

On the Use of ASTM A722-Like and Non-ASTM A722 Alternative Post-Tensioned Bars

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The Post-Tensioning Institute's *Recommendations for Prestressed Rock and Soil Anchors* (PTI DC35.1-14)¹ provides specific requirements for the use of prestressing steel bars that conform to ASTM A722, *Standard Specification for High-Strength Steel Bars for Prestressed Concrete*,² in prestressed rock and soil applications. However, there are only a limited number of suppliers of ASTM A722 bars, especially for larger diameters. There are high-strength bars that have similar tensile properties to ASTM A722-conforming materials but are made using different processes than those required by ASTM A722. These alternatives are referred to as "ASTM A722-like" and "non-ASTM A722" bars. ASTM A722-like and non-ASTM A722 bars will not behave in the same manner as fully conforming ASTM A722 bars when used in prestressed rock and soil anchors or similar post-tensioning (PT) bar applications.

PTI DC35.1-14 specifies the use of prestressing strand conforming to ASTM A416, *Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete*,³ and/or prestressing bar conforming to ASTM A722 in prestressed rock and soil applications. However, Section 4.2.5 of PTI DC35.1-14 does allow for the use of special prestressing materials, provided those materials have tested properties that meet or exceed ASTM A416 or ASTM A722. A licensed design professional (LDP) must have a clear understanding of the properties of materials conforming to ASTM A416 or ASTM A722 to determine whether

alternative types of strand or bars meet or exceed these requirements.

In June 2024, PTI issued Technical Notes 23⁴ and 24,⁵ which advise engineers on important differences between fully conforming ASTM A722 bars and ASTM A722-like or non-ASTM A722 bars. The main points made in the technical notes are as follows:

- ASTM A722 provides a specific process of cold stressing and stress relieving the bars to achieve specific properties. Alternative bars do not undergo this process.
- Alternative bars have some properties that are equivalent to ASTM A722-compliant bars, but the properties are not identical.
- Specifically, alternative bars may have greater relaxation than ASTM A722-compliant bars.
- Alternative bars may have a lower yield strength-to-ultimate strength ratio, which may cause an issue when stressing bars in the field.
- While using alternative bars is not recommended, if an LDP chooses to use them in prestressed rock and soil applications, the differences in properties must be accounted for in the design.

Technical Note 23, *Non-ASTM A722 Alternative Post-Tensioned Bar Considerations*, details the differences between fully conforming ASTM A722 bars and alternative bars for stress-strain behavior under tensile load, modulus of elasticity, and stress relaxation and creep. It also discusses corrosion considerations. Technical Note 24, *ASTM A722-Like Alternative Post-Tensioned Bar*

Considerations, discusses the relaxation and creep properties in greater detail. Technical Note 24 also discusses accounting for the effects of increased relaxation on relaxation-sensitive applications and provides an appendix that discusses common approaches for force monitoring using instrumentation.

These PTI Technical Notes both indicate that ASTM A722 is a "process specification" that requires bars to be subjected to cold stressing to no less than 80% of the minimum tensile strength followed by stress relieving to produce the prescribed tensile properties. This process produces a high-strength, low-relaxation bar. While ASTM A722 does not contain relaxation requirements, typical test values for relaxation losses in ASTM A722-compliant bars are less than 4% when held at $0.70F_{pu}$ for 1000 hours, where F_{pu} is the specified minimum ultimate tensile strength of the bar. As noted in PTI Technical Note 24, this is consistent with relaxation standards for similar bars found in other international standards. ASTM A722-like material includes bars that may meet the yield strength, tensile strength, and elongation properties of ASTM A722 but are not manufactured using the cold-stress and stress-relief process. As a result, ASTM A722-like material will usually not have relaxation values close to those of an ASTM A722-compliant material.

The cold-stressing technique has additional benefits. As pointed out in Technical Note 23, the cold-stressing technique creates a material that has a linear stress-strain relationship up to yield. It also proof-stresses the bar, which

greatly reduces the probability that a flaw in the bar will cause failure during tensioning in the field.

