POST-TENSIONING
(REV 11-10-21) (FA 1-19-22) (7-22)

ARTICLE 462-1 is deleted and the following substituted:

462-1 Description.

1. Furnish, test, transport, store, handle, and install all components of Post-Tensioning (PT) systems, in accordance with the requirements of this Section and the component manufacturer's recommendations. Constituent components of PT systems include, but are not limited to, anchorage assemblies, filler containment assemblies, filler material, and related steel reinforcement. Use the most stringent requirements, as determined by the Engineer, of those specified in this Section or the component manufacturer's recommendations for protecting components from damage due to environmental exposure, improper handling, or improper installation.

2. With the exception of mild reinforcing and prestressing steel, furnish all PT system components from a single supplier (vendor).

3. Submit PT system shop drawings in accordance with Section 5. Perform PT system testing in accordance with Section 960. Include in the PT system testing all possible combinations of components to be incorporated into the structure.

4. Use only PT systems meeting the requirements of Section 960 and approved by the Engineer in accordance with Section 5.

a. Use only PT systems of appropriate type and size required to construct tendons shown in the Contract Documents.

b. Use only the exact manufacturer and/or model of major components, as defined in 960-2, that were used in system testing and as listed on the approved PT system shop drawings.

c. With the exception of local zone reinforcement, do not substitute, modify, or delete any major components, as defined in 960-2, of a PT system approved by the Engineer for use on the project.

5. Provide a mockup test in accordance with this Section. PT system acceptance testing may be performed concurrent with mockup testing if performed prior to installation of any PT system hardware.

6. Install the PT tendon (e.g., strands, wires, or bars) in ducts. Stress the PT tendon to a predetermined load and anchor ends directly against hardened concrete. After anchoring the PT tendon, install permanent anchorage caps, inject ducts with filler to completely fill voids, and install protection at anchorages.

7. Submit all required documents in accordance with this Section and Section 5 to the Engineer for review and written approval.

8. Cable stays and extradosed bridges are not covered by this Specification.

9. Install duct filler. Provide fully filled duct and anchorage assemblies free from leaks, blockages, and voids. Submit test data to the Engineer to verify that the work meets the requirements of this Section. Perform filler injection operations in accordance with 462-7.4.

SUBARTICLE 462-2.2.1 is deleted and the following substituted:

462-2.2 Steel Reinforcing:

462-2.2.1 Mild:

1. Provide reinforcing steel per Section 931.

2. Final design and details of local zone reinforcement are project specific and are the responsibility of PT system supplier (vendor). Design project specific local zone reinforcement for the number of strands or wires a particular PT system can accommodate at maximum allowable strand or wire force; do not design project specific local zone reinforcement for a reduced system capacity.

3. Submit signed and sealed project specific local zone reinforcement details to the Engineer for review and written approval.

ARTICLE 462-5 is deleted and the following substituted:

462-5 Submittals.

1. Submit to the Engineer all necessary information, Plans, shop and working drawings, and manuals in accordance with this Section and Section 5. Submit to the Engineer signed and sealed PT related shop drawings designed by the Contractor's Engineer of Record.

2. Prepare shop drawings addressing all requirements stated in the Contract Documents and requirements of this Section. Show details of PT hardware components, tendon geometry and locations complying with the Contract Documents and limitations of selected PT system. Include all inlets, outlets, high point inspection port details, anchorage inspection details, permanent anchorage caps, protection system materials, and application limits.

SUBARTICLE 462-7.1 is deleted and the following substituted:

462-7 Construction.

462-7.1 General:

1. Prior to installing any PT system hardware:

a. Submit to the Engineer a list of all PT systems chosen for the project.

b. For each PT system, submit a package to the Engineer meeting the requirements of Section 960-3.6.

c. For each PT system, submit to the Engineer written certification that all major components, as defined in 960-2, furnished to the project and shown on the approved PT system shop drawings exactly match the major components used in PT system testing.

2. Use methods to place and consolidate concrete that will not displace or damage any PT ducts, anchorage assemblies, splices and connections, reinforcement, or other embedded items.

3. Conduct all stressing and filler injection operations in the presence of the Engineer.

SUBARTICLE 462-7.2.1 is deleted and the following substituted:

462-7.2.1 Ducts:

1. Construct tendon ducts using the minimum number of splices as practical.

2. Accurately position and align ducts at locations shown in the Contract Documents, or according to approved shop or working drawings, or as approved in writing by the Engineer.

3. Securely fasten all internal ducts at regular intervals not exceeding 30 inches for steel pipes, 24 inches for round plastic ducts, and 12 inches for flat ducts to prevent movement, displacement, or damage from concrete placement and consolidation operations.

