PTI Technical Manual for PT Systems Qualification Testing and Certification

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1. CERTIFICATIONS

1.1 A letter shall accompany each submittal indicating compliance with PTI/ASBI M50.3-19.

The letter shall include these items:

(a) Signature of company officer

(b) The systems designation

(c) System size (number and size of strands)

(d) Protection Level(s)

(e) Data sheet

(f) System drawing,

(g) Any other pertinent information.

1.2 Test required by PTI/ASBI M50.3-19 are to *be witnessed and certified by a certified independent lab (defined as testing laboratory AMRL or A2LA certified, or other organization accredited to ISO 17025 or AASHTO R 18).* As part of the review, it shall be verified that:

(a) Tests have been witnessed by a certified independent lab.

(b) Proof of the certification of the certified independent lab has been provided.

(c) Test report shall contain at a minimum:

1. Date and location of testing.

2. Name of laboratory and individuals who performed and/or witnessed the testing.

Questions	PL-1a	PL-1b	PL-2	PL-3
1.1 Has a letter been issued for the given PT system?	✓	✓	✓	✓
Does the Letter include all the following? (a) Signed by an Officer of the company	✓	✓	✓	✓
(b) System designation	✓	✓	✓	✓
(c) System size (number and size of strands)	✓	✓	✓	✓
(d) Applicable Protection Level (PL)	✓	✓	✓	✓
(e) A data sheet	✓	✓	✓	✓
(f) A System Drawing	✓	✓	✓	✓
1.2 Have all test reports been reviewed and validated to be from an independent approval body or a certified/accredited lab as required by the specification?	✓	✓	✓	✓
(a) Has testing been witnessed by a certified independent lab?	✓	✓	✓	✓
(b) Has documentation been provided to validate the credentials of the certified independent lab?	✓	✓	✓	✓
(c) Does the test report contain the following?				
1. Date and location of testing.	✓	✓	✓	✓
2. Name of laboratory and individuals who performed and/or witnessed the testing.	✓	✓	✓	✓
3. Tested materials description and properties including component drawings.	✓	✓	✓	✓
4. Documentation that test specimens conform to dimensional tolerance	✓	✓	✓	✓
5. Documentation of detailed test procedures	✓	✓	✓	✓
6. Confirmation that test specimen successfully completed testing and passed the acceptance criteria	✓	✓	✓	✓
7. Certified calibration reports of measuring and testing equipment (required for tests completed after April 30, 2022)	✓	✓	✓	✓

3. Tested materials description and properties including component drawings.

4. Documentation that test specimens conform to dimensional tolerances.

5. Documentation of detailed test procedures.

6. Confirmation that test specimen successfully completed testing and passed the acceptance criteria.

7. Certified calibration reports of measuring and testing equipment (required for tests completed after April 30, 2022).

1.3 Quality Assurance and Quality Control

Quality Assurance and Quality Control shall meet the requirements of PTI/ASBI M50.3-19, Section 6.0.

The PTS suppliers shall have a QA program and a qualified person of authority who is responsible for implementing and enforcing this QA program.

Procurement documents shall clearly and completely describe the materials and components being ordered, specify all QA/QC activities to be implemented, and all records to be delivered.

Procurement documents shall be checked and approved by the PTS supplier's purchasing authority for consistency with the governing design and project requirements, including QA/QC activities.

Secondary suppliers shall be qualified per PTS supplier's QA program.

Questions	**PL1a**	**PL1b**	**PL2**	**PL3**
1.3 Quality Assurance and Quality Control (a) Does the PTS have a written QA program? Y/N	✓	✓	✓	✓
(b) Has the PTS identified a qualified person who is responsible for implementing and enforcing the QA program? Y/N	✓	✓	✓	✓
c) Do procurement documents clearly and completely describe the materials and components being ordered, specify all QA/QC activities to be implemented, and all records to be delivered? Y/N	✓	✓	✓	✓
d) Have procurement documents been checked and approved by the PTS supplier's purchasing authority for consistency with the governing design and project requirements, including QA/QC activities? Y/N	✓	✓	✓	✓
(e) Do secondary suppliers meet criteria as required? Y/N	✓	✓	✓	✓
(f) Do secondary suppliers demonstrate competence as required? Y/N	✓	✓	✓	✓
(g) Do secondary suppliers have a quality control system in-place? Y/N	✓	✓	✓	✓
(h) Do secondary suppliers provide a signed "Certificate of Compliance" that goods meet requirements of procurement documents? Y/N	✓	✓	✓	✓
(i) Have audits been performed per PTS QA Program and contract specifications? Y/N	✓	✓	✓	✓
(j) Has testing of secondary supplier's material and components been performed per PTS QA Program and contract specifications? Y/N	✓	✓	✓	✓
(k) Does the project quality plan include: • Performance requirements;	✓	✓	✓	✓

PTS supplier shall perform source, plant, and factory inspections and audits of secondary suppliers as required by the contract specifications and its own QA program. *PTS supplier shall require testing of secondary supplier's material and components as required.* *A project quality plan shall be developed by the PTS supplier which will ensure the installed PTS meets all contract requirements.* The PTS supplier shall be responsible for receiving material or providing receiving instructions to the project site. *The PTS supplier's QA program shall contain procedures for receiving materials.* All material *shall be fully traceable to production and installation records*.	• Specific standards, practices, processes, procedures and instructions; • Testing, inspection, examination, and audit programs for PTS components and processes; • Allocation of personnel responsibilities and authority; • Procedure for changes and modifications of PTS components and processes; • Methods for measuring achievement of performance objectives; and • Other actions necessary to meet the performance requirements? Y/N				
	(l) Does the PTS supplier's QA program include: • Reviewing certified material test reports and certificates of conformance for compliance with the procurement documents; • Checking for identification with heat and batch numbers, lot codes, and so on to ensure full traceability; • Checking for specified material grades; • Checking for unauthorized substitutions of materials (size or grade); • Dimensional and angle checks; • Acceptable ranges; and • Nonconformance: documentation, control, and disposition? Y/N	✓	✓	✓	✓
	(m) Are records of all traceability numbers and documentation maintained by the PTS for	✓	✓	✓	✓

stored material? Y/N				
(n) Are records of all traceability numbers and documentation maintained by the PTS for materials supplied to projects? Y/N	✓	✓	✓	✓
(o) Are records of all traceability numbers and documentation maintained by the Contractor of stored and installed PTS materials to specific tendon numbers? Y/N	✓	✓	✓	✓
(p) Are traceability documentation and records formally transferred to the Owner? Y/N	✓	✓	✓	✓

2. ANCHORAGES

2.1 Bearing Plates

Post-tension system anchorages shall meet the requirements of PTI/ASBI M50.3-19 Sections 3.3, 3.4, 4.3.2 and 4.4.1.

