SECTION 033800

POST-TENSIONED CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes all labor, material, equipment, and related services necessary to furnish and install all post-tensioned prestressing steel indicated on the drawings or specified herein.

B. Related Sections:

1. 013300 – Submittal Procedures
2. 014500 – Structural Testing, Inspection, and Quality Assurance
3. 031000 – Concrete Forming and Accessories
4. 032000 – Concrete Reinforcing
5. 033000 – Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

A. The latest versions of the publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

1.	ACI 117	Standard Specification for Tolerances for Concrete
2.	ACI 301	Specifications for Structural Concrete for Buildings, and other standards referred to in ACI 318 such as ASTM, AWS, etc.
3.	ACI 423.6	Specification for Unbonded Single-Strand Tendons and Commentary
4.	PTI	Field Procedures Manual for Unbonded Single Strand Tendons

1.4 DEFINITIONS

A. Tendons: The complete assembly consisting of anchorage and prestressing steel with sheathing when required. The tendon imparts prestressing forces to the concrete.

B. Bonded Tendons: Tendons that are bonded to the concrete through grouting or other approved means and therefore are not free to move relative to the concrete.

C. Unbonded Tendons: Tendons in which the prestressing steel is permanently free to move relative to the concrete to which they are applying their prestressing forces.

D. Anchorage: The means by which the prestressing force is permanently transmitted from the prestressing steel to the concrete.

E. Prestressing Steel: That element of a post-tensioning tendon that is elongated and anchored to provide the necessary permanent prestressing force.

F. Coating: Material used to protect against corrosion and/or lubricate the prestressing steel.

G. Sheathing: Enclosure around the prestressing steel to avoid temporary or permanent bond between the prestressing steel and the surrounding concrete.

H. Coupling: The means by which the prestressing force may be transmitted from one partial-length prestressing tendon to another.

I. Encapsulated Tendon: A tendon that is completely enclosed in a watertight covering from end to end, including a protective cap over the tendon tail at each end.

1.5 SUBMITTALS

A. General: Submit the following data and drawings for review and acceptance prior to commencing fabrication.

1. Product Data: Product data indicating specifications, sizes, and materials used shall be provided for prestressing steel, anchorages, sheathing, couplings, accessories, and water-tight tape.
2. Placing Drawings: Placing drawings shall be provided for Architect's review. Placing drawings shall include calculations, stressing sequences, floor openings, calculated elongation, and added reinforcing at anchorages.
3. Calculations:
    a. Calculations shall be prepared by an engineer licensed to perform the work in the jurisdiction where the system will be installed.
    b. Calculations shall show losses due to anchorage seating, elastic shortening, creep, shrinkage, relaxation, wobble friction, and friction due to vertical and horizontal tendon curvature.
    c. Calculations shall show all coefficients used to determine the effective prestress force as well as information used to determine added reinforcing at the tendon anchorage zones.
    d. Placing drawings and calculations shall both be sealed by an engineer licensed to perform the work in the jurisdiction where the system will be installed.
    e. The post-tensioned prestressed slabs are designed based on the tendons being continuous between edges of slabs as shown on the Drawings. Additional intermediate stressing joints or closure strips required by the Contractor will require additional reinforcement. Additional reinforcement shall be designed in accordance with the Drawings and shall be described in detail in the calculations and placing drawings.
    f. Where a number or spacing of tendons is called out on the drawings, minimum final effective tendon force shall equal 26.8 kips per tendon at any location along the tendon length. If calculations show that final effective force is below 26.8 kips per tendon, the Contractor shall add tendons to attain a final effective force greater than or equal to 26.8 kips per tendon.
4. Experience Record: Post-tensioning experience record of Contractor who is to perform post-tensioning work, demonstrating compliance with the paragraph "Installer" below.
5. Marking: Marking method in accordance with the paragraph "Marking" below.
6. Test Reports:
    a. Certified Mill Test Reports for each coil or pack of strand containing, as a minimum, the following test information:
        1) Heat number and identification.
        2) Standard chemical analysis for heat of steel.
        3) Ultimate tensile strength.
        4) Yield strength at 1% extension.
        5) Elongation at failure.
        6) Modulus of elasticity.
        7) Diameter and net area of strand.
        8) Certification that the type of material is low relaxation.
7. Certified Test Reports confirming that the post-tensioning system anchorage meets or exceeds the minimum test requirements of ACI 423.6.

