Post-Tensioning Institute Launches Post-Tensioning System Prequalification Testing and Certification Program

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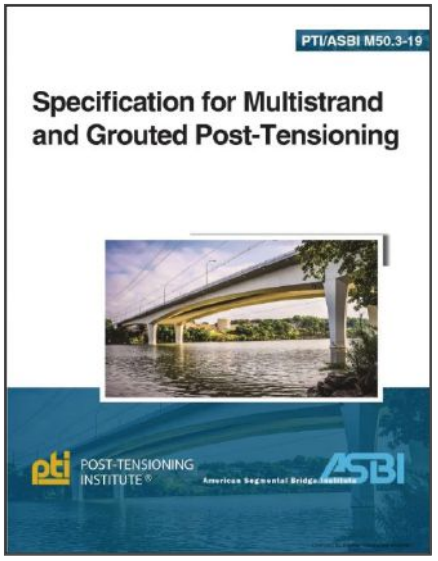
The Post-Tensioning Institute's (PTI's) Post-Tensioning System Qualification Testing and Certification program was developed to standardize the approval process for post-tensioning (PT) systems and provide independent certification of multistrand and grouted PT systems for use in bridges and other structures. The certification of a PT system under this program indicates that the system meets all requirements and is in conformance with PTI/ASBI M50.3, *Specification for Multistrand and Grouted Post-Tensioning*.[1] The program is intended to provide uniform objective acceptance criteria, validation that the PT systems were tested and met those criteria, and an online registry of approved systems.

The PT systems used in bridges are typically multistrand systems but also include some high-strength bar systems. In PT, high forces are applied with relatively small spaces for the anchorages, which necessitates proprietary systems with several anchorage sizes to accommodate project needs. These PT systems represent the main reinforcement for a bridge and therefore experience not only very high forces but also demands on durability based on the tendon protection level (PL) assigned for the project. There is also an increasing need for a means of monitoring a PT system in place or even for a replaceable system, which would extend the life of the structure. PTI/ASBI M50.3-19 specifies the required tests that must be successfully conducted to ensure compliance. The specification also requires that the testing be conducted or validated by an accredited laboratory to maintain high-quality standards.

PTI/ASBI M50.3-19 specifies the tests required to qualify a system.



The typical components for a commonly sized multistrand tendon will include a bearing plate, a wedge plate, wedges, strand, a grout cap, grout vents, transition trumpet, duct, and local zone reinforcement (commonly called confinement reinforcement). The force from a strand is transferred through the wedges into and through the wedge plate and then into the bearing plate. The bearing plate, together with the confinement reinforcement, transfers the load into the concrete component.

Testing Requirements

PTI/ASBI M50.3-19 specifies a series of performance tests used to initially qualify, or "prequalify," a PT system. These tests are required to demonstrate that the system can meet the various load capacities, ductility, durability, and other essential characteristics for the various components. The system used in the field must match the system tested without substitution of other components. Examples include the efficiency test, which is designed to test the strand–wedge–wedge plate connection by loading it to 95% of the actual ultimate tensile strength of the strand.

PTI/ASBI M50.3-19 also specifies the requirements and procedures in the American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Construction Specifications*[2] for a special anchorage device test consisting of a concrete block with the anchorage embedded, with the local zone and skin reinforcement as required. One of the three specified test procedures—cyclic, sustained, or monotonic loading—is followed. Crack widths are measured and, at the end of the test, the force is typically increased to a minimum of $1.1F_{pu}$ ($1.2F_{pu}$ for the monotonic loading test) or to failure. F_{pu} is the ultimate load of the largest tendon that the anchorage device is designed to accommodate. Finally, the wedge plate is tested to failure at a minimum of 120% of the minimum ultimate tensile strength. Currently, it is also required that the wedge plate deflection remain under the specified limit after it has been loaded to 95% minimum ultimate tensile strength and the force released.

For PT systems that are designed to remain unbonded, additional dynamic tests are necessary. Some tests focus on the ducts. A series of duct tests is performed to validate that the material and thickness of the duct will be sufficient for typical tensioning operations using the minimum acceptable radius of curvature established by the duct

supplier. Tests for flexibility of the duct, strength and function of the duct components, and pressure tests are also part of the testing protocol. Leak-tightness testing of the entire system is also required for PL2 and PL3.

Variations in State Specifications

The current requirements for PT systems and their installation vary across the United States. Accordingly, the PT system approval process and testing requirements also vary. As noted in National Cooperative Highway Research Program (NCHRP) Synthesis 562, *Repair and Maintenance of Post-Tensioned Concrete Bridges*,[3] results from a survey of bridge owners indicated that several specifications are referenced for post-tensioning. The report also noted that several states model practices and specifications of other states. One of the conclusions noted was, "While many state DOTs [departments of transportation] are referencing key guidance documents (such as PTI/ASBI M50.3 and PTI M55.1) or other states' specifications when developing or updating their own PT Specifications, non-uniformity is significant from state to state." The differences in specifications are often quite small, but the differences can sometimes be large enough to necessitate additional testing of a PT system to satisfy local requirements. If a PT system is not prequalified, the system may be reviewed and approved at the project level. Thus, there are many differences between states and projects, all requiring different acceptance criteria for the PT systems.

