

# pti *Technical Notes*

From M-10: Unbonded Tendon Committee

Issue 20 • December 2015

## Mandatory Barrier Cable Inspection Requirements

Inspection of barrier cable installation in accordance with the PTI M10.4-07, “Specification for Seven-Wire Prestressing Steel Strand for Barrier Cable Applications,”<sup>1</sup> is required to ensure proper functioning and durability of the barrier cable (BC) system. The BC system shall be inspected by a PTI Level 2 Unbonded PT Inspector and shall include the following:

**Note: The following definitions shall be used for the entire document:** The terms “verify,” “verified,” and “verification” indicate spot-checking, observations at critical steps, or forensic observations after an operation. The terms “monitor,” “monitored,” and “monitoring” indicate that an on-site inspector shall be present during the specified operations. The term “BC installation drawings” refers to the latest update issued for construction. Items listed below may not all be applicable to the BC system. Refer to the BC installation drawing for project-specific details.

### 1—INSTALLATION OF EMBEDDED ITEMS PRIOR TO CONCRETE PLACEMENT

Before concrete is placed in any columns or walls that contain barrier cable embedded hardware, the following items shall be verified to be in compliance with the BC installation drawings and applicable codes:

- Proper installation of the BC system, including anchors with pocket formers, polyvinyl chloride (PVC) sleeves, and inserts;
- Spacing between anchors, sleeves, and inserts;
- Height of the topmost anchors, sleeves, and inserts;
- Anchorage zone reinforcement;
- Steel plates with studs or bent reinforcing bar used to attach surface-mounted steel members; and
- Correct grade and size of steel plates located at the specified location.

### 2—INSTALLATION OF SURFACE-MOUNTED STEEL MEMBERS

Before any stressing or back stressing is performed, the following items shall be verified to be in compliance with the BC installation drawings and applicable codes:

- Proper installation of the BC system, including surface-mounted steel members, threaded insert anchors, and barrel anchors with wedges;
- Correct type, grade, and size of the steel members located at the specified location;
- Surface-mounted steel members secured to the concrete with the specified quantity, size, and length of anchor bolts;
- Surface-mounted steel members secured to steel plates with studs or bent reinforcing bar that were previously cast in the concrete, as a minimum, continuously welded on both sides of the steel members or as otherwise specified in the BC installation drawings;
- BC spacing; and
- Height of the topmost barrier cable.

### 3—BARRIER CABLE JACKING FORCE

BC jacking force in each barrier cable shall be monitored by one of the following methods:

- Inspector present during all stressing operations monitoring BC jacking force in each barrier cable; or
- Other method as approved by the licensed design professional.

Each barrier cable shall be stressed to the BC jacking force specified on the BC installation drawings.

Note: Barrier cables are stressed to a force significantly less than the typical  $80\% f_{pu}$  that is used for structural post-tensioning applications (refer to the BC installation drawings and the jack calibration and/or gauge reading supplied by the BC supplier).

### 4—BACK STRESSING

Back stressing force in each barrier cable shall be monitored by one of the following methods:

- Inspector present during all back stressing operations monitoring back stressing force in each barrier cable; or
- Other method as approved by the licensed design professional.