8. Evidence that the proposed post-tensioning system anchorage has been successfully used on projects of similar magnitude.
9. Stressing Records: Submit stressing records to the engineer for approval prior to cutting of tendon tails. Stressing records shall provide the information specified in the paragraph "Stressing Records" below. See the section "Quality Assurance" below for additional requirements.

1.6 QUALITY ASSURANCE

A. General: All post-tensioned concrete work shall be under the immediate control of a superintendent employed by the Prime Contractor with experience in this type of work. The Prime Contractor shall conduct operations as necessary to achieve full compliance with the Contract Documents.

B. Professional Engineer Qualifications: A professional engineer who is registered in the jurisdiction where the project is located and who is experienced in providing engineering services of the kind indicated.

C. Installer: The post-tensioning work shall be performed by a Contractor that specializes in post-tensioning and that has successfully performed five previous installations similar to the one in this project. The post-tensioning Contractor shall supply and install the post-tensioning system. The post-tensioning Contractor shall employ a superintendent who has had five years experience and technical knowledge using the post-tensioning supplied and who will oversee all field handling, placement, and stressing.

D. A Special Inspector shall be present during placement and stressing of the post-tensioning, placement of reinforcing, and placement and testing of concrete. The Contractor is solely responsible for the correctness and accuracy of his construction and shall perform his own independent inspection prior to the Owner's inspection. The Unbonded Post-Tensioned Slab Pre-Pour, Pour, and Stressing Inspection Checklists provided in Appendix A of this section shall be used to assist in quality assurance of slab construction. These checklists provide minimum inspection requirements for the Contractor and Owner's testing agency.

E. No concrete shall be placed in post-tensioned members until placement of tendons and conventional reinforcement steel have been inspected and approved. Provide 24 hours' notice to inspector prior to placing concrete.

F. The Contractor shall convene a pre-installation conference 2 weeks prior to commencing work in this section. The Owner, City Representative, General Contractor, Post-Tensioning System Installation Contractor, Architect, Structural Engineer, and Inspector shall attend.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Furnish concrete materials in accordance with Section 031000, "Concrete Forming and Accessories," Section 032000, "Concrete Reinforcing," and Section 033000, "Cast-in-Place Concrete."

2.2 PRESTRESSING STEEL

A. Prestressing steel shall be 1/2-inch diameter, seven-wire strand, low-relaxation tendons for prestressed concrete manufactured in accordance with ASTM A416, Grade 270 and shall have a minimum ultimate strength of 41,300 pounds.

B. Low relaxation strand shall be provided with mill supplied continuous permanent physical marking to permit field identification or verification that proposed supplier has adequate safeguards to insure that only low relaxation strand is furnished.

C. The material shall be packaged at the source in a manner that prevents physical damage to the strand during transportation and protects the material from deleterious corrosion during transit and storage until it is placed in the formwork.

2.3 ANCHORAGES AND COUPLINGS

A. The anchorages and couplings shall develop at least 95% of the actual ultimate strength of the prestressing steel tendons, without exceeding anticipated set. The actual strength of the prestressing steel tendons shall not be less than specified by applicable ASTM Standards. Actual strengths of the prestressing steel tendons shall be determined by tests of representative samples of the tendon material in conformance with ASTM Standards. The anchorage shall be so arranged that the prestressing force of the tendon may be verified prior to removal of the stressing equipment.

B. Anchorage castings shall be non-porous and free of sand, blow holes, voids, and other defects.

C. The post-tensioning system anchorage shall be specifically suited for unbonded tendons.

D. A fully encapsulated system shall be used at all locations. Anchorages shall provide a watertight, fully encapsulated connection of the tendon sheathing to the anchorage or coupling using either a zero-void or grease-filled tube encapsulation system. Anchors and couplers shall meet all requirements for use in aggressive environments in accordance with ACI 423.6 regardless of location.

