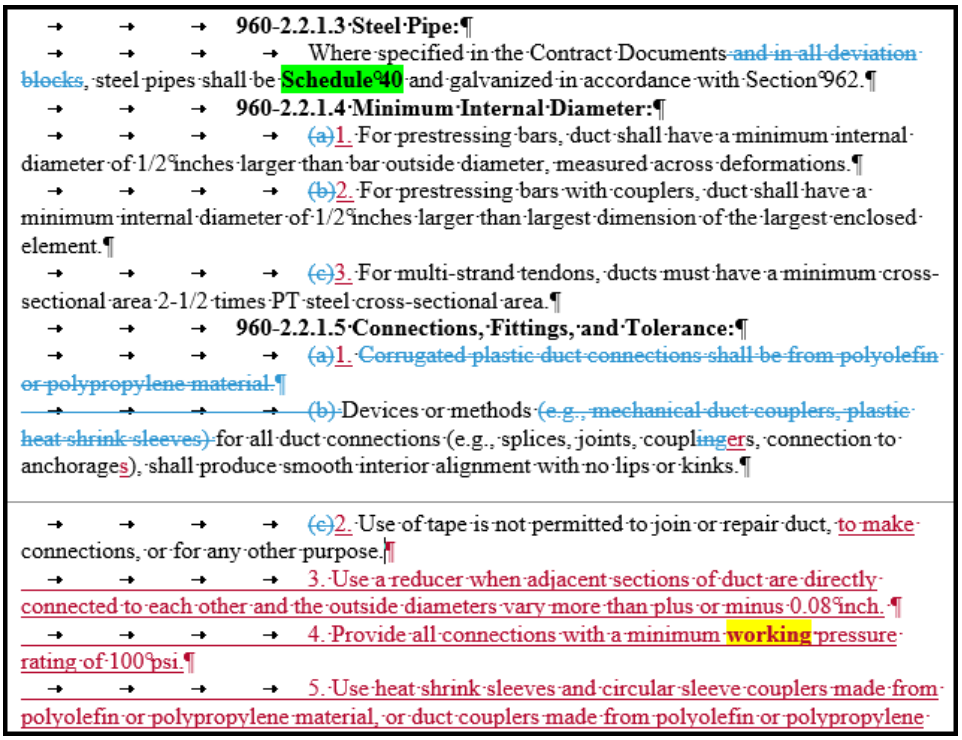
Comments: (5-27-15)
1. Should 2.2.1.4 and 2.2.1.5 be subarticles of 2.2.1.3? Also, schedule 40 pipe has a working of pressure of 150 psi and is often called class 150 pipe (ANSI B36.10).
I don't think 990-2.2.1.5(4) is necessary.

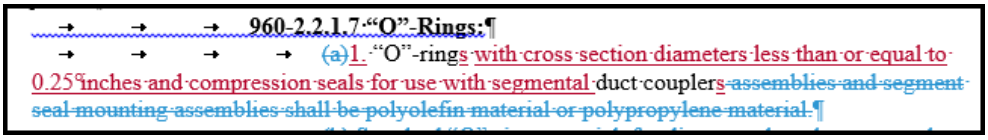


→ → → **960-2.2.1.3 Steel Pipe:**¶
→ → → → Where specified in the Contract Documents ~~and in all deviation blocks~~, steel pipes shall be **Schedule 40** and galvanized in accordance with Section 962.¶
→ → → **960-2.2.1.4 Minimum Internal Diameter:**¶
→ → → → ~~(a)~~1. For prestressing bars, duct shall have a minimum internal diameter of 1/2 inches larger than bar outside diameter, measured across deformations.¶
→ → → → ~~(b)~~2. For prestressing bars with couplers, duct shall have a minimum internal diameter of 1/2 inches larger than largest dimension of the largest enclosed element.¶
→ → → → ~~(c)~~3. For multi-strand tendons, ducts must have a minimum cross-sectional area 2-1/2 times PT steel cross-sectional area.¶
→ → → **960-2.2.1.5 Connections, Fittings, and Tolerance:**¶
→ → → → ~~(a)~~1. ~~Corrugated plastic duct connections shall be from polyolefin or polypropylene material.~~¶
→ → → → ~~(b)~~ Devices or methods ~~(e.g., mechanical duct couplers, plastic heat shrink sleeves)~~ for all duct connections (e.g., splices, joints, couplingers, connection to anchorages), shall produce smooth interior alignment with no lips or kinks.¶