Bearing plate materials and testing must be in accordance with the ASTM and PTS Specifications.

2.1.1 Identification and traceability of materials

Stored and installed bearing plates *shall be fully traceable to production lots and installation records. The PTS supplier shall maintain a complete list of all traceability numbers and documentation for materials supplied to the project. Records kept by the Contractor shall maintain traceability of stored and installed* bearing plates *to specific tendon numbers. Traceability documentation and records shall be formally transferred to the Owner.*

Questions	**PL-1a**	**PL-1b**	**PL-2**	**PL-3**
2.1.1 Identification and traceability of materials				
(a) Confirm traceability is maintained for bearing plates; Y/N	✓	✓	✓	✓
(b) Confirm positive identification and traceability markings on bearing plates	✓	✓	✓	✓
2.1.2.1 Basic Bearing Plates: Have the anchorage device and corresponding local zone been designed in accordance with the required AASHTO specification?	✓	✓	✓	✓
At a minimum, the following items shall be verified: (a) Do material properties and dimensions shown on system drawings comply with material properties and dimensions used in design calculations?	✓	✓	✓	✓
2.1.2.2 Special Bearing Plate 2.1.2.2.1: (a) Was the volumetric ratio of steel skin reinforcement to concrete < 1%?	✓	✓	✓	✓

Positive identification and traceability marking on bearing plates *shall be as follows:*

Each bearing plate shall have an identifying number or code punched into, cast in, or recorded on an attached, weatherproof tag.

2.1.2 Local Zone

2.1.2.1 Basic Bearing Plates

Local zones and related anchorage devices shall be designed in accordance with the AASTHO LRFD Bridge Design Specification, fourth or fifth edition, Section 5.10.9.7, Design of Local Zones (AASHTO LRFD 2007, 2010).

2.1.2.2 Special Bearing Plates

The following tests must be verified by reviewing test reports which have been certified by a certified independent lab:

2.1.2.2.1 Test and provide written certification that anchorages meet the testing requirements in the AASHTO LRFD Bridge Construction Specifications, Section 10, "Prestressing": Special Anchorage Device Acceptance Test (Section 10.3.2.3). Test the anchorage in three (3) test blocks according to one of the three procedures described in AASHTO (that is, cyclic loading, sustained loading, or monotonic loading). Anchorages in the specimen do not need to be coated for any PLs.

(b) Do block dimensions meet requirements and correlate to specified edge distance and anchorage spacing?	✓	✓	✓	✓
(c) Were all three (3) test blocks using the same details?	✓	✓	✓	✓
(d) Is the specified minimum concrete strength at time of stressing greater than the concrete strength of the test specimen at the time of testing?	✓	✓	✓	✓
(e) Is the confinement reinforcement indicated on the system approval drawings equivalent to the confinement reinforcement used in the tests?	✓	✓	✓	✓
(f) Did the loading sequence comply with the selected test procedure (cyclic loading, sustained loading, or monotonic loading)?	✓	✓	✓	✓
(g) Were crack widths measured in compliance with the selected test procedure (cyclic loading, sustained loading, or monotonic loading)?	✓	✓	✓	✓
(h) Did the crack widths meet the criteria for moderately aggressive environments?	✓	✓	✓	✓
(i) For use in higher aggressivity environments, did the crack widths meet the criteria for higher aggressivity environments?				
(j) Did all three (3) test blocks meet the requirements?	✓	✓	✓	✓
(k) Were equipment calibrations included and current at time of test?	✓	✓	✓	✓
(l) Was test witnessed and certified by a certified independent lab?	✓	✓	✓	✓
2.1.2.3 PT bars: Does the angular alignment in system drawings between PT bar and bearing plate meet the allowable tolerance?	✓	✓	✓	✓
2.1.3 Inspectability: (a) Do drawings indicate inlets/outlets on top or in front suitable for inspection?		✓	✓	✓

2.1.2.3 PT Bars

Maximum allowable angular misalignment of bars with respect to the bearing plate—For spherical bearing plate/nut applications, ±2 degrees for all live-end anchor nuts and ±3 degrees for all fixed-end anchor nuts; for non-spherical bearing plate applications, ±1 degree at live- and fixed-end anchor nuts. A system drawing shall be provided for verification.

2.1.3 Inspectability

For PL-2 and PL-3, bearing plates are inspectable per PTI/ASBI M50.3-19, Section 4.3.2. Drawings shall be reviewed for compliance.

2.1.4 Coating

For PL-2 and PL-3, embedded parts of the anchorage shall be galvanized or epoxy coated per PTI/ASBI M50.3-19, Sections 3.3 and 3.4. Drawings shall be reviewed for compliance.

(b) Does the geometry of the inlets/outlets permit drilling using a 3/8 in. diameter straight bit?		✓	✓	✓
2.1.4 Coating Do drawings indicate imbedded parts of the anchorage being galvanized or epoxy coated?			✓	✓

2.2 Wedge Plates

Wedge plates and wedges shall meet the requirements of PTI's "Acceptance Standards for Post-Tensioning Systems," Section 4.1. Provide self-centering wedge plates to facilitate alignment with the bearing plate. This must be verified by reviewing test reports certified by a certified independent lab.

2.2.1 Test and provide test reports that anchorages develop at least 95% of AUTS of the prestressing steel, when tested in unbonded state, without exceeding anticipated set

2.2.2 Identification and traceability of materials

Stored and installed wedge plates *shall be fully traceable to production lots and installation records. The PTS supplier shall maintain a complete list of all traceability numbers and documentation for materials supplied to the project. Records kept by the Contractor shall maintain traceability of stored and installed* wedge plates *to specific tendon numbers. Traceability documentation and records shall be formally transferred to the Owner.*

Positive identification and traceability marking on wedge plates *shall be as follows:*

Each wedge plate shall have an identifying number or code punched into, cast in, or recorded on an attached, weatherproof tag.