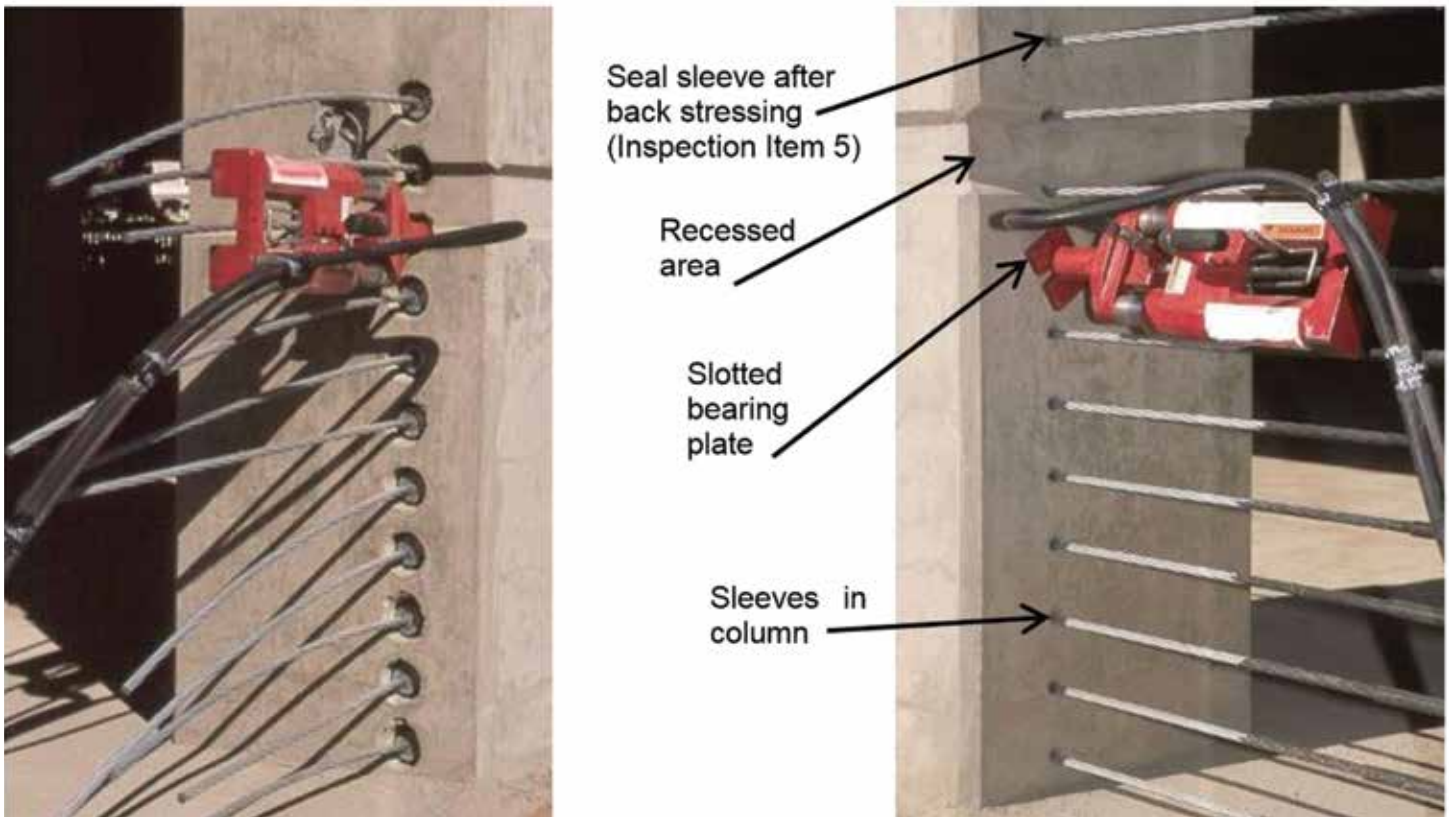
Each barrier cable shall be back stressed to the force specified on the BC installation drawings and recorded in the BC inspection log. Back stressing should be done immediately

after each barrier cable is stressed. Monitor that wedges are seated evenly.

For jobsite-installed anchorages only, an indication that back stressing has occurred is the presence of jack gripper marks (Fig. 2) on the barrier cable on the backside of the column/channel/end terminal condition; verification of the jack gripper marks should not be considered as a confirmation that the full required back stressing force has been applied. Jobsite or plant preinstalled anchorages may not have visible jack gripper marks. The full wedge seating in this case should be verified by the installer or supplier.

## 5—RESTORATION OF CORROSION PROTECTION AFTER BACK STRESSING

Verify that corrosion protection of barrier cables was restored after back stressing according to the BC installation drawings. Check that damaged coating was repaired using methods and materials as specified or approved by the licensed design professional (LDP). Damaged coating materials can be repaired using repair materials and methods compatible with the coating material such as heat-shrink sleeve, silicone caulk, epoxy coating, zinc-rich coating, or other approved materials that will provide protection against corrosion.



(a) Barrier cable being stressed to specified force (refer to the BC installation drawings for BC jacking force)

(b) Barrier cable being back stressed (refer to the BC installation drawings for back stressing force)

**Note:** For back stressing in recessed areas, a level bearing surface must be created by either using an oversized special bearing plate spanning over the recess or by using shims to create a level area.

Fig. 1—(a) Barrier cable stressing; and (b) back stressing.



Fig. 2—Galvanized barrier cable with jack gripper marks after back stressing.