E. Bearing Stresses: The average bearing stresses on the concrete created by the anchorage plates shall not exceed the values allowed by ACI 318 and ACI 423.6.

F. All post-tensioning system stressing anchorages shall be capable of lift-off, detensioning, or retensioning a tendon at any time.

G. Additional reinforcement required in local anchorage zones due to post-tensioning forces shall be part of the post-tensioning system anchorage. This additional reinforcing shall be designed by the supplier as specified in Section 1.5-A-3.

H. Bearing surfaces shall be perpendicular to and concentric with the tendons and the line of action of the tensioning force.

2.4 SHEATHING

A. Materials: Tendon sheathing shall be formed by a continuous extrusion process and shall be of sufficient strength to withstand damage during fabrication, installation, and tensioning.

B. Thickness: Waterproof polyethylene sheathing shall be a minimum thickness of 0.050 inches (50 mils).

C. Watertightness: Sheathing shall be connected to all anchorages in a manner that makes it watertight at every place along its length.

D. Damage: Damaged sheathing shall be repaired with waterproof polyethylene tape or duct tape. Extensive damage shall be cause for rejection.

E. Details of Construction: Sheathing shall have an inside diameter at least 0.030 inches larger than the maximum diameter of the strand. Sheathing shall be smooth and solid.

F. Non-Reactive: Sheathing shall be non-reactive with concrete, steel, and the tendons' corrosion preventative coating.

2.5 TENDON COATING

A. Materials: The prestressing steel for unbonded tendons shall be permanently protected against corrosive conditions with a specially compounded, corrosion-inhibiting and lubricating grease meeting PTI recommendations.

B. Application: The grease coating shall be applied under pressure to ensure the filling of the interstices between the individual wires of the strand.

C. The corrosion preventive coating material shall have the following properties:

1. Provide corrosion protection to the prestressing steel.
2. Provide lubrication between the strand and the sheathing.
3. Resist flow from the sheathing within the anticipated temperature range of exposure.
4. Provide a continuous non-brittle film at the lowest anticipated temperature of exposure.
5. Be chemically stable and non-reactive with the prestressing steel, the sheathing material, and the concrete.

D. Coating: The coating film shall be an organic coating with appropriate polar, moisture displacing, and corrosion preventive additives.

E. Weight: Minimum weight of coating material on the prestressing strand shall be not less than 2.5 pounds of coating material per 100 feet of 0.5-inch diameter strand, and 3.0 pounds of coating material per 100 feet of 0.6-inch diameter strand. The amount of coating material used shall be sufficient to ensure complete filling of the annular space between the strand and the sheathing.

F. Test Results: Test results in accordance with Table 1 (see Appendix B) shall be provided for the corrosion preventive coating material. Submit to engineer for review.

2.6 ACCESSORIES

A. Tendons shall be firmly supported, to prevent displacement during concrete placement, by wiring to conventional reinforcing and/or standard reinforcing steel accessories, as recommended by the post-tensioning material supplier.

B. If standard reinforcing steel accessories are required, they shall meet the requirements contained in Section 032000, "Concrete Reinforcing."

2.7 FABRICATION

A. Post-tensioning tendons shall be manufactured in accordance with detailed placement drawings approved by the Engineer.

B. Post-tensioning tendons shall be of the non-fixed length type to allow for possible form adjustments in the event that field conditions generate an unscheduled increase or decrease in member length.

PART 3 - EXECUTION

3.1 PLACING REINFORCING AND TENDONS

A. Placement of mild steel reinforcement shall be coordinated with placement of post-tensioning tendons. Tendons shall not be displaced to clear reinforcing bars, embedments, and embedded electrical conduit except as noted on the Drawings. Place heads where indicated. Coordinate placement of heads with Architectural Drawings. Bring discrepancies to the attention of the Architect.

B. Tendons shall clear openings and drains by a minimum of 3 inches.

C. Deviation in horizontal spacing of the slab tendons is permitted in accordance with Structural Drawings where required to avoid openings and inserts that are specifically located, with engineer's approval. A minimum horizontal radius of curvature of 480 strand diameters shall be provided.

