

The Right Materials and the Right Quality: Important Updates to Post-Tensioning Bridge Specifications M50 and M55

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For decades, long-span concrete bridges have relied on post-tensioning (PT) as the primary reinforcement because it enables the designer to achieve long spans and attractive, slender shapes. Two specifications represent the industry standards for PT and should be used in design and construction. The Post-Tensioning Institute (PTI) is proud to announce that the latest updates of these two specifications will be published in summer 2019:

- PTI/ASBI M50.3-19, *Specification for Multistrand and Grouted Post-Tensioning*
- PTI M55.1-19, *Specification for Grouting of Post-Tensioned Structures*

These two specifications include the newest state-of-the-art provisions and uphold the fundamental principle of construction that must be satisfied to achieve the desired performance and longevity: We must have the right materials and the right quality of work. The specifications include mandatory minimum requirements regarding materials, testing, installation, tensioning, grouting, finishing, and inspection. Commentaries provide guidance, explaining the background and showing options on how to meet the mandatory requirements.

It is important to emphasize that these specifications are prepared following American National Standards Institute requirements for a full consensus process, including public review at the end of the development process. The PTI committees producing these documents represent a wide range of interested parties, including owners (Federal Highway Administration and state departments of transportation), designers, researchers, contractors, and PT system suppliers.

All provisions or provision changes are balloted, and all negative votes are

resolved by the committee consensus, as required by the PTI *Technical Committee Manual*.

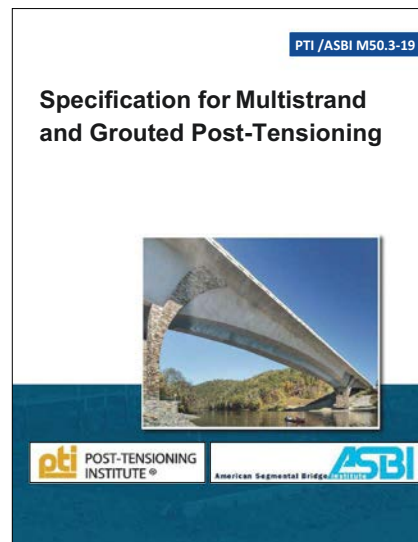
A major advantage of a standard specification is that it establishes best-practice procedures and reduces or eliminates unnecessary differences in requirements of specifications developed by various designers and owners. Consistency and standardization to the new specifications help ensure that the focus in projects remains on properly executing the work using industry-established best practices.

It has been noted that some specifications are silent on important aspects of the PT system. Use of the M50 and M55 specifications helps project stakeholders address this lack of information.

In 2014 the Texas Department of Transportation (TxDOT) incorporated both standards, with a few minor modifications, into the TxDOT *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges*. TxDOT's efforts serve as a good example of how the specifications can be adapted if the owner and designer think that some modifications are necessary for a locality or project.

PTI/ASBI M50.3-19

PTI first published the M50 specification in 2012, and PTI/ASBI M50.3-19 is the second edition. This specification was developed in cooperation with the American Segmental Bridge Institute (ASBI), which provided expertise from their membership to the committee. The title of the specification was modified for the second edition to better reflect the scope. It is applicable to all multistrand and grouted PT for any application and in any environment. It addresses all multistrand and grouted PT issues except for the grout materials, testing, and



All Figures: Post-Tensioning Institute.

grouting operation. Those latter items are covered in the companion specification, PTI M55, which specifically addresses grouting.

The M50 specification includes tendon protection levels (PLs), which simplify and standardize the selection of the PT systems and procedures by allowing the owner and designer to determine the appropriate degree of corrosion protection necessary for the PT system based on the environment of the structure, the design life, and the importance factor. The PLs provide a specific set of requirements to address the durability expectations for each level.

PTI/ASBI M50.3-19 allows for innovation by stating the testing requirements for prequalification of existing and new systems. These standard requirements will simplify the PT system prequalification. All the testing must be witnessed by a certified agency, the requirements of which are identified in the specification. The PTI PT System Prequalification Testing and Certification Program (PTI CRT-70) will be based on the M50 requirements and is expected to be launched in early 2020. The updated specification also spells out requirements for installation items, such

as tolerances, support spacing, venting of ducts, and provides time limits for important construction milestones.