2.3 Trumpets

2.3.1 Trumpets associated with anchorages shall be made of either ferrous metal or plastic.

2.3.1.1 Plastic Trumpets

Questions	PL-1a	PL-1b	PL-2	PL-3
2.2 Wedge Plates 2.2.1 Do wedge plates and wedges meet the requirements of PTI's "Acceptance Standards for Post-Tensioning Systems"?	✓	✓	✓	✓
At a minimum, the following items shall be verified: For system efficiency test - (a) Did the anchorage specimen achieve 95% AUTS of the prestressing steel?	✓	✓	✓	✓
(b) Was the force applied by pulling on the strand tendon?	✓	✓	✓	✓
(c) Were standard system wedges used?	✓	✓	✓	✓
(d) Was test witnessed and certified by a certified independent lab?	✓	✓	✓	✓
For wedge plate test – (a) Did the specimen achieve 120% MUTS prior to failure?	✓	✓	✓	✓
(b) Was test witnessed and certified by a certified independent lab?	✓	✓	✓	✓
Do wedge plates include provisions to ensure self-centering in bearing plate?	✓	✓	✓	✓
2.2.2 Identification and traceability of materials				
(a) Confirm traceability is maintained for wedge plates; Y/N	✓	✓	✓	✓
(b) Confirm positive identification and traceability markings on wedge plates; Y/N	✓	✓	✓	✓
2.3 Trumpets 2.3.1 Is the trumpet material called out on the drawing one of the following materials? • Ferrous metal • High density polypropylene (HDPE)	✓	✓	✓	✓

For plastic trumpets, the trumpet shall be made of high-density polyethylene or polypropylene. The thickness of the trumpet at the duct end shall not be less than the thickness of the duct. Drawing and material certificates shall be provided for verification.

2.3.1.2 Ferrous Metal Trumpets

For ferrous metal trumpets, the material and dimensions shall be specified. The thickness shall not be less than 16 gauge.

2.3.2 For PL-2 and PL-3, connections from the trumpet to the duct and the trumpet to the bearing plate shall meet requirements of PTI/ASBI M50.3-19, Sections 4.4.5.3 and 4.4.5.4. This must be verified by reviewing test reports certified by a certified independent lab.

2.3.3 Identification and traceability of materials

Stored and installed trumpet *shall be fully traceable to production lots and installation records. The PTS supplier shall maintain a complete list of all traceability numbers and documentation for materials supplied to the project. Records kept by the Contractor shall maintain traceability of stored and installed* trumpets *to specific tendon numbers. Traceability documentation and records shall be formally transferred to the Owner.*

Positive identification and traceability marking on trumpets *shall be as follows:*

Each trumpet shall have an identifying number or code punched into, cast in, or recorded on an attached, weatherproof tag.

• Polypropylene (PP)				
(a) Are drawings provided?	✓	✓	✓	✓
(b) Are material certificates provided?	✓	✓	✓	✓
(c) Is the minimum thickness provided?	✓	✓	✓	✓
(d) Does the trumpet to duct and bearing plate to trumpet connections meet requirement of PTI/ASBI M50.3-19, Sections 4.4.5.3 and 4.4.5.4?	✓	✓	✓	✓
(e) Is the leak tightness certified by a certified independent lab per PTI/ASBI M50.3-19?			✓	✓
2.3.3 Identification and traceability of materials				
(a) Confirm traceability is maintained for trumpets; Y/N	✓	✓	✓	✓
(b) Confirm positive identification and traceability markings on trumpets; Y/N	✓	✓	✓	✓

2.4 PT Bar Couplers

High-strength bar couplers shall meet the requirements of ASTM A722 and shall develop 100% of the specified tensile strength (f_{pu}) of the bar when tested in an unbonded state. Test and provide written certification that the couplers meet these requirements. Couplers and components shall be enclosed in enclosure long enough to permit the necessary movements. Tendon enclosure shall be designed so that complete grouting of all the coupler components is achievable.

Questions	PL-1a	PL-1b	PL-2	PL-3
PT Bar Couplers				
(a) Does the PT Bar Coupler meet 100% of the minimum ultimate tensile strength of the PT bar?	✓	✓	✓	✓
(b) Is written certification provided of the MUTS of the PT bar?	✓	✓	✓	✓
(c) Do material properties and dimensions shown on system drawings comply with material properties and dimensions used in testing?	✓	✓	✓	✓
(d) Is the tendon enclosure designed so that complete grouting of all of the coupler components is achievable?	✓	✓	✓	✓

2.5 Grout Caps

2.5.1 Temporary Grout Caps

Temporary grout caps shall be tested to a minimum pressure of 75 psi.

Test report shall be provided by the supplier and shall clearly demonstrate that the full system (cap, bolts, O-ring/gasket, bearing plate/anchorage) meet the 75 psi pressure requirement.

2.5.2 Permanent Grout Caps

Permanent grout caps shall meet the requirements of PTI/ASBI M50.3-19 Section 4.3.3.

Permanent grout caps shall be non-metallic, stainless steel (type 316) or galvanized ferrous metal with a minimum thickness of zinc in accordance with ASTM A123. Resin for use in the polymer are nylon, acrylonitrile butadiene styrene, or polyester. Cell class of Nylon according to ASTM D5989 shall be S-PA0141, S-PA0231, or S-PA0401.

Questions	PL-1a	PL-1b	PL-2	PL-3
2.5.1 Temporary Grout Caps (a) Are temporary grout caps tested to a minimum pressure of 75 psi?	✓			
2.5.2 Permanent Grout Caps (a) Is the permanent grout cap material called out on the drawing one of the following materials? • Non-metallic (ASTN D5989 S-PA0141, S-PA0231 or S-PA0401 Nylon; ABS; or Polyester) • Stainless steel type 316 • Galvanized ferrous metal with a minimum thickness of zinc in accordance with ASTM A123		✓	✓	✓
(b) Is the certified test report and chemical analysis for metallic caps and certificate of conformance for non-metallic caps in accordance with the drawing?		✓	✓	✓
(c) Does the cap fully enclose the wedge plate?		✓	✓	✓
(d) Is an O-ring or gasket used to seal the connection between grout cap and bearing plate?		✓	✓	✓

Drawing and material certificate as well as corrosion protection certificate if galvanized ferrous metal, shall be provided for verification of the requirements. Material certificate shall document the chemical analysis of the steel, and conformance of Nylon with the PTI requirements.

The grout cap shall fully enclose the wedge plate. *Use ASTM F593 Type 316 stainless steel bolts to attach the cap to the anchorage.*

Assembly drawing shall be provided for verification to confirm the use of ASTM F593 bolts for stainless steel and non-metallic caps, ASTM A153 galvanized bolts for galvanized steel and non-metallic caps and an O-ring or gasket for all cap types.