→ → → → ~~(c)~~2. Use of tape is not permitted to join or repair duct, to make connections, or for any other purpose.¶
→ → → → 3. Use a reducer when adjacent sections of duct are directly connected to each other and the outside diameters vary more than plus or minus 0.08 inch.¶
→ → → → 4. Provide all connections with a minimum **working** pressure rating of 100 psi.¶
→ → → → 5. Use heat shrink sleeves and circular sleeve couplers made from polyolefin or polypropylene material, or duct couplers made from polyolefin or polypropylene

Response: 2.2.1.3 refers specifically to steel pipe. 2.2.1.4 and 2.2.1.5 refers to duct and pipe in general and encompasses steel pipe, polyethylene smooth duct, and polypropylene corrugated duct. The minimum working pressure criteria applies to all connections in general and not just to steel pipe connections.
No change made

2. **960-2.2.1.7(1) "O"-Rings:**
Should this be the thickness of the "O" ring rather than the cross section diameter? I am confused.



→ → → **960-2.2.1.7 "O"-Rings:**¶
→ → → → ~~(a)~~1. "O"-rings with cross section diameters less than or equal to 0.25 inches and compression seals for use with segmental duct couplers ~~assemblies and segment seal mounting assemblies shall be polyolefin material or polypropylene material.~~¶

Response: 960-2.2.1.7(1) and (2) have been revised (highlighted) as follows:

→ → → 960-2.2.1.7 "O"-Rings:¶

→ → → → (a)1. "O"-rings with cross section diameters less than or equal to 0.25 inches and compression seals with thicknesses less than or equal to 0.25 inches for use with segmental duct couplers assemblies and segment seal mounting assemblies shall be polyolefin material or polypropylene material.¶

→ → → → (b) Standard "O" ring material, for diameters less than or equal to 0.25 inches, anchorage caps and other similar components shall conform to the requirements of the following tTable 2.2.1.7-1:.¶

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Table 2.2.1.7-1¶ "O"-Ring and Compression Seal Material Properties¶ (cross section diameter or thickness ≤ 0.25 in)¤

→ → → → (c)2. Segment seal assemblies for "O"-rings and compression seals with cross section diameters greater than 0.25 inches, and compression seals with thicknesses greater than 0.25 inches for used to couple ducts at with segmental joints duct couplers, anchorage caps and other similar components, shall conform to the requirements in Table 2.2.1.7-1 with the additions and modifications in the following tTable 2.2.1.7-2:.¶

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Table 2.2.1.7-2¶ Large Diameter "O"-Rings and Compression Seals Material Properties¶ (cross section diameter or thickness > 0.25 in)¤	
Mechanical Properties¤	
Shore hardness, ASTM D2240¤	30-60¤

3. 960-2.2.2.2 Inlets, Outlets, Drains, Valves, and Plugs:

I recommend ¼ turn ball valves. I don't think we want to allow knife gate, plug valves, etc. These are more prone to locking up and often do not provide full volume flow without resistance like a ball valve.

→ → → 960-2.2.2.2 Inlets, Outlets, Drains, Valves, and Plugs:¶

→ → → → (a)1. Provide permanent grout inlets, outlets, drains, valves, and threaded plugs made of nylon, polyolefin materials, or stainless steel.¶

→ → → → (b)2. All inlets, and outlets, and drains shall have pressure rated mechanical shut-off valves or plugs.¶

→ → → → (c)3. Inlets, outlets, drains, valves, and plugs shall have a minimum pressure rating of 150 psi.¶

→ → → → (d)4. Inlets and outlets shall have a minimum inside diameter of 3/4 inches for strand and 3/8 inches for single bar tendons and four-strand ducts.¶

→ → → → (e)5. 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 grouting PT systems.¶

→ → → → (f)7. Specifically designate temporary items, not part of the permanent structure, on PT system drawings.¶

Response: 960-2.2.2.2(2) has been revised (highlighted) as follows:

→ → → 960-2.2.2.2 Inlets, Outlets, Drains, Valves, and Plugs:¶

→ → → → (a)1. Provide permanent grout inlets, outlets, drains, valves, and threaded plugs made of nylon, polyolefin materials, or stainless steel.¶

→ → → → (b)2. All inlets, and outlets, and drains shall have pressure rated mechanical shut-off valves or plugs. Mechanical shut-off valves must be 1/4 turn ball valves.¶

→ → → → (c)3. Inlets, outlets, drains, valves, and plugs shall have a minimum pressure rating of 150 psi.¶

→ → → → (d)4. Inlets and outlets shall have a minimum inside diameter of 3/4 inches for strand and 3/8 inches for single bar tendons and four-strand ducts.¶

→ → → → (e)5. Drains shall have a minimum inside diameter of 3/8 inches.