D. Tendons shall have a parabolic profile and shall conform to the control points shown on the Drawings. Dimensions locating this profile apply to the center of gravity of the tendon. Low points of the tendons are at mid-span unless noted otherwise. High points of tendons are at or near slab or beam support points as specified in the Contract Documents.

E. Suitable horizontal and vertical supports or chairs shall be installed as shown on the placement drawings to hold the tendons in true position. Tendons shall be tied to supports or chairs at a maximum of 4'-0" on center. Tendons shall be tied to chairs and supports in such a way that the sheathing is not damaged.

F. Tendons and tendon anchorages shall be firmly supported to prevent displacement during concrete placement.

G. Tendons shall be placed with a vertical tolerance of +/- 1/4 inch in slabs 8 inches thick or less, and +/- 3/8 inch in beams. Tolerance on minimum cover shall be -0, +1/4 inch in slabs, and -0, +3/8 inch in beams. Additional tolerances per ACI 117.

H. Post-tensioning anchorages shall be installed perpendicular to the tendon axis.

I. The ends of prestressing steel will be at least 1 inch inside the edge of the concrete.

J. Tendons shall not be exposed to abrasion, chemicals, flexing movements, excessive temperatures, welding sparks, or electric ground currents.

K. All prestressing steel shall be satisfactorily protected from rust or other corrosion prior to placement. Sufficient protection shall also be provided for exposed prestressing steel at the ends of members to prevent deterioration by corrosion.

L. At temporary construction joints, protect intermediate anchors sufficiently to prevent water intrusion.

3.2 ANCHORAGES

A. Anchorages shall be attached rigidly to secure formwork by bolting or screwing. Minimum concrete cover for anchorages shall be the same as that for reinforcing bars.

B. Pockets for intermediate stressing anchorages shall be formed to positively prevent intrusion of concrete into the anchor cavity. Minimum concrete cover over the face of the anchorage shall be 2 inches.

C. At intermediate anchorages, sheathing shall be repaired with waterproof polyethylene tape as stated in the paragraph "Damage" above.

D. Fixed-end anchorages shall be shop-installed and furnished with a shop-installed watertight cover. The cover shall be shop-installed after filling the void around the wedge grips with a corrosion preventative coating. Fixed end anchorages shall be seated with a load between 75% to 80% of the minimum ultimate tensile strength of the tendon. Minimum clear concrete cover over fixed-end anchorages shall be 2 inches.

E. During stressing of an intermediate anchorage, the sheathing must be locally removed. After stressing, the continuity of the watertight sheath to the intermediate anchorage should be re-established by wrapping the sheath in polyethylene tape or by using a telescopic pipe section.

F. It must be shown that the notches in the strand produced by the teeth of the jack grips during stressing do not significantly reduce the ultimate tensile stress of the strand.

3.3 SHEATHING INSPECTION

A. Prior to placing tendons in the forms, the sheathing shall be inspected for damage and repaired as stated below. Torn sheathing shall be grounds for rejecting the tendon if, in the opinion of the Architect, the damage cannot be adequately repaired in the field.

B. At all locations that sheathing is damaged, tape shall be spirally wrapped around the damaged area of the tendon to completely seal the tendon. The pitch of the spiral shall be such to insure that at least two layers of tape cover all areas. The taped area shall extend at least 3 inches beyond the damaged area in both directions along the tendon.

C. After installation, the contract's testing agency shall reinspect all sheathing and verify a watertight installation.

3.4 MARKING

A. Immediately before new concrete is placed, the position of tendons shall be marked on the forms such that a clear, permanent mark is left on the underside of the slab. The Contractor's proposed method of marking shall be reviewed and accepted by the Architect before starting construction.

3.5 CONCRETE PLACEMENT

A. Concrete shall be placed in conformance with the requirements as outlined in Section 033000, "Cast-in-Place Concrete."

B. Calcium chloride shall not be used as an admixture in post-tensioned concrete.

C. No concrete shall be placed until the tendons have been inspected and approved.

D. Concrete shall be placed in such a manner as to insure that the position of the tendons and reinforcement remains unchanged. If the tendons move out of their designed positions, they shall be adjusted to their correct positions prior to proceeding with concrete placing operations.