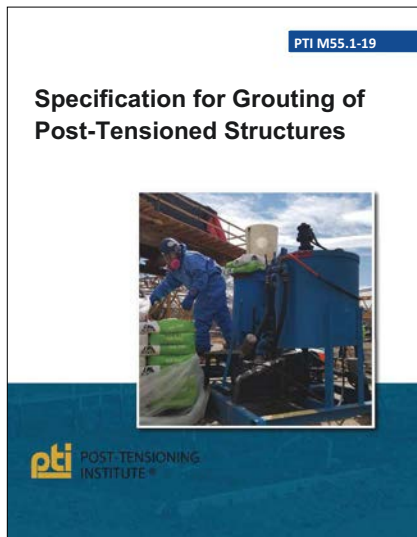
PTI/ASBI M50.3-19 also addresses field personnel qualifications. Certification requirements for direct supervisors, leaders, and members of tendon installation and tensioning crews, as well as the grouting crew, are specified. Because quality is such an important part of a successful project, owners and specifiers are urged to require certified personnel. The certification training goes a long way in preventing costly errors on projects.

The following are the most significant modifications and new items in PTI/ASBI M50.3-19:

- Updates were made to reflect advances and changes in materials and testing (for example, changes to the specifications for PT ducts).
- Commentary was added to most provisions to help users navigate through the specification and to provide guidance to meet specification requirements.
- Several items related to grouting (for example, the location and details of the grout inlets and outlets) were moved to this specification from the M55 specification because they need to be addressed during the installation process. The intent is to make the two specifications complementary and avoid any potential, inadvertent conflict between them.

PTI M55.1-19

PTI M55 addresses grouting, a common, effective, and proven way to achieve strain



compatibility in PT bonded tendons and provide effective corrosion protection for prestressing steel. PTI first published this specification in 2001, and each subsequent edition has included important updates. The 2012 edition received an addendum in 2013 to immediately address some issues associated with chlorides and soft grout. Those significant modifications included the following:

- Testing for chloride ion content based on the weight of the mixed grout, because the cement weight is not available for proprietary prepackaged grouts
- Prohibiting addition of any sulfates except for those already in the portland cement
- Limiting the Blaine value to be between 300 and 400 m²/kg to address water demand fluctuations in cement supply
- Adding the inclined tube test to improve testing for bleed and segregation
- Imposing limits on constituent materials for the Class C prepackaged grouts
- Prohibiting tendon flushing to avoid residual water in the ducts
- Prohibiting aggregates and inert fillers in Class B or C grouts

PTI M55.1-19 is the fourth edition of the specification, and it includes some far-reaching new requirements to address the reliability of grouting, such as the following:

- Certification of grout material bag weight and sampling of bag weights on site
- Certification of sulfate ion level
- Testing and documentation of the wet density at the last outlet of each tendon
- Material storage requirements
- Further clarification of the prohibition on flushing
- Updates to grouting procedures and equipment
- Requirements for personnel training, experience, and certification
- Sample grouting record and checklist (provided in an appendix)
- Postgrouting inspection requirements and recommendations
- Updates to testing procedures:
 - Robustness test to determine whether grout can meet other requirements with 110% of the maximum recommended water content
 - Volume change test: Updates to reflect practical parameters
 - Chloride ion test: Updates to procedures for independent testing for maximum chloride ion content either 0.08% by weight of portland

cement or 0.03% by weight of mixed grout

- Shelf-life test (new addition)

As these examples show, the specification applies to both the grout materials and the grouting process itself. PTI M55.1-19 is a comprehensive specification covering minimum requirements for the grout materials for each PL, including qualification testing, testing for quality control and quality assurance, field trial and mockup testing, production testing, and grouting procedures with mixing and pumping requirements. It provides detailed guidance on what a grouting plan should include and how that plan should be followed from start to completion of the work, including contingencies and repair procedures. It also addresses postgrouting inspection requirements.

Conclusion

To develop the M50 and M55 specifications, committee volunteers and others spent countless hours writing the specifications, in meetings, on the balloting process, and completing other tasks. These efforts are greatly appreciated because the specifications improve the industry and the structures in which they are used. PTI/ASBI M50.3-19 and PTI M55.1-19 represent the state of the art in material and installation requirements for multistrand and grouted PT. Whenever new findings for multistrand and grouted post-tensioning have been identified, PTI has updated these specifications to remain a reliable resource for PT materials and quality practices for bridges. For this reason, bridge owners and designers/specifiers are urged to adopt these specifications in their projects. **A**

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EDITOR'S NOTE

The Winter 2017 issue of ASPIRE® contains several Concrete Bridge Technology articles presenting the state-of-the-art for materials, installation, grouting process, and personnel training for post-tensioning systems.