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Comments: (6-30-15)

1. 960-2.1.5 Dynamic test of unbonded anchorage. AASHTO section 10.3.2.2 requires the test to be done on a representative anchorage. It is our understanding that for multi-strand systems, one representative tendon size shall be sufficient. This is interpreted, for example, that a 19-0.6 tendon size is representative of all multi-strand tendon sizes 7-0.6 through 31-0.6 that use similar components of different sizes. Is that so?

Response: The dynamic testing requirements for unbonded tendons is still being evaluated. No change made.

2. 960-2.2.1.5.5 The use of heat shrink is intended to make the connection air-tight without it. Heat shrink is expensive and labor intensive. If the proposed connection of a system is air-tight without the use of heatshrink, we believe the use of heatshrink should not mandatory. We recommend the text of the specifications be changed to… "Make all connections air-tight or use heat shrink sleeves and circular sleeve……."

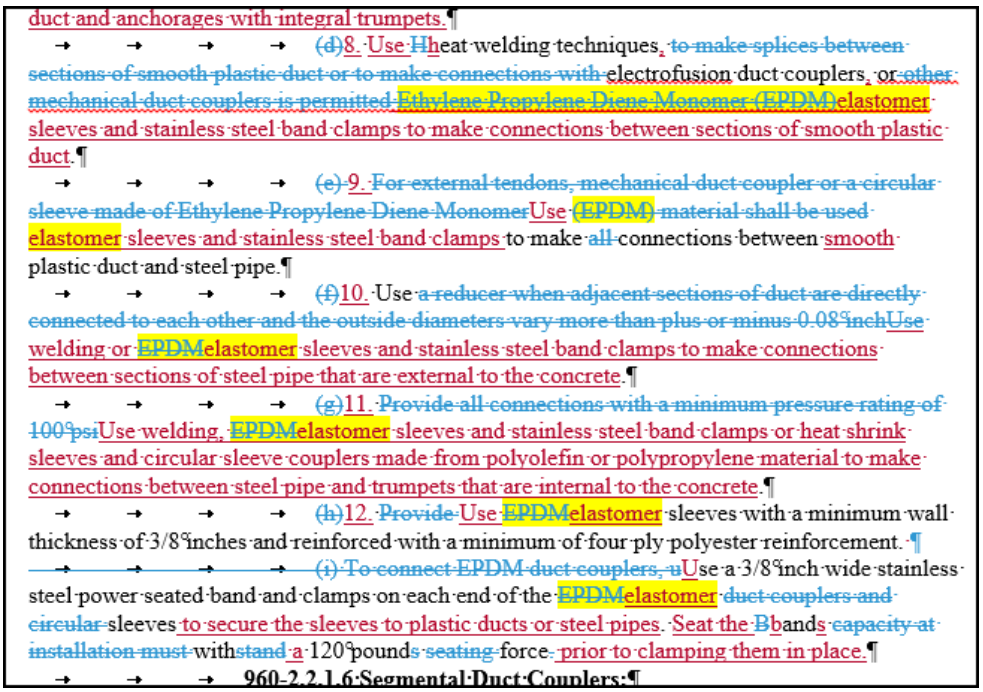
Response: The use of heat shrink sleeves is only mandatory with circular sleeve couplers. Circular sleeve connectors of the type that have been previously approved would not be airtight without the use of heat shrink sleeves. Other types of couplers that utilize O-rings or seals are also permitted. The use of both of these types of couplers is consistent with current practices. No change made

3. 960-2.2.1.5.6 Same as above, the use of heat shrink should not mandatory if the connection is air-tight. We recommend "Make all connections air-tight or use heat shrink sleeves with or without circular sleeve……"

Response: Please see previous response.

4. 960-2.2.1.5.8, 9, 10, 11 and 12 Regarding the use of EPDM to couple section of ducts or duct and pipe, it is our understanding that EPDM is not recommended for use with petroleum based material according to the manufacturer. Did the department give a consideration to this issue?

Response: The language has been changed to refer to "elastomer sleeves" compatible with the filler material. Although EPDM rubber is not considered compatible with microcrystalline wax, other elastomer materials such as Buna-N are considered compatible. The following changes have been made.