E. Special provisions shall be made to insure proper consolidation of concrete in anchorage zones to eliminate any voids or honeycombing and ensure complete concrete filling under anchorages.

3.6 STRESSING

A. The stressing operations shall not begin until tests of the concrete cylinders cured under jobsite conditions indicate that the concrete in the members has attained the compressive strength specified in the Drawings. See Section 033000, "Cast-in-Place Concrete," for testing and curing procedures.

B. Tendons should be stressed within 72 hours after the concrete is placed unless noted otherwise.

C. The tendons shall be stressed by means of hydraulic jacks equipped with calibrated hydraulic pressure gauges to permit the stress in the prestressing steel to be computed at any time. A calibration chart shall accompany each jack. In no case shall a jack and gauge combination be used that has not been calibrated to each other. In order to insure that proper calibration is maintained, care shall be exercised in the handling of all stressing equipment. Stressing rams

and gages shall individually be identified and calibrated against known standards at intervals not exceeding 6 months. Calibration certificates for each jack used shall be available upon request. Hydraulic stressing rams used to stress unbonded single strand tendons shall be equipped with stressing grippers that will not notch the strand more severely than normal anchoring wedges.

D. The stressing operations shall be conducted so that accurate elongation of the prestressing steel tendons can be measured and recorded to the nearest 1/8 inch and compared with calculated elongations. For members greater than 30 feet in length, an agreement within +/- 7% between measured and calculated elongations shall be satisfactory. If inconsistencies exceeding +/- 7% elongation occur, the cause of the inconsistency shall be determined and resolved prior to proceeding with further stressing. For members less than 30 feet in length, measured elongation shall be within 1/4 inch of calculated elongation. Elongation shall be measured at each stressing location to verify that the tendon force has been properly achieved. Calculated elongations shall be based on actual tendon length and actual modulus of elasticity of the prestressing steel as indicated on the mill certificates.

E. Stressing from both ends of the prestressing steel shall be performed when there is excessive friction between the prestressing steel and the sheathing. This shall be clearly called for on the approved placement drawings.

F. The maximum temporary tensile strength (jacking stress) in the prestressing steel shall not exceed 80% of the specified guaranteed minimum ultimate tensile strength of the prestressing steel. The prestressing steel shall be anchored at stresses (initial stress) that will result in the ultimate retention of working forces of not less than those shown in the Drawings, but in no case shall the initial stress at the anchorage exceed 70% of the specified guaranteed minimum ultimate tensile strength of the prestressing steel.

G. Safety precautions shall be taken to prevent workers from standing over or behind the stressing jacks when tendons are being stressed.

H. Finishing Tendons: Trim excess length of tendons by means of abrasive wheel, hydraulic shears, or cutting torch. Do not heat anchor or wedges with cutting torch. The tendon length protruding beyond wedges after cutting shall be 0.5 to 0.75 inch.

I. Coating: The exposed strand and wedge areas shall be coated with tendon coating material (grease) comparable to that used over the length of the tendon. A watertight cap shall also be applied over the coated area of the tendon end within one day after tendon cutting.

J. Stressing Pockets: Stressing pockets shall be filled with an approved non-shrink grout within one day after tendon stressing and cutting. Non-shrink grout shall conform to the requirements of Section 033000, "Cast-in-Place Concrete." Under no circumstances shall the grout used for pocket filling contain chlorides or other chemicals known to be deleterious to the prestressing steel. Prior to installing the grout, the inside concrete surfaces of the pocket shall be cleaned to remove laitance or post-tensioning coating and coated or sprayed with a resin bonding agent conforming to ASTM C881. Finish exposed surfaces to match architectural concrete requirements.

K. The Contractor is responsible for repairing any broken tendons regardless of cause. Repair of broken tendons shall be made in a timely manner such that the original design parameters of the structure are maintained. Broken tendons shall be repaired by splicing, inserting a new strand into the existing sheathing, or other methods approved of in writing by the Engineer.

