PTI/ASBI M50.3-19 Specification for Multistrand and Grouted Post-Tensioning

Addendum #1 December-2024

[Update your specification by changing the items identified]

FOREWORD

Multistrand and grouted post-tensioning is critical reinforcement for concrete bridges and many other structures. Bonded and unbonded multistrand tendons are central to the performance and durability of these structures. This specification provides minimum requirements for the selection, design, testing, and installation of multistrand and grouted post-tensioning systems and is intended for use in a wide variety of structure types, including buildings and bridges.

It has been developed by the PTI/ASBI M-50 Multistrand and Grouted Tendon Committee through a consensus-standards process. The committee is a diverse international group comprised of representatives from specifying government agencies, researchers, designers, contractors, industry suppliers, and other experts.

The committee began work on the specification in 2010, with the first edition published in 2012. This is the second edition that was augmented by the addition of a Commentary and many updates in other section, including inclusion provisions on grout inlets and outlets. The specification is a comprehensive document addressing selection of the tendon protection levels, system components, materials, installation, and stressing of tendons. This addendum to the second edition includes important updates to the requirements specified in Section 4.3, Component standards, and Section 4.4, System approval testing.

The specifiers are encouraged to use this specification in its entirety and the contractors to apply all applicable provisions. The companion document, PTI M55.1 Specification for Grouting of Post-Tensioned Structures should be used in conjunction with this document.

PTI appreciates any comments or suggestions from the readership, as the committee's work continues.

SPECIFICATION	COMMENTARY

4.3.2 — Post-tensioning anchorages
Local zones and related anchorage devices shall be designed and tested in accordance with the AASTHO LRFD Bridge Design Specification, Design of Local Zones (AASHTO LRFD).

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.

PTI/ASBI M50.3-19 Specification for Multistrand and Grouted Post-Tensioning

Addendum #1 December-2024

[Update your specification by changing the items identified]

SPECIFICATION | **COMMENTARY**

Wedge plates and wedges shall meet the requirements of PTI's "Acceptance Standards for Post-Tensioning Systems," Section 4.1, except 4.1.1(1) is not applicable. Provide self-centering wedge plates to facilitate alignment with the bearing plate.

Equip all anchorages for PL-1B, PL-2, and PL-3 with a permanent, vented grout cap that is secured to the anchorage. Grout inlets/outlets shall also serve as post-grouting inspection access points (hence, manufactured anchorages with grout inlets/outlets on top or in front and suitable for inspections). The geometry of the grout inlets/outlets shall permit drilling using a 3/8 in. (9.5 mm) diameter straight bit to facilitate bore-scope inspection directly behind the wedge plate.

Permanent grout caps shall be nonmetallic, stainless steel, or galvanized ferrous metal with a minimum thickness of zinc of 4.7 mils (120 μm).

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

For PL-2 and PL-3, connections from the trumpet to the duct and the trumpet to the bearing plate shall have the same leak tightness requirements as duct-to-duct couplers.

4.4 – System approval testing

For acceptance and approval of a PTS, the components and system testing shall be witnessed and certified by an independent testing laboratory or institute. The testing laboratories or institutes shall be:

POST-TENSIONING INSTITUTE
Strength in Concrete

PTI/ASBI M50.3-19 Specification for Multistrand and Grouted Post-Tensioning

Addendum #1 December-2024

[Update your specification by changing the items identified]

SPECIFICATION

- AMRL or A2LA certified, or
- ~~o~~Other organizations accredited to ISO 17025 or AASHTO R 18, or
- Alternatively, for tests performed prior to the publishing of M50.3-19, an ABET Engineering accredited Academic Institute with a materials/structural testing laboratory with capabilities (subject to approval by the PTI CRT-140 Certification Advisory Board) to perform the tests.

~~. This~~ System approval testing shall be completed prior to submission of PT Installation Drawings and other related documents to the Engineer for approval.

COMMENTARY

4.4.1 — Post-tensioning anchorages
1. Test and provide test reports that anchorages develop at least 95% AUTS of the prestressing steel, when tested in an unbonded state, without exceeding anticipated set.

2. 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 a test block according to one of three procedures described (that is, cyclic loading, sustained loading, or monotonic loading, in full conformance with AASHTO Section 10.3.2.3).

3. Wedge plates shall pass the following wedge plate test. ~~Per PTI’s “Acceptance Standards for Post-Tensioning Systems,” Section 4.1.1.~~ Adequacy of wedge plates shall be established by static tests. The number of tests is specified below. The following requirements shall be met.

C4.4.1 – Post-tensioning anchorages

Special anchorage device
Most suppliers have developed special anchorage devices. They have special shapes, frequently have multiple bearing surfaces, and often are ductile iron castings. Such special anchorage devices normally produce very high local bearing stresses on the concrete and, therefore, require spirals or equivalent confinement reinforcement in the local zone. They are not readily amenable to rational stress analysis and their adequacy must be established by tests.

Basic bearing plates design criteria
The design of single and grouped basic bearing plates depends on the size of the distribution area.

Wedge plate test requirements
Wedge plates have very complex loading conditions and internal stresses. Their safety margins against failure can only be established by destructive tests, which simulate the actual loading conditions. PTI’s “Acceptance Standards for Post-Tensioning Systems,” Section 6.1.5, specifies three static tests to failure.