Assembly drawing shall specify the grout caps are bolted to the anchorage.

Grout vent must be on the top of the cap. Drawing and assembly drawing shall be provided for verification of the grout vent location on the part and on the system after assembly.

Permanent grout caps shall be certified to a minimum pressure of 150 psi by the PTS supplier.

Test report shall be provided by the supplier and shall clearly demonstrate that the full system (cap, bolts, O-ring/gasket, bearing plate) meet the 150 psi pressure requirement. The report shall be documented with pictures and detailed procedure.

(e) Is the bolt material(s) specified on the drawing in accordance with PTI's requirements?		✓	✓	✓
(f) Is the bolt material certificate in accordance with the drawing?		✓	✓	✓
(g) Is the grout cap bolted to the anchorage?		✓	✓	✓
(h) Is a grout vent located on the top of cap after assembly?		✓	✓	✓
(i) Are permanent grout caps tested to a minimum pressure of 150 psi?	✓	✓	✓	✓

3. DUCTS AND PIPES

3.1 General Duct Requirements

Requirement
(a) A written quality control program shall be maintained by the duct manufacturer.
(b) Procurement documents for duct shall clearly and completely describe the duct being ordered, specify all QA/QC activities to be implemented, and all records to be delivered (such as material certificates, certificate of compliance, certificate of analysis, etc.).
(c) Duct for multi-strand tendons shall have a *minimum cross-sectional area two-and-a-half times the cross-sectional area of the prestressing steel based on the inside diameter of the duct*. Duct for prestressing bars shall have a *minimum inside diameter of at least 1/2 in. larger than the outside diameter of the bar, measured across the deformations*. Duct for prestressing bars with couplers shall be at least *1/2 in. larger than the outside diameter of the bar and/or coupler*.
If the Quality Plan requires items (d), (e), and (f) below, they shall be complied with. (d) All duct shall be shipped and stored in bundles held together with lightweight framing.
(e) For all duct *caps are required at each end of duct during shipping and storage*.
(f) All duct shall be covered during shipment to prevent contamination (road salts, etc.).

Questions	**PL-1a**	**PL-1b**	**PL-2**	**PL-3**
(a) Is there a written quality control program for duct? Y/N	✓	✓	✓	✓
(b) Do procurement documents clearly and completely describe the duct being ordered, specify all QA/QC activities to be implemented, and all records to be delivered (such as material certificates, certificate of compliance, certificate of analysis, etc.)? Y/N	✓	✓	✓	✓
(c) Does the minimum internal diameter of the duct for the tendon meet one of the following criteria? Y/N • Multi-strand – 2.5 times the cross-sectional area of the prestressing steel. • Prestressing Bars – 1/2 in. larger than the outside diameter of bar across deformations. • Prestressing Bar with Coupler – 1/2 in. larger than the outside diameter of bar and /or coupler.	✓	✓	✓	✓
Does the Quality Plan require that the duct is: (d) shipped and stored in bundles held together with lightweight framing? Y/N	✓	✓	✓	✓
Does the Quality Plan require that the duct is: (e) capped at both ends during shipping and storage? Y/N	✓	✓	✓	✓
(f) covered during shipping to prevent contamination (road salts, etc.)? Y/N	✓	✓	✓	✓

3.2 Corrugated Galvanized Duct

Galvanized ducts shall meet the requirements of PTI/ASBI M50.3-19, Sections 4.3.5, 4.3.5.1, 4.3.6, 4.4.3, and 8.4.

A sample part of each duct and connection to be utilized shall be provided to the auditor for review. Test reports or previous project documented experience shall be provided for review to establish that:

1) Duct and duct connections installed and cast into concrete are capable of withstanding 10 ft of concrete fluid pressure when strand is installed after concrete placement and 5 ft of concrete fluid pressure when strand is installed before concrete placement, respectively.

2) The duct has longitudinal bending stiffness for smooth placement.

Semi-rigid ducts shall be corrugated and their minimum wall thickness shall be as follows: 26 gauge for ducts less than or equal to 2.625" diameter, 24 gauge for ducts greater than 2.625" diameter.

Ducts shall be connected to anchorages with devices or methods producing a smooth interior alignment with no lips or kinks: this must be proven with drawings and samples.

Questions	**PL-1a**	**PL-1b**	**PL-2**	**PL-3**
3.2 Galvanized Duct (a) Are samples of duct and connectors available for review? Y/N	✓	✓		
(b) Do samples of duct and connectors match the drawings? Y/N	✓	✓		
(c) Are reports available showing duct and connections concrete fluid pressure resistance or documented project experience?	✓	✓		
(d) Are reports available showing adequate longitudinal bending stiffness or documented project experience?	✓	✓		
(e) Is the material called out on the drawing Galvanized sheet steel as per ASTM A653/653M, coating designation G90?	✓	✓		
(f) Are ducts fabricated with either welded or interlocked seams?	✓	✓		
(g) In case of welded seams, are they galvanized?	✓	✓		
(h) Are wall thicknesses equal or greater than 26 gauge for ducts less than or equal to 2.625" diameter, 24 gauge for ducts greater than 2.625" diameter?	✓	✓		
(i) Are ducts connected to anchorages with devices or methods producing smooth alignment with no lips or kinks?	✓	✓		
(j) Does the sample available match the drawing?	✓	✓		

3.3 Corrugated Plastic Duct

Corrugated plastic duct shall meet the requirements of PTI/ASBI M50.3-19, Sections 4.3.5, 4.3.5.2, 4.3.6, 4.3.7, 4.4.3, 4.4.4, 4.4.5.1 and 8.5.

Requirement
A sample part of each duct and connection to be utilized shall be available to the auditor for review.
Corrugated plastic duct shall be manufactured using seamless extrusion fabrication methods.
Corrugated plastic duct manufactured from polypropylene shall be *virgin, unfilled, non-colored polypropylene meeting the requirements of ASTM D4101 with a cell classification range of PP0340B44541 to PP0340B67884* and for cold weather construction (-22 to 32^{o}F) *with a cell classification range of PP0340B44531 to PP0340B67884*. Corrugated plastic duct manufactured from polyethylene shall be *fabricated from resins meeting or exceeding the requirements of ASTM D3350 with a cell classification range of PE344434D to PE445574D* (there is no difference based upon temperature for polyethylene). Cell classification test reports shall be on file for the corrugated plastic duct from an independent lab demonstrating that the initial vendor batch was tested and then tested at least annually to confirm continued compliance.