3.7 SEQUENCING

A. The Contractors shall develop a tendon tensioning sequence that meets the requirements indicated on the Drawings.

B. Stressing Records: Stressing reports shall be filled out during the stressing operation and be submitted to the Architect for review. Stressing reports shall, at a minimum, include the following information:

1. Date of stressing operation and mark of tendon, and identification of area in project.
2. Calculated elongation, based upon elastic modulus and cross-sectional area of tendons used.
3. Actual field elongation of each tendon.
4. Calculated gage pressure and jacking force applied to each tendon.
5. Actual gage pressure and jacking force applied to each tendon.
6. Required concrete strength at time of jacking.
7. Actual concrete strength at time of jacking.
8. Range of allowable elongations for jacking force.
9. Name and signature of the stressing jack operator and the inspector.
10. Serial number or identification number of the jack.

C. Submit copies of actual field records to Architect promptly upon completion of each member. At the time of stressing the first member of each type, check individual tendons to establish procedure for insuring uniform results. See the Unbonded Post-Tensioned Slab Inspection Checklists in Appendix A for additional information.

D. Certify that stressing process and records have been reviewed and that forces specified have been provided.

E. If it appears that design post-tensioning stresses are not being attained, a recheck will be required. Further stressing will not occur until a resolution to this issue is developed by the Contractor and reviewed by the Architect.

F. Do not cut tendon ends until the Contractor receives the Architect's written review of post-tensioning records.

G. Submit written reports as required within 72 hours of stressing.

3.8 REMOVAL OF FORMS

A. Removal of Forms: In accordance with Section 031000, "Concrete Forming and Accessories."

B. Do not remove forms, shores, and bracing until concrete has been tensioned to a strength sufficient to carry its own weight, construction loads, and design loads. Place curing compound on bottom of deck after form removal.

3.9 REPAIR OF SURFACE DEFECTS

A. Repair of Surface Defects: In accordance with Section 033000, "Cast-in-Place Concrete."

B. Modify or replace concrete not conforming to required lines, detail, and elevations.

C. Repair or replace concrete not properly placed that resulted in honeycombing, rock pockets, and other defects.

3.10 FINISHING CONCRETE SURFACES

A. Provide exposed post-tensioned structural concrete surfaces with a finish as specified in Section 033000, "Cast-in-Place Concrete."

3.11 FASTENERS AND CORING INTO SLABS AND BEAMS

A. At penetrations into post-tensioned slabs and beams, fastener lengths for attachment of miscellaneous items shall be limited to the following:

1. 5/8" maximum at slabs.
2. 1" at post-tensioned beams.

B. Coring into post-tensioned beams or slabs is not allowed unless x-ray surveying, scanning, or another submitted and approved method has been performed to accurately locate post-tensioned tendons. X-ray surveying at coring locations may be performed by the testing and inspection agency or by another testing agency under the General Contractor's direction. Trades requesting the coring shall pay surveying costs. No coring operations shall commence without the prior written approval of the Structural Engineer of Record.

