

# The Quality Partnership: Ensuring the Performance and Reliability of Post-Tensioning Installation and Grouting

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Concerns are being raised about post-tensioning (PT) grouting and installation, even though the majority of PT bridges worldwide are performing well and without problems. Why then the concern?

Several highly publicized problems have focused attention on PT bridge construction, and particularly on grouting. While actual cases of poor grouting are very few in number, these problems have shown that quality has not always been achieved and better reliability is needed.

### Quality and Reliability

In an ideal world, everyone on the project team would share responsibility and ensure that everything is done right and with the highest quality possible. But as experience has shown in all aspects of construction, "stuff" happens. Whether it be from inattention, ignorance, inexperience, neglect, competitive pressures or simply bad luck, things do not always go according to plan.

### Identifying Problems and Ensuring Quality Construction

Recognizing that some problems are inevitable, it is critical that appropriate controls are in place to ensure that these situations are identified and appropriate corrective/preventive actions are taken in a timely manner. To do so effectively requires the following:

- Good plans, specifications, and project details
- Quality control by the contractor and all of its subcontractors and suppliers
- Quality assurance by the owner or specifier
- Education and training of all personnel involved in the construction process

All are needed to consistently achieve a high degree of reliability.

### Plans, Specifications, and Details

Plans, specifications, and details are typically the responsibility of the owner's engineer. Suitable plans and details greatly impact constructability and are the foundation for achieving quality. Poor details, such as improper location of grout inlets and outlets, may lead to voids and difficulty in completely filling a duct with grout. Furthermore, effective specifications "set the bar" for quality and ensure that the owner's performance and reliability objectives are met. Alternatively, lax specifications may put contractors, who are trying to do a good job, at a competitive disadvantage, and entice them to a hurried schedule without properly controlled processes to stay competitive.

**Effective specifications "set the bar" for quality.**

### Contractor Quality Control

The contractor must have adequate quality control (QC) measures in place to ensure that the completed construction meets the owner's requirements as detailed in the plans, specifications, and other contract documents. This responsibility also applies to all of the suppliers and subcontractors on the project.

Often materials and products are pre-approved through ASTM testing or a qualification program before the project begins. However, as was learned the hard way with prepackaged grout in the PT industry, it is important that manufacturers have an ongoing QC program to ensure that their materials and products continue to meet project requirements throughout production and not just during initial qualification.

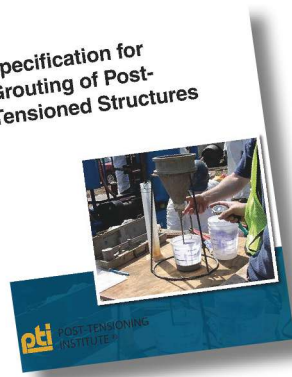
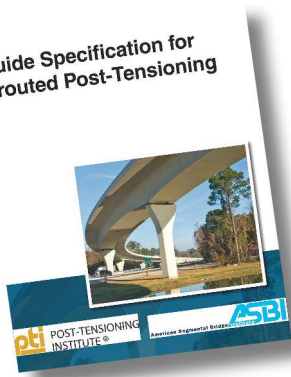
**It is important that manufacturers have an ongoing QC program to ensure that their materials and products continue to meet project requirements.**

Contractor QC must take into account the coordination and interaction of different subcontractors and operations that impact quality of the post-tensioning construction. If left solely to a subcontractor, there are often factors that are beyond the subcontractor's control. For example, reinforcement conflicts or misaligned ducts in precast concrete elements can lead to difficulties in PT installation and subsequent grouting. In these cases, the PT installation subcontractor is responsible for installation and grouting but may not have any control over the quality of other subcontractors' operations. The contractor's oversight and jobsite testing (for example, flow cone, density, and pressure testing) at critical points is essential to ensuring the quality of subcontractor work.

### Owner's Quality Assurance

Quality assurance (QA) is normally the responsibility of the owner or its representative. Acceptance testing and related payment items are keys to a successful QA program. Enforcement of specification requirements is vital to achieving quality on the immediate job, as well as future projects.

Timely inspection of PT installation and grouting before a contractor leaves a jobsite generally means that corrective action, when necessary, will be easier than later when the structure is in service. For example, inspecting tendons shortly after grouting will identify voids, if any, that can be filled using vacuum grouting techniques while the grouting crew is still onsite. Furthermore, when problems are discovered early and a contractor must correct errors before being paid, it serves as a powerful economic incentive to do it right in the first place.



## Keys to maximizing quality of PT installation

- Train personnel.
- Use standard specifications and details.
- Require contractor/supplier quality control.
- Require acceptance testing and inspection.
- Enforce contract requirements.
- Identify problems and take timely corrective action.
- Communicate.

## Education and Training

Qualified personnel are the “grease” that makes the construction process run smoothly. Having installers who know what they are doing, designers who are familiar with PT construction and related details, and inspectors who know what to look for and why, are essential to achieving quality with a high level of reliability.

## PTI Quality Efforts

The mission of the Post-Tensioning Institute (PTI) is to promote quality and advance the state-of-the-art of post-tensioned concrete design and construction. PTI has several activities that are intended to enhance quality of PT installation, including the following.

### Standards and Specifications

The joint *PTI/ASBI M50.3-12: Guide Specification for Grouted Post-Tensioning* and the *PTI M55.1-12: Specification for Grouting of Post-Tensioned Structures* provide consensus-based standards that represent the latest state-of-the-art in PT bridge construction. These specifications are being continually updated by PTI’s technical committees, with membership representation from industry, academia, and owners. In addition, PTI is developing a new program to evaluate and qualify multistrand and bar PT systems. Updated editions of both specifications as well as the launch of the PT System Qualification Program are expected in early 2017.

### Education and Training

PTI and ASBI certification programs provide education and training for field personnel. The existing PTI Bonded PT Field Installation and the ASBI Grouting Certification courses provide in-depth training on installation and grouting of PT tendons. A new companion program focused on inspection of bonded PT systems is being developed by PTI and will be available in early 2017.


Once in place, it is planned that a provision be added to the M-50 specification which would require a contractor to hire a certified third party inspector to oversee PT installation and grouting QC unless waived by the owner. This self-policing requirement would greatly strengthen contractor QC and minimize problems that go undetected and uncorrected.

## Research

In 2017, PTI will sponsor research with a two-fold objective:

- First, study the suitability of using cement that meets the American Petroleum Institute’s API 10-A, *Specification for Cements and Materials for Well Cementing*, as PT grout. API well cements are produced to a much tighter specification standard with frequent QC testing, which may lead to reduced variability and improved reliability.
- The second phase of the study will be to evaluate the effectiveness and accuracy of in-line density meters in PT grouting. Automatic in-line density meters are widely used to monitor soil slurries, and have the potential to provide continuous, real-time monitoring of water content in PT grout.

## Summary

Experience has shown that perfection in construction quality is probably not possible, but our goal should be to come as close as possible and realize a degree of reliability consistent with the owner’s needs. With a team approach where all parties—the PT installer, the general contractor and related subcontractors, the designer and the owner—take responsibility to pursue and achieve quality, a high degree of reliability and performance is not only possible, but likely. 

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