Questions	**PL-1a**	**PL-1b**	**PL-2**	**PL-3**
3.3 Corrugated Plastic Duct (a) Are samples of duct and connectors available for review? Y/N	✓	✓	✓	✓
(b) Do samples of duct and connectors match the drawings? Y/N	✓	✓	✓	✓
(c) Are drawings and compliance certificates on file confirming that seamless fabrication methods are used to manufacture corrugated plastic duct? Y/N	✓	✓	✓	✓
(d) Are compliance certificates on file confirming that corrugated plastic duct is manufactured from virgin, unfilled, non-colored resins? Y/N	✓	✓	✓	✓
(e) Are cell classification test reports on file from an independent lab demonstrating the initial vendor batch was tested and then tested once annually, to confirm the following based on material type and temperature? Y/N • Polypropylene meeting the requirements of ASTM D4101 with a cell classification range of PP0340B44541 to PP0340B67884. • Polypropylene for cold weather construction (-22 to 32^{o}F) with a cell	✓	✓	✓	✓

	classification range of PP0340B44531 to PP0340B67884. • Polyethylene meeting or exceeding the requirements of ASTM D3350 with a cell classification range of PE344434D to PE445574D.				
PTS supplier shall submit to project owner material certifications for each batch of material used on the project for the corrugated plastic duct.	(f) Are material certifications on file for each batch of material used on the project for the corrugated plastic duct? Y/N	✓	✓	✓	✓
Material tracking shall be maintained to track batch numbers to the duct manufactured.	(g) Are corrugated plastic duct lot numbers maintained to track batch tests to ducts produced? Y/N	✓	✓	✓	✓
Corrugated plastic duct shall contain antioxidant(s) with a minimum oxidation induction time (OIT) according to ASTM D3895 of 20 minutes and containing a non-yellowing light stabilizer. Environmental stress cracking of the corrugated plastic duct shall be in accordance with ASTM F2136 at 348 psi for 3 hours.	(h) Are compliance certificates on file that the antioxidants contain a non-yellowing light stabilizer? Y/N	✓	✓	✓	✓
	(i) Are reports on file demonstrating that the corrugated plastic duct achieves a minimum oxidation induction time (OIT) according to ASTM D3895 of 20 minutes? Y/N	✓	✓	✓	✓
The minimum wall thickness of corrugated plastic duct shall be in accordance with Table 4.1 of PTI/ASBI M50.3-19.	(j) Are reports on file from an independent lab demonstrating that the corrugated plastic duct complies with the ESCR requirement of 3 hours at 348 psi in accordance with ASTM F2136? Y/N	✓	✓	✓	✓
	(k) Are drawings and inspection reports on file demonstrating that the corrugated plastic duct complies with the minimum thickness requirements of Table 4.1 – Minimum wall thickness of corrugated plastic duct of PTI/ASBI M50.3-19? Y/N	✓	✓	✓	✓
Splices, joints, couplings, and connections to corrugated plastic duct and anchorages shall be made *with devices or methods (mechanical couplers, plastic sleeves, heat-shrink sleeve) producing a smooth interior alignment with no lips or kinks*.	(l) Are drawings on file confirming that splices, joints, couplings, and connections to corrugated plastic duct and anchorages are made with devices or methods (mechanical	✓	✓	✓	✓

	couplers, plastic sleeves, heat-shrink sleeve) producing a smooth interior alignment with no lips or kinks? Y/N				
Heat-shrink sleeves shall comply with the requirements of Section 4.3.7 of PTI/ASBI M50.3-19. Heat-shrink sleeves shall be installed *using procedures and methods in accordance with the manufacturer's recommendations*.	(m) Are compliance certificates on file confirming that heat-shrink sleeves shall comply with the requirements of Section 4.3.7 of PTI/ASBI M50.3-19? Y/N	✓	✓	✓	✓
	(n) Are manufacturer's instructions on file for the method of installing heat-shrink sleeves? Y/N	✓	✓	✓	✓
The design of connections and fittings are to be concrete-paste tight. *All connections and fittings for PL-2 and PL-3 shall be airtight and watertight. Tape-sealed connections are permitted in PL-1 only but shall meet the sealing requirements for fluid pressure.*	(o) Are reports on file from an independent lab demonstrating that the corrugated plastic duct and connections are airtight and watertight? Y/N			✓	✓
	(p) Are drawings on file demonstrating the connection and fitting details for corrugated plastic duct? Y/N	✓	✓	✓	✓
Duct and duct connections installed and cast into concrete prior to prestressing steel installation shall be capable of withstanding 10 ft of concrete fluid pressure. Duct and duct connections for use with straight preinstalled prestressing steel, installed prior to concreting, shall be capable of withstanding 5 ft of concrete fluid pressure.	(q) Are reports on file from an independent lab demonstrating that the corrugated plastic duct and connections are concrete-paste tight and are capable of withstanding the following concrete fluid pressures for the installation technique? Y/N • 10 ft. when strand installed after concrete placement. • 5 ft. when strand installed prior to concrete placement.	✓	✓	✓	✓
The duct shall have adequate longitudinal bending stiffness for smooth placement. To establish this, test reports or previous project documented experience shall be provided for review.	(r) Are reports on file from an independent lab or documented experience from previous projects to indicate support spacing for corrugated plastic duct so that there is adequate longitudinal bending stiffness for smooth placement? Y/N	✓	✓	✓	✓

The corrugated plastic duct system, components, and accessories shall meet the requirements of fib Bulletin 7, Chapter 4, Sections 4.1.1 through 4.1.8 as modified by Section 4.4.4 of PTI/ASBI M50.3-19.	(s) Are reports on file from an independent lab demonstrating that the corrugated plastic duct and connections comply with the requirements of *fib* Bulletin 7, Section 4.1, "Definition of Components"? Y/N	✓	✓	✓	✓
	(t) Are reports on file from an independent lab demonstrating that the corrugated plastic duct complies with the requirements of *fib* Bulletin 7, Section 4.2, "Flexural Behaviour of Duct"? Y/N	✓	✓	✓	✓
	(u) Are reports on file from an independent lab demonstrating that the corrugated plastic duct and connections comply with the requirements of *fib* Bulletin 7, Section 4.3, "Flexibility of Duct"? Y/N	✓	✓	✓	✓
	(v) Are reports on file from an independent lab demonstrating that the corrugated plastic duct and connections comply with the requirements of *fib* Bulletin 7, Section 4.4, "Lateral Load Resistance of Duct" as modified by Section 4.4.4 of PTI/ASBI M50.3-19? Y/N	✓	✓	✓	✓
	(w) Are reports on file from an independent lab demonstrating that the corrugated plastic duct and connections comply with the requirements of *fib* Bulletin 7, Section 4.5, "Longitudinal Load Resistance of Duct System"? Y/N	✓	✓	✓	✓
	(x) Are reports on file from an independent lab demonstrating that the corrugated plastic duct and connections comply with the requirements of *fib* Bulletin 7, Section 4.6, "Leak Tightness of Duct System"? Y/N			✓	✓
	(y) Are reports on file from an independent lab demonstrating that the corrugated plastic	✓	✓	✓	✓