APPENDIX A and APPENDIX B attached

END OF SECTION

APPENDIX A

Unbonded Post-Tensioned Slab Inspection Checklists

Contents

Unbonded Post-Tensioned Slab Pre-Pour Inspection Checklist

Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____

Conforms Y	Conforms N	See Comments	
		1	**Preparation**
☐	☐	1.a	Have own set of current approved drawings (Structural, Post-Tensioning tendon placement drawings & Rebar placement drawings)
☐	☐	1.b	Have consulted with Engineer over critical inspection needs for this slab Name of Engineer _____ Engr. Tel.# _____
		2	**Formwork**
☐	☐	2.a	Geometry of drop caps, drop panels, beams, soffit slopes, slab thicknesses, etc.
☐	☐	2.b	Tight, clean & free of puddles
☐	☐	2.c	Reshoring in place if required
		3	**Mild Steel Reinforcing**
☐	☐	3.a	Reinforcing at walls and columns (sizes, lengths, spacings & staggers)
☐	☐	3.b	Bottom mat (size & spacings)
☐	☐	3.c	Beams (top bars, bottom bars, bar cutoff points, stirrups & spacings)
☐	☐	3.d	Additional special locations shown on plans (corners, etc.)
☐	☐	3.e	Cover: Required at top _____ Required at bottom _____
☐	☐	3.f	Clean
☐	☐	3.g	Lap splice lengths (bottom mat, beams, etc.)
☐	☐	3.h	Slab/wall dowels cast into walls & at correct position within slab
☐	☐	3.i	Reinforcing & chairs securely tied
☐	☐	3.j	Proper tools used for field bends
☐	☐	3.k	Proper grade reinforcement
		4	**Post-Tensioning**
☐	☐	4.a	Tendon condition (sheathing intact, no kinks, no tears, etc.)
☐	☐	4.b	Number and location of tendons
☐	☐	4.c	Tendon profiles (all high points and low points checked) Tolerance per drawings _____
☐	☐	4.d	Smooth curvature of tendons (horizontally and vertically)
☐	☐	4.e	Sweep of tendons around blockouts & openings (smooth curvature & radius per drawings)
☐	☐	4.f	Column cap details (precedence of tendon layers, etc.)
☐	☐	4.g	Watertight corrosion protection details
☐	☐	4.h	Tendons, support bars and chairs securely tied at all support locations
☐	☐	4.i	Tendons locations marked on forms for future reference

Unbonded Post-Tensioned Slab Pre-Pour Inspection Checklist (cont.)

Conforms		See Comments	
Y	**N**	**4**	**Post-Tensioning (cont.)**
☐	☐		4.j Anchorages:
☐	☐		4.j.1 Special reinforcing details
☐	☐		4.j.2 Live ends secured tightly to formwork
☐	☐		4.j.3 Dead ends chaired to appropriate profile
☐	☐		4.j.4 Anchors to bear against solid concrete (not near conduit, etc.)
☐	☐		4.j.5 Spacing, stagger & orientation of anchors
☐	☐		4.j.6 Tendon straight into anchor (per placement drawings)
☐	☐		4.j.7 Adequate tails for stressing
☐	☐		4.j.8 Adequate clearance for stressing equipment
			_____
			_____
			_____

Y	N	5	Embedments
☐	☐		5.a Embedments near anchorages approved by engineer
☐	☐		5.b Conduit:
☐	☐		5.b.1 Engineer approval (if not shown on engineer-approved plans)
☐	☐		5.b.2 Maximum approved size _____
☐	☐		5.b.3 Approved material _____
☐	☐		5.b.4 Locations and congestion
☐	☐		5.b.5 Special reinforcing details
☐	☐		5.c Plumbing and other blockouts:
☐	☐		5.c.1 Engineer approval (if not shown on engineer-approved plans)
☐	☐		5.c.2 Maximum approved sizes _____
☐	☐		5.c.3 Locations (specific engineer approval if in drop caps or highly reinforced areas)
☐	☐		5.c.4 Special reinforcing details
☐	☐		5.d Anchor Bolts and Hold-Downs secured in place
			_____
			_____

Y	N	6	Blockouts & Closure Strips
☐	☐		6.a Geometry and location
☐	☐		6.b Special reinforcing details
☐	☐		6.c Special shear key details (if required)
☐	☐		6.d Adequate clearance for stressing equipment (if required)
			_____
			_____

Y	N	7	Other
☐	☐		7.a All details shown on drawings (Structural, Post-Tensioning tendons & Rebar) applied appropriately
☐	☐		7.b Typical details applied appropriately
☐	☐		7.c Projections of walls & columns into slab within tolerance
☐	☐		7.d Special release/slip details applied appropriately
☐	☐		7.e Engineer notified of any conflicts that required modifications
☐	☐		7.f Engineer notified of pour date and of any changes to pour date
			_____
			_____