4. Show method and spacing of duct supports on appropriate shop drawings.

5. Ensure external tendon ducts are straight between connections to internal ducts at anchorages, diaphragms, and deviation saddles and are supported at intermediate locations according to the Contract Documents including approved shop drawings.

6. Ensure all alignments, including curves and straight portions, are smooth and continuous with no lips, kinks, or dents. This also applies to curves in pre-bent steel pipe.

7. Check and repair all ducts in accordance with 462-7.5 as necessary before placing any concrete.

8. Ensure ducts at end connections to anchorages, splices, inlets, outlets, drains, and all other duct openings are sealed at all times after installing ducts and until tendon installation is complete. Briefly open low point drains just prior to tendon installation and again just prior to filler injection to allow for drainage of any water that may be present within the duct.

9. Provide an absolute seal of anchorage and duct termination locations per the pre-approved system drawings.

10. Use of tape, caulking, epoxy or other sealants is not permitted to make connections or sealing for any reason.

11. Use heat welding techniques, in accordance with duct manufacturer’s instructions, to make splices between sections of smooth plastic duct or make connection with electrofusion duct coupler as shown on the approved PT system shop drawings.

12. When connecting steel pipe to plastic pipe with a boot, use a 3/8 inches wide power seated band and clamps in accordance with 960-2.2 on each end of a duct boot to seal against filler leakage. Install band per manufacturer's instructions.

13. Ducts for prestressing used exclusively for temporary erection where PT will be removed from structure are not required to be coupled across segment joints.

SUBARTICLE 462-7.4.1.1 is deleted and the following substituted:

462-7.4.1.1 Plan:

1. Submit a Grouting Operations Plan to the Engineer for approval at least six weeks in advance of any scheduled grouting operation.

2. Written approval of Grouting Operations Plan by the Engineer is required before any grouting of permanent structure takes place.

3. At minimum, Grouting Operations Plan will address and provide:

a. Names and proof of training for grouting crew and crew supervisor in conformance with this Specification;

b. Type, quantity, and brand of materials to be used in grouting, including all required certifications;

c. Type of equipment to be used, including capacity in relation to demand and working conditions, as well as, standby equipment and spare parts;

d. General grouting procedure;

e. Duct pressure test and repair procedures;

f. Method to be used to control rate of flow within ducts;

g. Theoretical grout volume calculations;

h. Mixing and pumping procedures in accordance with the manufacturer's recommendations;

i. Direction of grouting accounting for grade and/or slope of tendon;

j. Sequence of inlet and outlet pipes use;

k. Procedures for handling blockages;

l. Procedures for possible post grouting repair.

4. Conduct a joint meeting of the Contractor, grouting crew, and the Engineer before grouting operations begin. Discuss Grouting Operations Plan, required testing, corrective procedures, and any other relevant issues at the meeting.

5. Prior to production grouting, demonstrate to the Engineer's satisfaction successful grout injection by injecting full-scale mockups that are constructed with all associated PT system components using the mockup tendon profiles shown in the Plans and the proposed Grouting Operations Plan. Utilize smooth duct and associated couplers and fittings meeting the requirements of Section 960 for all mockups. Utilize smooth duct for the mockups which has an inside diameter required for a given mockup tendon size. If the mockup is also being used to perform PT system acceptance testing,

use the duct type appropriate for the PT system location. Place the mockup tendons specified in the Plans inside the ducts to simulate the in-place PT tendons. Stress mockup tendons to the minimum values shown in the Plans by using jacks or other methods approved by the Engineer. Perform pressure tests on the mockups in accordance with 462-8.2.1 prior to grout injection. For the grout injection operations, utilize the same grout material and types and sizes of grout injection equipment that will be used on the project including but not limited to mixers, pumps, hoses, valves and pressure gauges. Inject grout into the mockups using the proposed Grouting Operations Plan. Allow the grout to harden a minimum of 24 hours after injection before inspecting the mockup. Inspect the mockup in accordance with the requirements of 462-8.3.2.1 and then carefully cut open the duct at all high points and other locations as directed by the Engineer to check for voids. Prepare a report documenting the findings and submit it to the Engineer. If voids are found, determine the cause and revise the proposed Grouting Operations Plan accordingly. If directed by the Engineer, construct additional mockups and repeat the grout injection operation using the revised Grouting Operations Plan as many times as are required until the results are acceptable.

SUBARTICLE 462-7.4.2.1.1 is deleted and the following substituted:

462-7.4.2.1.1 Wax Injection Operations Plan:

1. Prepare a Wax Injection Operations Plan in cooperation with the PT system vendor and the PT wax manufacturer.

2. Submit the Wax Injection Operations Plan to the Engineer for approval at least six weeks in advance of any scheduled injection operation.