	duct complies with the requirements of *fib* Bulletin 7, Section 4.7, "Wear Resistance of Duct" as modified by Section 4.4.4 of PTI/ASBI M50.3-19? Y/N				
	(z) Are reports on file from an independent lab demonstrating that the corrugated plastic duct complies with the requirements for "Modified Wear Resistance of Duct" as defined by Section 4.4.4 of PTI/ASBI M50.3-19? Y/N	✓	✓	✓	✓
	(aa) Are reports on file from an independent lab demonstrating that the corrugated plastic duct complies with the requirements of *fib* Bulletin 7, Section 4.8, "Bond Behaviour of Tendon" as modified by Section 4.4.4 of PTI/ASBI M50.3-19? Y/N	✓	✓	✓	✓
When material properties change or geometry of the duct changes the performance testing in *fib* Bulletin 7, Chapter 4, Sections 4.1.1 through 4.1.7 as modified by PTI/ASBI M50.3-19 must be repeated.	(bb) Have the material properties or geometry of the corrugated plastic duct changed? Y/N	✓	✓	✓	✓
	(cc) If so, has retesting per *fib* Bulletin 7, Chapter 4, Sections 4.1.1 through 4.1.7 as modified by Section 4.4.4 of PTI/ASBI M50.3-19 been performed? Y/N	✓	✓	✓	✓
When the tensile strength of the corrugated plastic duct material has been reduced by more than 10% from the previous test or the geometry of the duct changes, the "Bond Behaviour of Tendons" performance test must be repeated.	(dd) Has the tensile strength of the corrugated plastic duct material been reduced by more than 10% from the previous "Bond Behaviour of Tendons" performance test or the geometry of the duct changed? Y/N	✓	✓	✓	✓
	(ee) If so, has retesting per *fib* Bulletin 7, Chapter 4, Sections 4.1.8 as modified by Section 4.4.4 of PTI/ASBI M50.3-19 been performed? Y/N	✓	✓	✓	✓

When fib Bulletin 75 is used for testing, testing shall conform to fib Bulletin 75, Sections 6.1 through 6.10.	When *fib* Bulletin 75 is used for testing, are satisfactory test results from *fib* Bulletin 75, Appendices A1-A10 available?	✓	✓	✓	✓

3.4 External Duct

External duct shall meet the requirements of PTI/ASBI M50.3-19, Sections 4.3.5, 4.3.5.3, 4.3.9 and 8.5.

Requirements	**Questions**	**PL-1a**	**PL-1b**	**PL-2**	**PL-3**
Cell classification test reports shall be on file for the smooth HDPE duct from an independent lab demonstrating that smooth HDPE duct is *manufactured from 100% virgin polyethylene resin meeting the requirements of ASTM D3350 with a minimum cell class of PE345464C*.	3.4 External Duct (a) Are compliance certificates on file confirming that the polyethylene resin is 100% virgin material? Y/N	✓	✓	✓	✓
	(b) Are cell classification test reports on file from an independent lab confirming that the polyethylene resin meets the requirements of ASTM D3350 with a minimum cell classification of *PE345464C*? Y/N	✓	✓	✓	✓
Smooth HDPE duct shall be manufactured from duct containing antioxidant(s). Samples from finished smooth HDPE duct shall be tested to confirm that a minimum OIT according to ASTM D3895 of 40 minutes is achieved.	(c) Are reports on file from an independent lab confirming that the smooth HDPE duct achieves a minimum oxidation induction time (OIT) according to ASTM D3895 of 40 minutes? Y/N	✓	✓	✓	✓
Environmental stress cracking of the corrugated plastic duct shall be in accordance with ASTM F2136 at 348 psi for 3 hours.	(d) Are reports on file from an independent lab demonstrating that the corrugated plastic duct complies with the ESCR requirement of 3 hours at 348 psi in accordance with ASTM F2136? Y/N	✓	✓	✓	✓
Smooth HDPE duct shall have a wall thickness *dimension ratio (DR) of 17.0 or less as specified by ASTM D5309 or ASTM F714, using appropriate dimensions and tolerances*.	(e) Are inspection reports and drawings on file demonstrating that the manufactured smooth HDPE duct has a wall thickness dimension ratio (DR) of 17.0 or less as specified by ASTM D5309 or ASTM F714, using appropriate dimensions and tolerances? Y/N	✓	✓	✓	✓

	(f) Are reports on file from an independent lab demonstrating that the manufactured smooth HDPE can achieve the minimum pressure rating (working pressure) of 100 psi and is manufactured to either ASTM D3035 or ASTM F714? Y/N	✓	✓	✓	✓
Smooth HDPE duct shall meet a *minimum pressure rating (working pressure) of 100 psi and manufactured to either of the following specifications: ASTM D3035 or ASTM F714.*	(g) Are compliance certificates on file confirming that the smooth HDPE duct is manufactured to either ASTM D3035 or ASTM F714? Y/N	✓	✓	✓	✓
Splices between sections of smooth HDPE duct are made using heat-welding techniques, electro-fusion couplers, or other mechanical couplers that meet the requirements of PTI/ASBI M50.3-19. All connections shall *have a minimum pressure rating (working pressure) of 100 psi* and produce *a connection with no lips or kinks*.	(h) Are drawings and manufacturer's instructions on file for the method of splicing smooth HDPE duct? Y/N	✓	✓	✓	✓
	(i) Are reports on file from an independent lab confirming the connection techniques between smooth HDPE duct sections can achieve a minimum pressure rating (working pressure) of 100 psi? Y/N	✓	✓	✓	✓
	(j) Are drawings or other method on file showing that the connection creates no lips or kinks? Y/N	✓	✓	✓	✓
Connections between steel pipe and smooth HDPE duct are made *with an ethylene propylene diene monomer (EPDM) coupler with a minimum wall thickness of 3/8 in. or other mechanical coupler, having a minimum working pressure rating of 100 psi*. The connection is sealed with *a 3/8 in. wide power seated band clamp made of 316 stainless steel to seal each end of the coupler against grout leakage*.	(k) Are drawings or other method on file for the method of connecting steel pipe and smooth HDPE duct? Y/N	✓	✓	✓	✓
	(l) Are reports on file from an independent lab confirming the connection techniques between steel pipe and smooth HDPE duct can achieve a minimum pressure rating (working pressure) of 100 psi? Y/N	✓	✓	✓	✓