## 6—SEALING SLEEVES IN COLUMNS (WHEN APPLICABLE)

Verify that sleeves in end columns have been sealed per the BC installation drawings to avoid moisture penetration. Use an elastic material that will remain pliable, watertight, and be compatible with the coating material. It shall extend at least 1 in. (25 mm) inside the face of the column (Fig. 1(b)).

## 7—FINISHING

Verify that strand tails were trimmed to the specified length and protected against corrosion as specified, maintaining required concrete cover. Verify that stressing pockets were properly filled with specified or approved material.<sup>2</sup> Verify that stressing pockets were filled within the time period specified. If the strand tails are left exposed to the elements in their final configuration, verify that the strand tails have been protected according to the BC installation drawings.

## 8—BARRIER CABLE INSPECTION LOG

Submit the BC inspection log (Attachment A) to LDP with verification of spacing/height, BC jacking force, and finishing for each barrier cable.

Recording the required inspection items on the BC installation log.

- a. During the initial inspection, inspect items for barrier cable fixed ends, spacing and height, stressing, and finishing. If all the items are in compliance with BC installation drawings, enter “Yes” in the appropriate column. If any item is not in compliance, enter “No” in the appropriate column and indicate which barrier

cable(s) (numbering top to bottom) and what is out of compliance. This information is recorded in the non-compliance/notes column. The installer or inspector enters their initials and the date of the initial inspection.

- b. Any items that were out of compliance during the initial inspection will need to be corrected. Once corrected, a follow-up inspection is required (shaded cells in Appendix A). The inspector will review the noncompliance items and if they have been corrected, will enter “Yes” in the noncompliance items corrected column. The action taken to correct the noncompliance is recorded in the notes column. The inspector enters their initials and the date of the follow-up inspection.
- c. If the BC installation drawings specify different BC jacking forces for each barrier cable (for example, higher BC jacking forces in the impact area), multiple BC installation logs should be used during the inspection. The form is designed to inspect the barrier cables at a single BC jacking force.

## 9—REFERENCES

1. PTI Committee M10, “Specification for Seven-Wire Prestressing Steel Strand for Barrier Cable Applications (PTI M10.4-07),” second edition, Post-Tensioning Institute, Farmington Hills, MI, 2007, 16 pp.
2. PTI FAQ No. 11, “Proper Filling of Single-Strand Tendon Stressing Pockets,” Post-Tensioning Institute, Farmington Hills, MI, 2010, 1 p.



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## Inspection of Barrier Cable Installation Through or Attached to Concrete Columns

Page      of     

Project Name \_\_\_\_\_  
 Site Address \_\_\_\_\_  
 General contractor \_\_\_\_\_  
 Barrier cable supplier \_\_\_\_\_  
 Installation company \_\_\_\_\_  
 Installed by \_\_\_\_\_  
 Inspected by \_\_\_\_\_

Project # \_\_\_\_\_  
 Date \_\_\_\_\_  
 Jack Serial # \_\_\_\_\_  
 Gauge Serial # \_\_\_\_\_  
 Date of For Construction BC installation drawings \_\_\_\_\_  
 Special remarks \_\_\_\_\_

### Barrier Cables at the exterior on lines      and

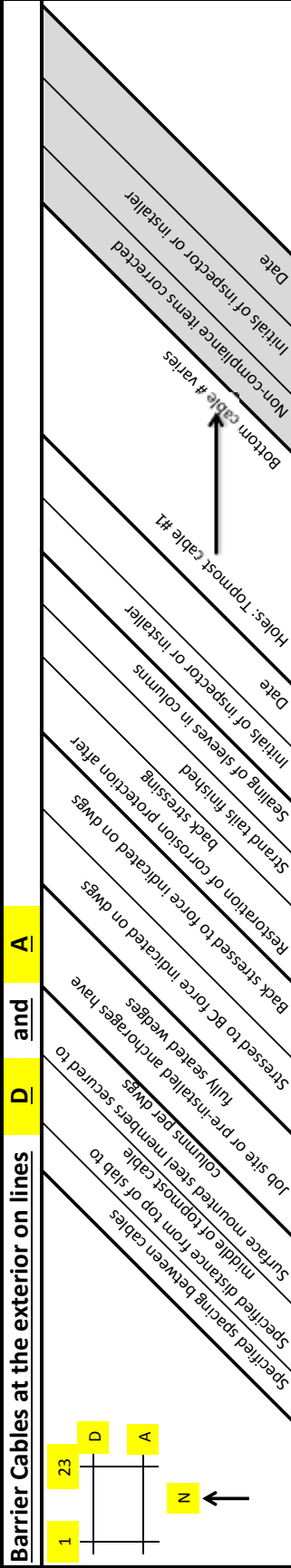


Level	to	Specified jacking force (kips):	Spacing / Height	Fixed-End	Stressing	Finishing	Inspection	Non-compliance / notes	Follow-up (if needed)	Notes
Level										
Level										
Level										
Level										
Level										
&	to									
Level										
Level										
Level										
Level										
Level										