Technical Note 23 states that PTI DC35.1 allows a maximum design load of $0.60F_{pu}$ and a maximum test load not exceeding $0.80F_{pu}$. For alternative bar materials, the test load of $0.80F_{pu}$ may exceed the yield strength (F_y) of the material, leading to large deformations in the field.

Technical Note 23 concludes with the following:

PTI DC35.1 applies to prestressed ground anchors using prestressing steel conforming to ASTM A416 strands and ASTM A722 bars. While PTI DC35.1 does allow for special prestressing steel materials, the properties of that steel must be equal to or better than ASTM A416 or ASTM A722. This discussion describes the differences between using prestressing steel bars conforming to ASTM A722 and alternative steel bars that are being used in some post-tensioning applications. Direct use of PTI DC35.1 with alternative steel must be carefully considered by the LDP to avoid unsafe conditions and unexpected results during load testing and unexpected behavior during the design life of the structure.

Technical Note 24 addresses the differences in relaxation between ASTM A722-compliant bars and alternative bars in greater detail. While using a prestressing bar that does not meet or exceed the requirements of ASTM A722 is not recommended by PTI DC35.1-14, should an LDP decide to specify that type of prestressing bar, the LDP must understand how the properties of the alternative bar differ from ASTM A722-compliant bars and adjust the design accordingly.

A section in Technical Note 24 accounts for the effects of increased relaxation on relaxation-sensitive applications. It states:

While establishing a specification for ASTM A722-like material is currently a topic of conversation under review by ASTM International, the PTI Committee DC-35, Task Group A722-Like Material, interim recommendations to Owners/Engineers fall under the following categories.

Technical Note 24 then makes the following recommendations:

- Obtain specific bar relaxation properties from the bar manufacturer and adjust calculations accordingly.
- Specify the threshold of relaxation of the bar used.
- Lower the prestress level of the bar.
- Specify a monitoring and retensioning program (Appendix A of Technical Note 24 provides information on instrumentation for monitoring.).

Technical Note 24 concludes with the following statement:

This technical paper intends to provide awareness of the higher relaxation that is possible for high-strength ASTM A722-like bars. The use of this material may require further accommodation in estimating long-term losses and its impact on creep and creep testing methods currently described in PTI DC35.1-14.

Design considerations include obtaining the expected relaxation loss from the manufacturer, specifying the maximum relaxation loss, reducing the stressing load, or force monitoring and/or re-tensioning.

These important technical notes for high-strength, post-tensioned bar can be downloaded for free from the PTI website (<https://www.post-tensioning.org/FAQTECHNICALNOTES>). If you have any questions about this topic or would like additional information, please email technical.inquiries@post-tensioning.org for assistance.

The PTI DC-35 Prestressed Rock and Soil Anchor Committee will include the information found in these technical notes in their current update cycle for the DC35.1 publication. These revisions and others will be issued in the next version of these recommendations, which is planned for release as DC35.1-27.

References

1. Post-Tensioning Institute (PTI). 2014. *Recommendations for Prestressed Rock and Soil Anchors*. PTI DC35.1-14. Farmington Hills, MI: PTI.
2. ASTM International. 2018. *Standard Specification for High-Strength Steel Bars for Prestressed Concrete*. ASTM A722/A722M-18. West Conshohocken, PA: ASTM International.
3. ASTM International. 2024. *Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete*. ASTM A416/A416M-24. West Conshohocken, PA: ASTM International.
4. PTI. 2024. *Non-ASTM A722 Alternative Post-Tensioned Bar Considerations*. PTI Technical Note 23. <https://www.post-tensioning.org/Portals/13/Files/PDFs/Education/PTI-TechnicalNote-23.pdf>.
5. PTI. 2024. *ASTM A722-Like Alternative Post-Tensioned Bar Considerations*. PTI Technical Note 24. <https://www.post-tensioning.org/Portals/13/Files/PDFs/Education/PTI-TechnicalNote-24.pdf>. 



A post-tensioned bar being tensioned in the field. Photo: Pete Speier, Williams Form.