3.5 Rigid Duct / Steel Pipes

Rigid duct / steel pipes shall meet the requirements of PTI/ASBI M50.3-19, Sections 4.3.10 and 4.3.11. Rigid ducts / steel pipe may be used to couple to galvanized metal duct, corrugated plastic duct or smooth plastic duct. The use of rigid duct or steel pipe would generally be used where the use of typical ducts is either impractical due to tight bend radii or would not provide the wear through performance. These may be used in deviation blocks or slabs for horizontal tendons, in deviators or piers for external tendons or as loops.

Rigid ducts shall be capable of being curved to the proper configuration without crimping or flattening. To establish this, test reports, samples, or previous project documented experience showing a given minimum bend radius is achievable, shall be provided for review. If the material is called out as corrugated plastic duct, it must be shown through testing to meet the requirements for the plastic duct bend radius as specified in PTI/ASBI M50.3-19, Section 4.4.

A drawing shall be provided which illustrates the connection or connections to the appropriate systems. For example, rigid ASTM A53B pipe connected to metal duct. This drawing shall call out the materials, illustrate a sample bend and show the connection tolerance of the ID's of the connection. Multiple connections may be illustrated on the same sheet. The minimum radius of the system shall be stated on the drawing and shown through testing, samples or demonstrated through past project experience as indicated above.

If the tolerance is greater than what is required by specification, reducers must be employed as identified in the specification. Verify the tolerance by reviewing the measurements shown on the drawing. Also confirm all dimensions of the components are accurate. Confirmation of the components shall be verified through use of data sheets or drawings of the relevant components or measurement of

Questions	PL-1a	PL-1b	PL-2	PL-3
3.5 Rigid Pipes (a) Is the minimum bend radius called out on the drawing?	✓	✓	✓	✓
(b) For Steel Pipe: Has the bend radius been confirmed through samples with relevant test reports?	✓	✓	✓	✓
(c) For Duct: Validated through performance of the duct tests in Section 4.4 for the given minimum radius identified on the drawings?	✓	✓	✓	✓
(d) Is the material called out on the drawing as one of the following materials? • Galvanized ASTM A53 Grade B, Schedule 40 steel pipe • Galvanized ASTM A500 structural steel tubing • Corrugated Plastic Duct	✓	✓	✓	✓
(e) Has the tolerance between the ID of the steel pipe (or duct) been shown to not vary by more than +/- 1/16" as compared to the duct or pipe it is connecting, or if it is greater, has an appropriate reducer been shown at this location?	✓	✓	✓	✓
(f) Do the sample components match the drawing?	✓	✓	✓	✓

sample parts. Components such as HDPE smooth duct and galvanized pipe are produced in readily available standard sizes and data sheets for these should suffice. A sample part of each connection to be utilized shall be provided to the auditor for review of the fitup of the connections.

3.6 Inlets, Outlets and Plugs

Inlets, outlets, valves and plugs shall meet the requirements of PTI/ASBI M50.3-19, Sections 4.3.2, 4.3.12 and 9.9.

Materials of the inlets, outlets, valves and plugs typically used in the industry are made of nylon, polyolefin or stainless steel.

All inlets and outlets shall be equipped with pressure-rated mechanical shutoff valves or plugs. Inlets, outlets, valves, and plugs shall be designed and tested to resist a minimum pressure of 150 psi. To comply with this requirement, test reports from an independent lab confirming compliance shall be provided for review.

Inlets shall be used for injecting the grout into the duct; outlets shall allow the escape of air, water, grout, and bleed water*. Provide inlets and outlets having a minimum inside diameter of 3/4" for strand and 3/8" for individual bar tendon and four-strand tendons.*

It must be clearly designated on the PT installation drawings those outlets, inlets, valves and plugs that are temporary and not part of the permanent structure.

The locations of inlets and outlets shall be detailed on PT system drawings.

Questions	PL-1a	PL-1b	PL-2	PL-3
3.6 Inlets, Outlets and Plugs (a) Are inlets, outlets, valves and plugs made of nylon, polyolefin or stainless steel?	✓	✓	✓	✓
(b) Do all inlets, outlets, valves and plugs have a minimum pressure rating of 150 psi?	✓	✓	✓	✓
(c) Are mechanical shutoff valves provided at all inlets and outlets?	✓	✓	✓	✓
(d) Do inlets and outlets have a minimum inside diameter of 3/4" for strand tendons and 3/8" for single bar tendons and four-strand tendons?	✓	✓	✓	✓
(e) Are temporary items labelled on the PT system drawings?	✓	✓	✓	✓

3.7 Precast Segmental Duct Couplers

Precast segmental duct couplers are required for PL-2 or PL-3 systems. Verify the couplers meet the requirements of PTI/ASBI M50.3-19, Sections 4.3.8 and 4.4.5.2.

A test report certified by a certified independent lab shall be prepared demonstrating the following. Items not required by testing shall be demonstrated through drawings and/or samples of the couplers.

- *Are airtight and meet the performance requirements of this specification.*
- *A precast segmental duct coupler shall:*
  - *Be securely mounted to the joint (bulkhead)*
  - *Be designed to receive the duct at a minimum deviation angle from perpendicular equal to the maximum present in the structure and at an angle of at least 6 degrees from perpendicular.*
  - *Be designed to allow for segment misalignment up to 1/8 in. in any axis; and*
  - *Not induce any additional angle change in the tendon as it passes through the coupler.*
- *Assemblies holding the precast segmental duct coupler sealing gaskets shall mount to the form bulkhead and provide for duct alignment;*
- *Shall be compatible with the prestressing steel, concrete, grout, and duct material; and*
- *Sealing gaskets shall not interfere with the erection or prevent the joint from being fully closed at temporary erection forces.*

A test report shall be provided by a certified independent lab to demonstrate compliance with Section 4.4.5.2.