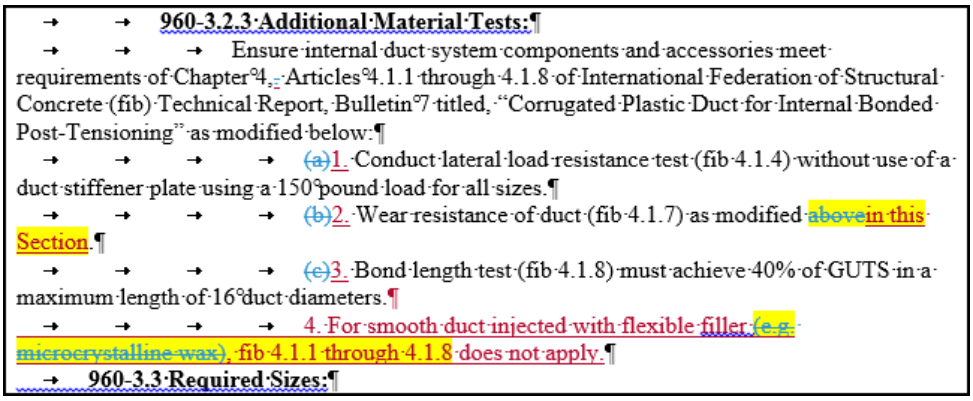

duct and anchorages with integral trumpets.¶
→ → → → (d)8. Use Hheat welding techniques, to make splices between sections of smooth plastic duct or to make connections with electrofusion duct couplers, or other mechanical duct couplers is permitted Ethylene Propylene Diene Monomer (EPDM)elastomer sleeves and stainless steel band clamps to make connections between sections of smooth plastic duct.¶
→ → → → (e) 9. For external tendons, mechanical duct coupler or a circular sleeve made of Ethylene Propylene Diene MonomerUse (EPDM) material shall be used elastomer sleeves and stainless steel band clamps to make all connections between smooth plastic duct and steel pipe.¶
→ → → → (f)10. Use a reducer when adjacent sections of duct are directly connected to each other and the outside diameters vary more than plus or minus 0.08"inchUse welding or EPDMelastomer sleeves and stainless steel band clamps to make connections between sections of steel pipe that are external to the concrete.¶
→ → → → (g)11. Provide all connections with a minimum pressure rating of 100 psiUse welding, EPDMelastomer sleeves and stainless steel band clamps or heat shrink sleeves and circular sleeve couplers made from polyolefin or polypropylene material to make connections between steel pipe and trumpets that are internal to the concrete.¶
→ → → → (h)12. Provide Use EPDMelastomer sleeves with a minimum wall thickness of 3/8"inches and reinforced with a minimum of four ply polyester reinforcement. ¶
→ → → → (i) To connect EPDM duct couplers, uUse a 3/8"inch wide stainless steel power seated band and clamps on each end of the EPDMelastomer duct couplers and circular sleeves to secure the sleeves to plastic ducts or steel pipes. Seat the Bbands capacity at installation must withstand a 120"pounds seating force prior to clamping them in place.¶
→ → → **960-2.2.1.6 Segmental Duct Couplers:**¶

5. 960-3.2.1.4 Is this necessary? A successful pressure test of 1.5 psi would typically ensure a system that can hold vacuum as well.

Response: This test is for use of a vacuum assisted process of injection of flexible filler. In 462-7.4.2.1.4(5), the PT system will be subjected to 90% vacuum during a vacuum assisted injection. This test assures the PT system will handle the vacuum required during the vacuum assisted injection process prior to installation of the PT system in the concrete section

6. 960-3.2.3: Much of the duct testing was written around qualifying bonded, corrugated duct of PP composition. HDPE pipe for external applications per ASTM D3035 have defined chemistries and sizes, and have been around for many years. There is little gained by having each supplier qualify the HDPE pipe specified, since it will be the same for every supplier. DSI would ask that the Department simply specify what resin should be used.

Response: Smooth duct, including polyethylene resin, is specified in 960-2.4.5 and 960-2.2.1.2. 960-3.2.3 has been revised as follows.


→ → **960-3.2.3 Additional Material Tests:**¶
→ → → Ensure internal duct system components and accessories meet requirements of Chapter 4, - Articles 4.1.1 through 4.1.8 of International Federation of Structural Concrete (fib) Technical Report, Bulletin 7 titled, "Corrugated Plastic Duct for Internal Bonded Post-Tensioning" as modified below:¶
→ → → → (a)1. Conduct lateral load resistance test (fib 4.1.4) without use of a duct stiffener plate using a 150 pound load for all sizes.¶
→ → → → (b)2. Wear resistance of duct (fib 4.1.7) as modified abovein this Section.¶
→ → → → (c)3. Bond length test (fib 4.1.8) must achieve 40% of GUTS in a maximum length of 16 duct diameters.¶
→ → → → 4. For smooth duct injected with flexible filler (e.g. microcrystalline wax), fib 4.1.1 through 4.1.8 does not apply.¶
→ **960-3.3 Required Sizes:**¶

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