PTI CRT70 Prequalification Testing and Certification Program

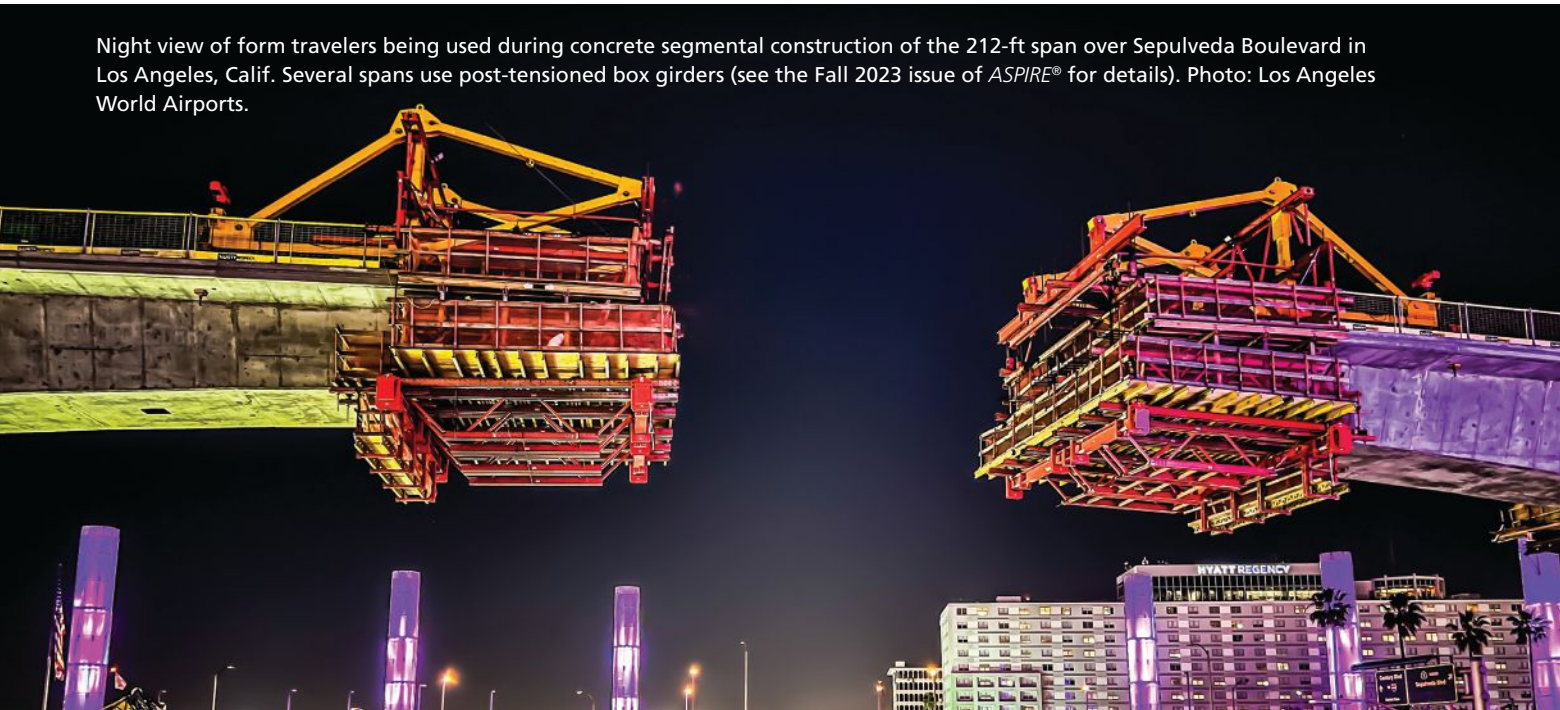
To establish a consistent method of qualification and certification for PT systems, it has been suggested that prequalification testing and certification of the systems could take place in a central location where PTI would administer the verification and certification processes. With decades of certification experience from the ANSI-accredited PTI plant-certification program, PTI launched Committee CRT-70: PT Systems Qualification Testing and Certification in 2015 to create the PTI Prequalification Testing and Certification Program.