PTI/ASBI M50.3-19 Specification for Multistrand and Grouted Post-Tensioning

Addendum #1 December-2024

[Update your specification by changing the items identified]

SPECIFICATION

(1) After loading to 95% of tendon MUTS and subsequent force release, the permanent deflection of the wedge plate's top surface shall be measured and recorded. Residual deformations of anchorage components after testing shall be less or equal to the allowable deflection declared by the PT Supplier. The load test shall be performed with the wedge plate support simulating conditions in the anchorage assembly. The force shall be applied by pulling on a sample tendon using the standard system wedges.

(2) Wedge plates shall be tested to failure in static load tests, or to the loading capacity of the testing equipment. The tests shall simulate actual tendon forces applied to the wedges. The failure force shall be at least 120% MUTS.

Three successful qualification tests on wedge plates for each tendon size shall establish that they will meet the requirements of Section 4.4.1.3. Each sample shall be taken from a different heat.

COMMENTARY

The destructive tests must simulate the lateral forces the wedges exert on the wedge plate. Replacing the strand with high strength bolts of equivalent diameter and loading the assembly in a testing frame, over a relatively soft steel distribution plate, provides adequate realism to such tests. Figure C4.1 shows how this test can be performed.

Typical wedge

Suppliers and manufacturers have developed a variety of different types of wedges for particular systems and specific applications. A standard wedge, which fits all systems and applications, has not evolved; but most wedges have certain features in common.

A typical wedge has a five- to seven-degree angle and has a length of at least 2.5 times the nominal strand diameter.

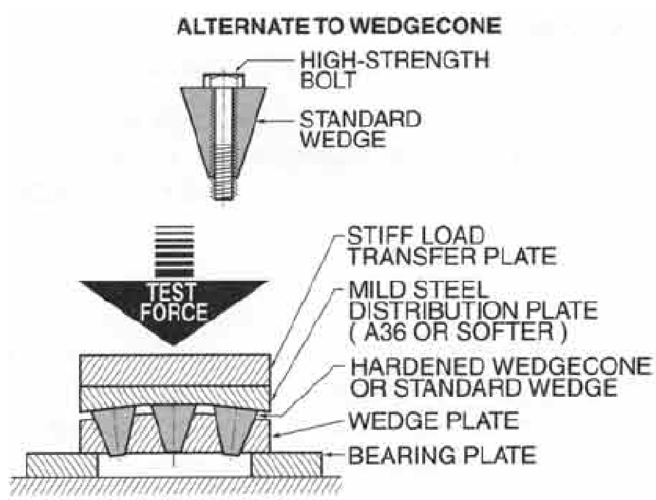

Fig. C4.1 – Wedge Plate Test

It is manufactured from low carbon steel (AISI 12-L14 or 11-L17) or alloy steel (AISI 86L20), which are suitable for case-hardening while maintaining a ductile core. After machining, the wedge is case-hardened to at least 58 HRC measured at 1/3 case depth (or equivalent

PTI/ASBI M50.3-19 Specification for Multistrand and Grouted Post-Tensioning

Addendum #1 December-2024

[Update your specification by changing the items identified]

SPECIFICATION | **COMMENTARY**

hardness scale), and an effective case depth of at least 0.008 in. (0.20 mm), while maintaining a ductile core hardness less than 46 HRC.

Cracks in wedges
Wedges are designed to have hard surfaces, as required for the wedge teeth to bite into the high-strength strand. Wedges are also designed to have ductile cores, which allow the wedges to adjust to irregular strand shape and hard surfaces may crack, while the ductile cores prevent wedges from breaking into pieces.

Surface cracks have caused concern and acceptance problems on some projects. Experience has shown, however, that surface cracks are not a safety hazard and do not affect the performance of strand-wedge connections adversely. Surface cracks signify hard and brittle surfaces.

Not acceptable are wedges that have broken into several pieces, signifying not only hard surfaces but also brittle cores. Nevertheless, wedges broken longitudinally into several slices perform adequately. Horizontal or inclined breaks, however, are considered unacceptable.

Bar-anchor nut and bar-coupler connection performance requirements
Bars normally have threaded connections to anchor nuts and couplers. Such connections rely on mechanical interlock and have only a few important variables, such as type of thread, engagement length, dimensional tolerances, and material strength. Their performance can be established reliably by rational analysis and verified by small test series.

4.4.5.3 — Internal duct systems

Perform a system test of the assembly for compliance with the requirements of Chapter 4, Article 4.2, Stage 1 and Stage 2 Testing, contained in fib Technical Report, Bulletin 7, “Corrugated

PTI/ASBI M50.3-19 Specification for Multistrand and Grouted Post-Tensioning

Addendum #1 December-2024

[Update your specification by changing the items identified]

SPECIFICATION

Plastic Duct for Internal Bonded Post-tensioning." Alternatively, perform a system test of the assembly for compliance with the requirements of Articles 7.4 and 7.5 (with their relevant Annex B.4 and B.5), contained in fib Technical Report, Bulletin 75, "Polymer-Duct Systems for Internal Bonded Post-Tensioning". For bar systems, modify the system test length to 15 ft (4.6 m).

COMMENTARY