Exterior Slabs

## Inspection of Barrier Cable Installation Through or Attached to Concrete Columns

Project Name \_\_\_\_\_ Project # \_\_\_\_\_  
 Site Address \_\_\_\_\_ Date \_\_\_\_\_  
 General contractor \_\_\_\_\_ Jack Serial # \_\_\_\_\_  
 Barrier cable supplier \_\_\_\_\_ Gauge Serial # \_\_\_\_\_  
 Installation company \_\_\_\_\_ Date of For Construction BC installation drawings \_\_\_\_\_  
 Installed by \_\_\_\_\_ Special remarks \_\_\_\_\_  
 Inspected by \_\_\_\_\_



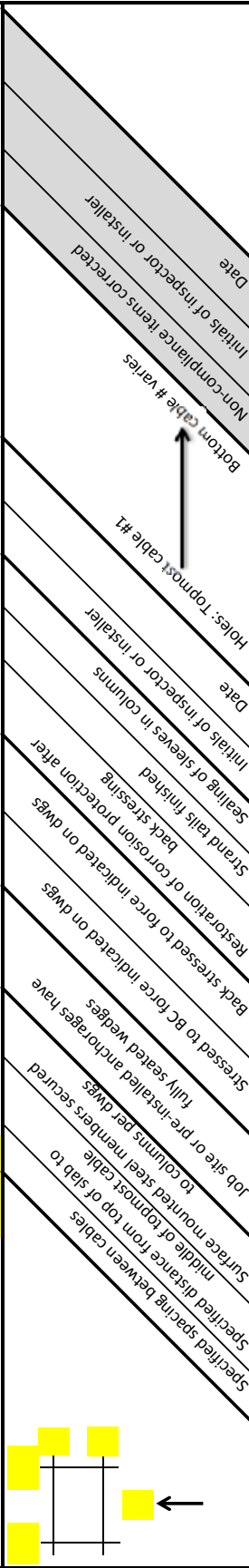
Level	Specified Jacking Force (kips): 3.5		Fixed-End		Stressing		Finishing		Inspection		Non-compliance / notes		Follow-up (if needed)		Notes		
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Specified Back Stressing Force (kips): 33	Specified Gauge Reading (psi): 900	Yes	No		Cable Numbers:	
Level 2	Yes	Yes	Yes	Yes	Yes	No	Yes	N/A	DGS	10/26	Cable #7 did not get epoxy coating.	Yes	PS	11/15	11 - #6 and #10 - #11	Cable was coated with epoxy.	
Level 3	Yes	No	Yes	Yes	Yes	Yes	N/A	DGS	10/26	Angles at lines 10 thru 14 were too low.		Yes	DGS	11/28		All 5 angles were raised 4" so cable #1 was 42".	
Level 4	Yes	Yes	Yes	Yes	Yes	Yes	N/A	DGS	10/26								
Level 5	Yes	Yes	Yes	Yes	Yes	Yes	N/A	DA	11/2								
Level 6	Yes	Yes	Yes	Yes	Yes	No	Yes	N/A	DA	11/2	Cable #1 not back stressed & c. p. restored.	Yes	DA	11/3		Cable was back stressed and epoxy coated.	
<b>Example Exterior Slabs</b>																	
Level 2	Yes	No	Yes	Yes	Yes	Yes	N/A	DGS	10/28	Line 23 tube not welded correctly to steel plate.		Yes	PS	11/21		Tube was cont. welded to embed on both sides.	
Level 3	Yes	Yes	Yes	Yes	Yes	Yes	N/A	DGS	10/28								
Level 4	Yes	Yes	Yes	Yes	Yes	Yes	N/A	DGS	10/28								
Level 5	Yes	No	Yes	Yes	Yes	Yes	N/A	DA	11/2	Inter. angle at line 14 had only one anchor bolt.		Yes	DA	11/3		Additional anchor bolt was added at the bottom.	
Level 6	Yes	Yes	Yes	Yes	Yes	Yes	N/A	DA	11/2								