3. Written approval of the Wax Injection Operations Plan by the Engineer is required before any injection of permanent structure can begin.

4. At a minimum, the Wax Injection Operations Plan will address and provide the following:

a. .Names and qualifications for wax injection crew and crew supervisor in conformance with this Specification;

b. Type, quantity, and brand of materials to be used in wax injection including all required certifications;

c. Type of equipment to be used, including capacity in relation to demand and working conditions, as well as, standby equipment and spare parts;

d. Location and sequence of ducts to be injected;

e. Calculation of temporary elongation of tendons due to wax injection temperature;

f. General wax injection procedure for all duct geometries and types;

g. Duct pressure test and repair procedures;

h. Method to be used to control rate of flow within ducts and anchorage assembly;

i. Theoretical wax volume calculations;
j. Injection rate;
k. Maximum injection pressure during injection and locking pressure;
l. Vacuum (gauge) pressure requirements, vacuum tests and repair procedures;
m. Heating, mixing and pumping procedures in accordance with the manufacturer's recommendations;
n Direction of wax injection accounting for grade and/or slope of tendon;
o. Location of all high points and all low points accounting for grade and/or slope of tendon;
p. Sequence of valve operations at PT system inlets and outlets, including minimum wax discharge quantities;
q. Procedures for handling blockages;
r. Procedure for sealing duct after wax injection;
s. Procedure for inspecting the PT system after wax injection, filling voids created by inspection procedures, and sealing duct after PT system inspection;
t. Procedures for possible post injection repair;
u. Method(s) and material(s) that will be used to protect concrete surfaces from wax spills, leaks, etc. during wax injection, post injection inspection and post injection repair;
v. Safety and clean-up procedures;

5. Conduct a joint meeting of the Contractor, wax injection crew, and the Engineer before wax injection operations begin. Discuss Wax Injection Operations Plan, required testing, corrective procedures, and any other relevant issues at the meeting.

6. Prior to production wax injection, demonstrate to the Engineer's satisfaction successful wax injection by injecting full-scale mockups that are constructed with all associated PT system components using the mockup tendon profiles shown in the Plans and the proposed Wax Injection Operations Plan. Utilize smooth duct and associated couplers and fittings meeting the requirements of Section 960 for all mockups. Utilize smooth duct for the mockups which has an inside diameter required for a given mockup tendon size. If the mockup is also being used to perform PT system acceptance testing, use the duct type appropriate for the PT system location. Place the mockup tendons specified in the Plans inside the ducts to simulate the in-place PT tendons. Stress mockup tendons to the minimum values shown in the Plans by using jacks or other methods approved by the Engineer. Perform pressure tests on the mockups in accordance with 462-8.2.1 prior to wax injection. If vacuum assisted wax injection is required to be used, perform vacuum tests on the mockups in accordance with 462-8.2.1 prior to wax injection. For the wax injection operations, utilize the same wax material and types and sizes of wax injection equipment that will be used on the project including but

not limited to heaters, pumps, hoses, valves and pressure gauges. Inject wax into the mockups using the proposed Wax Injection Operations Plan. Allow the wax to cool a minimum of 24 hours after injection before inspecting the mockup. Inspect the mockup in accordance with the requirements of 462-8.3.2.2.1 and then carefully cut open the duct at all high points and other locations as directed by the Engineer to check for voids. Prepare a report documenting the findings and submit it to the Engineer. If voids are found, determine the cause and revise the proposed Wax Injection Operations Plan accordingly. If directed by the Engineer, construct additional mockups and repeat the wax injection operation using the revised Wax Injection Operations Plan as many times as are required until the results are acceptable.

SUBARTICLEA 462-7.5.1 is deleted and the following substituted:

462-7.5.1 Lifting and Access Holes:

1. Repair all holes with magnesium ammonium phosphate concrete meeting requirements of Section 930 or Type Q epoxy grout meeting requirements of Section 926. Immediately before casting concrete (i.e., within 24 hours), mechanically clean and roughen the mating concrete surfaces to remove any laitance and expose small aggregate. Use grit blasting or water blasting using a minimum 10,000 psi nozzle pressure. Flush surface with water and blow dry. Form, mix, place, and cure material in strict compliance with manufacturer's recommendations.

2. Upon completion of deck grooving, coat repaired holes, block-outs, and an area extending six inches outside perimeter of repair with a high molecular weight methacrylate (HMWM) meeting the requirements of Section 413. Prepare surface to be coated and apply HMWM in accordance with Section 413. Friction (skid) tests per Section 413 are not required.