Questions	PL-1a	PL-1b	PL-2	PL-3
3.7 Precast Segmental Duct Couplers (a) Is the segmental coupler airtight and meet the performance requirements of PTI/ASBI M50.3-19?			✓	✓
(b) Does the precast segmental duct coupler securely mount to the joint (bulkhead)?			✓	✓
(c) Is the precast segmental duct coupler designed to receive the duct at a minimum deviation angle from perpendicular equal to the maximum present in the structure and at an angle of at least 6 degrees from perpendicular?			✓	✓
(d) Is the precast segmental duct coupler designed to allow for segment misalignment up to 1/8 in. in any axis?			✓	✓
(e) Does the precast segmental duct coupler induce any additional angle change in the tendon as it passes through the coupler?			✓	✓
(f) Do assemblies holding the precast segmental duct coupler sealing gaskets mount to the form bulkhead and provide for duct alignment?				
(g) Is the precast segmental duct coupler compatible with the prestressing steel. Concrete, grout, and duct materials?				
(h) Do the sealing gaskets interfere with the erection or prevent the joint from being fully closed at temporary erection forces?				
(i) Is a test report provided meeting the requirements of Section 4.4.5.2 and certified by a certified independent lab?			✓	✓
(j) Has the precast segmental duct coupler been included in the Internal Duct System Test?			✓	✓

A sample of the precast segmental duct coupler and drawing of the coupler shall be provided and measurements performed to ensure the part matches the drawing and is representative of the part identified in the test report.

4. COMPONENT ASSEMBLY AND PRESSURE TESTS

4.1 Grouting Component Assembly Tests

Grouting component assembly pressure test (PL-1B, PL-2 and PL-3 only) and system safety proof test (PL-1A only).

Component and system testing shall meet the requirements of PTI/ASBI M50.3-19, Sections 4.4.2.

Assemble anchorage and grout cap with all required grouting attachments.

Test report showing the complete system as represented by the system assembly drawings shall be provided.

PL-1B, PL-2 and PL-3, condition the assembly at 150 psi for 3 hours.

Test report shall clearly demonstrate that the PL-1B, PL-2 and PL-3 assemblies have been conditioned at 150 psi for 3 hours before conducting the test.

PL-1B, PL-2 and PL-3 assemblies shall sustain a 150 psi internal pressure for 5 minutes with no more than 15 psi reduction in pressure.

Test report shall clearly demonstrate that the PL-1B, PL-2 and PL-3 assemblies did not lose more than 15 psi after 5 minutes of 150 psi internal pressure.

PL-1A assemblies shall sustain a 75 psi internal pressure for 5 minutes with no more than 15 psi reduction in pressure.

Questions	**PL-1A**	**PL-1B**	**PL-2**	**PL-3**
4.1 Grouting Component Assembly Tests (a) Are all the parts called out on the drawing assembled to test the system?	✓	✓	✓	✓
(b) Is the assembly conditioned at 150 psi for 3 hours		✓	✓	✓
(c) Does the report demonstrate the assembly sustains 150 psi for 5 minutes with no more than 15 psi in pressure reduction?		✓	✓	✓
(d) Does the report demonstrate that the assembly sustains withstands at 75 psi for 5 minutes with no more than 15psi in pressure reduction?	✓			

Test report shall clearly demonstrate that the PL-1A assemblies did not lose more than 15 psi after 5 minutes of 75 psi internal pressure.

4.2 System Pressure Tests

PTS shall meet the requirements of PTI/ASBI M50.3-19, Sections 4.4.5, 4.4.5.3 and 4.4.5.4.

Each assembly of PTS, including all sizes and configurations, should be tested with all components needed to make a tendon from one grout cap to the other. Test reports must be issued by a certified independent lab.

In case of internal duct systems, testing on each assembly of PTS must be carried out as per PTI/ASBI M50.3-19, Sections paragraph 4.4.5.3.: i.e. *fib* Bulletin 7 Article 4.2 – stage 1 and stage 2.

Stage 1 refers to a system which should be able to be properly assembled according to a method statement.

Stage 2 refers to a system which should be sufficiently leak tight, able to withstand a pressure level of 1.5 psi for at least 5 minutes without losing more than 10% of the initial pressure.

Test set-up for both stages should be in compliance with layout given in Annex A9 (and Fig. A9.1) of *fib* bulletin 7.

In case of external duct systems, testing on each assembly of PTS must be carried out as per PTI/ASBI M50.3-19, Section 4.4.5.4.

Anchorage connection to the duct/pipe assembly should be tested as per stage 2 of internal duct system but with 150 psi pressure.

Duct and pipe assembly consisting of all external duct connections must be conditioned at 150 psi for 30 minutes before being able to withstand for 1 minute not more than a loss of 10% in pressure.

Questions	**PL-1a**	**PL-1b**	**PL-2**	**PL-3**
4.2 System Pressure Tests (a) Are the test reports provided issued by a certified independent lab?			✓	✓
(b) Are the systems described in the drawings mentioned as tested in the test reports?			✓	✓
(c) For internal duct systems: Do test reports provide information on complete compliance with requirements set for stage 1, i.e.:			✓	✓
(d) Is there a method statement for system assembly?			✓	✓
(e) Is tendon profile in compliance with geometry set in Annex 9 (Figure A9.1) of *fib* Bulletin 7?			✓	✓
(f) Is tendon profile assembled in the vertical plane to properly represent high and low points?			✓	✓
(g) Are “as built” drawings of the specimen and test photographic documentation available?			✓	✓
(h) Has the assembly test met all acceptance criteria?			✓	✓
(i) For internal duct systems: Do test reports provide information on complete compliance with requirements set for stage 2, i.e.			✓	✓
(k) Is tendon profile in compliance with geometry set in Annex 9 (Figure A9.1) of *fib* Bulletin 7?			✓	✓
(l) Is tendon profile assembled in the vertical plane to properly represent high and low points?			✓	✓
(m) Has the test been carried out with a pressure level of 1.5 psi for at least 5 minutes having a loss of pressure not higher than 10%?			✓	✓
(n) For external duct system:			✓	✓

Do test reports provide information on complete compliance with requirements set for anchorage connection to the duct/pipe assembly, i.e.				
(o) Has the test been carried out with a pressure level of 150 psi for at least 5 minutes having a loss of pressure not higher than 10%?			✓	✓
(p) Do test reports provide information on complete compliance with requirements set for duct and pipe assembly, i.e.			✓	✓
(q) Has the assembly been conditioned for 30 minutes at 150 psi before sustaining an internal pressure of 150 psi for 1 minute with no more than 10% reduction in pressure?			✓	✓