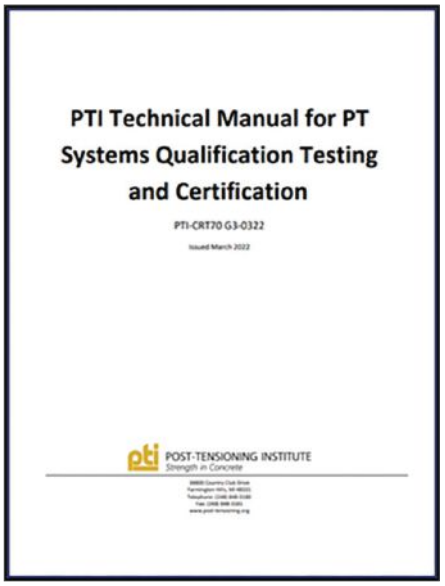
With the general consensus of owners, PT system suppliers, engineers, contractors, manufacturers, and others, the first edition of PTI/ASBI M50.3 was published in 2012. The goal of this joint PTI-ASBI effort was to provide a national consensus-based standard that could be referenced. The second edition of the specification was published in 2019, and the committee is currently working on the third edition, expected to be published in late 2025 or 2026. Some state DOTs have adopted PTI/ASBI M50.3, with minor exceptions noted. Some major projects have also adopted PTI/ASBI M50.3 as the project specification. As noted in the Fall 2023 *ASPIRE®* article "Recently Approved Changes to the Ninth Edition *AASHTO LRFD Bridge Design Specifications*," an agenda item was approved during the 2023 meeting of the AASHTO Committee on Bridges and Structures to reference PTI/ASBI M50.3-19 and PTI M55.1-19, *Specification for Grouting of PT Structures*,[4] align the documents, and incorporate the protection level concept in the forthcoming 10th edition of the AASHTO LRFD specifications.[5]

There are three key PTI program manuals, outlined in the following paragraphs, that define the technical, administrative, and management structure requirements that the PTI CRT-70 Committee has established for this program. PTI's goal is to keep these program documents updated and to simultaneously publish new editions of each document when updates occur.

PTI-CRT70 G3-0322, *PTI Technical Manual for PT Systems Qualification Testing and Certification*,[6] addresses the requirements from the M50.3 specification and provides a checklist for each protection level for use during audits. When a PT system supplier submits a system for certification, they must include documentation matching the G3 checklist, provide all test data and evaluations, and demonstrate that the system meets all the requirements of PTI/ASBI M50.3. Each system undergoes two audits by two independent agencies. One audit will cover all the questions in the G3 checklist; the other audit will focus on the critical items in the G3 checklist, as determined by PTI CRT70. Resubmission of documentation

Night view of form travelers being used during concrete segmental construction of the 212-ft span over Sepulveda Boulevard in Los Angeles, Calif. Several spans use post-tensioned box girders (see the Fall 2023 issue of *ASPIRE®* for details). Photo: Los Angeles World Airports.





PTI-CRT70 G3-0322 provides a checklist for each tendon protection level for use during audits.

and possibly additional testing might be necessary when the M50.3 specification changes or when the system changes regarding materials or dimensions.

PTI CRT-140 G2, *PTI Quality Management System Manual for Certification Programs,*[7] outlines the management structure of all PTI certification programs, including the ANSI-accredited PTI plant-certification program, and the procedures for monitoring performance and quality. It provides procedures on how to handle and respond to complaints and how to resolve appeals, including time frames for several steps. In a case of a complaint from the end user, PTI collects the documentation, which is sent to the agency for evaluation. PTI determines certification based on the evaluation report from the agency. In the case of an appeal by a PT system supplier, the PTI Certification Advisory Board establishes an appeals board with a balance of interests to review the appeal. The appeals board's decision is final.

A key element of the program is an online registry of certified PT systems maintained by PTI. PTI CRT70 G1-0722, *PTI Administrative Manual for PT Systems Qualification Testing and Certification*,[8] outlines the PT system application process, audits by independent agencies, PT system certification, re-reviews, and the registry of certified systems. The registry includes the supplier's name, the system designation, including the number of strands or bar size, and a link to nonconfidential system drawings. State DOTs and other owners can access additional supporting information as required. However, access by the general public is restricted because the documentation contains proprietary information about the systems. The registry will be maintained by PTI, and any changes in certifications, such as new certifications, conditional certifications, or suspended certifications, will be reflected in a timely manner.

Conclusion

Reference to the PTI/ASBI M50.3-19 specification as part of the forthcoming AASHTO LFRD design and construction specifications,[5,9] especially as it relates to testing, will serve to establish uniform requirements for PT systems. A uniform specification will make it easier to communicate the requirements and apply them consistently to all projects. Any regional or special requirements can always be added, but a consistent baseline of system testing helps maintain a threshold of quality. Consistency also facilitates the ability of industry members to communicate and train to the current standards more effectively to ensure that the systems used in the field match the prequalified approved systems. All stakeholders are encouraged to work together on the PTI/ASBI M-50 Committee to continue to enhance the specification.

The PT system qualification testing and certification program invited PT system suppliers to initially submit up to three systems each by the end of June 2024. Currently, all submitted systems are being audited and evaluated by the independent agencies, with the results expected by the end of September 2024. Those submitted systems that meet all requirements will be certified and listed in the PTI registry in October 2024. Additional systems can be submitted for certification consideration after the initial batch of systems is certified and listed in the PT system registry.

References

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