# Inspection of Barrier Cable Installation Through or Attached to Concrete Columns

Project Name \_\_\_\_\_  
 Site Address \_\_\_\_\_  
 \_\_\_\_\_  
 General contractor \_\_\_\_\_  
 Barrier cable supplier \_\_\_\_\_  
 Installation company \_\_\_\_\_  
 Installed by \_\_\_\_\_  
 Inspected by \_\_\_\_\_

Project # \_\_\_\_\_  
 Date \_\_\_\_\_  
 Jack Serial # \_\_\_\_\_  
 Gauge Serial # \_\_\_\_\_  
 Date of For Construction BC installation drawings \_\_\_\_\_  
 Special remarks \_\_\_\_\_

**Barrier Cables at the ramp along line:**



Ramp	to	Spacing / Height	Fixed-End	Stressing	Finishing	Inspection	Non-compliance / notes	Follow-up (if needed)	Notes
Level	to	Specified jacking force (kips):	Specified gauge reading (psi):	Specified back stressing force (kips):	Cable Numbers:				
Level	to								
Level	to								
Level	to								
Level	to								
Flat	to								
Level									
Level									
Level									
Level									
Level									

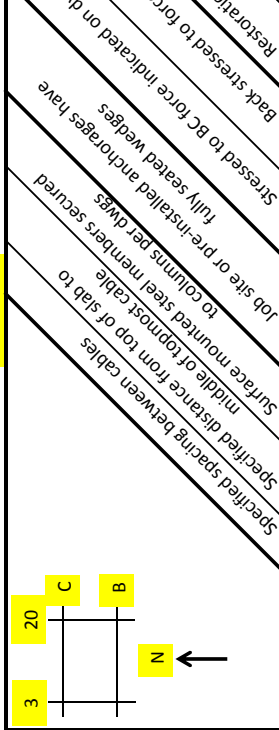
Ramped Slabs

# Inspection of Barrier Cable Installation Through or Attached to Concrete Columns

Project Name \_\_\_\_\_  
 Site Address \_\_\_\_\_  
 \_\_\_\_\_  
 General contractor \_\_\_\_\_  
 Barrier cable supplier \_\_\_\_\_  
 Installation company \_\_\_\_\_  
 Installed by \_\_\_\_\_  
 Inspected by \_\_\_\_\_

Project # \_\_\_\_\_  
 Date \_\_\_\_\_  
 Jack Serial # \_\_\_\_\_  
 Gauge Serial # \_\_\_\_\_  
 Date of For Construction BC installation drawings \_\_\_\_\_  
 Special remarks \_\_\_\_\_

**Barrier Cables at the ramp along line: C**



Ramp 3 to 20	Spacing / Height	Fixed-End	Stressing	Finishing	Inspection	Non-compliance / notes	Follow-up (if needed)	Notes
Specified jacking force (kips): 3.5		Specified Gauge Reading (psi): 900		Specified Back stressing Force (kips): 33		Cable Numbers: #1 - #6 and #10 - #11		
Level 1 to 2	Yes	Yes	Yes	Yes	DGS	Cable #5 did not get galvanized coating	Yes	PS 11/15 Cable was covered with galvanized coating
Level 2 to 3	Yes	Yes	No	Yes	DGS	Cable #3 was not back stressed	Yes	DA 11/2 Cable was back stressed & corrosion protected
Level 3 to 4	Yes	Yes	Yes	Yes	DGS			
Level 4 to 5	Yes	Yes	Yes	Yes	DGS			
Level 5 to 6	Yes	Yes	Yes	No	DGS	Cable #6 needs pocket grouted	Yes	DGS 10/30

**Flat 3 to 20**

Level 2	Yes	Yes	No	No	N/A	Cables #1 thru #11 were not stressed or finished	Yes	DA 11/2 All 4 non-compliance items were corrected
Level 3	Yes	Yes	Yes	Yes	N/A			
Level 4	Yes	Yes	Yes	No	N/A	Cables #10 & #11 did not get galvanized coating	Yes	PS 11/8 Both cables were covered with galvanized coating
Level 5	Yes	Yes	Yes	Yes	N/A			
Level 6	Yes	Yes	Yes	Yes	N/A			

Example Ramped Slabs