Unbonded Post-Tensioned Slab Pour Inspection Checklist

Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____

Conforms Y	Conforms N	See Comments	
		1	**Concrete**
☐	☐	1.a	Approved design mix number _____ Slump: Specified _____ Actual Min _____ Actual Max _____
☐	☐	1.b	Contains no chlorides
☐	☐	1.c	Engineer approved admixtures
☐	☐	1.d	No water added in field
			_____ _____ _____ _____
		2	**Protection of Embedded Items**
☐	☐	2.a	Hoses not supported by tendons or other embedded items
☐	☐	2.b	Displaced items corrected immediately
			_____ _____ _____
		3	**Other**
☐	☐	3.a	Concrete consolidation at anchors and congested areas
☐	☐	3.b	Care taken to avoid cold joints
☐	☐	3.c	Care taken to get complete consolidation Method of consolidation _____
☐	☐	3.d	Moist curing applied per specification
			_____ _____ _____

Unbonded Post-Tensioned Slab Stressing Inspection Checklist

Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____
Special Inspector: _____ Date: _____

Conforms Y	Conforms N	See Comments		
		1	**Stressing**	
☐	☐		1.a	Method for curing test cylinders is pre-approved (Method: Field cure similar to in situ)
☐	☐		1.b	Required concrete strength before stressing: 3,000 psi
☐	☐		1.c	Wedge holes cleaned (of cement paste, dirt, plastic, etc.)
☐	☐		1.d	Tendons marked accurately and durably
☐	☐		1.e	Elongation record that clearly identifies all tendons individually (gage pressure, elongation, and date)
☐	☐		1.f	Calibrations for equipment checked. Include serial number of jack
☐	☐		1.g	Safe positions and procedures used
☐	☐		1.h	Engineer & supplier consulted before continuing if problems occur
☐	☐		1.i	Is a consistent dimension used for the elongation datum mark on the strand?
☐	☐		1.j	Is the stressing equipment well maintained?
☐	☐		1.k	Is the stressing ram operator careful with the equipment and consistent from tendon to tendon?
☐	☐		1.l	Are the tendons stressed slowly enough to allow the strand to overcome as much friction as possible prior to seating?
☐	☐		1.m	Are the wedges seated evenly and under pressure?
		2	**Other**	
☐	☐		2.a	Engineer approval of tendon elongation report before tails cut off Approved by _____ Date Approved _____
☐	☐		2.b	Anchors' corrosion protection intact and covers in place?
☐	☐		2.c	Are tendons trimmed with cutoff wheel or shears leaving 0.5" to 0.75" tails?
☐	☐		2.d	Are pockets clean, coated with approved resin bonding agent, and filled with approved non-shrink grout?

APPENDIX B

Table 1 - Performance Specification for Corrosion Preventive Coating

	TEST	TEST METHOD	ACCEPTANCE CRITERIA
1.	Dropping Point °F (°C)	ASTM D-566 or ASTM D-2265	Minimum 300 (148.9)
2.	Oil Separation at 160°F (71.1°C) % by weight	FTMS 791B Method 321.2	Maximum 0.5
3.	Water, % Maximum	ASTM D-95	0.1
4.	Flash Point, °F (°C) (Refers to oil component)	ASTM D-92	Minimum 300 (148.9)
5.	Corrosion Test 5% Salt Fog at 100°F (37.8°C) 5 mils, minimum hours (Q Panel, Type S)	ASTM B-117	Rust grade 7 or better after 1,000 hours of exposure according to ASTM D-610. [1]
6.	Water Soluble Ions [2]		
	a. Chlorides, ppm maximum	ASTM D-512	10
	b. Nitrates, ppm maximum	ASTM D-992	10
	c. Sulfides, ppm maximum	APHA 427D (15th Ed.)	10
7.	Soak Test 5% Salt Fog at 100°F (37.8°C) 5 mils coating, Q panels, Type S (Modified) Immerse panels 50% in a 5% salt solution and exposure to salt fog	ASTM B-117	No emulsification of the coating after 720 hours of exposure
8.	Compatibility with Sheathing		
	a. Hardness and volume change of polymer after exposure to grease, 40 days at 150°F	ASTM D-4289	Permissible change in hardness 15% Permissible change in volume 10%
	b. Tensile strength change of polymer after exposure	ASTM D-638	Permissible change in tensile strength 30%

[1] Extension of exposure time to 1,000 hours for greases used in corrosive environments requires use of more or better corrosion-inhibiting additives.

[2] Procedure: The inside (bottom and sides) of a 1L pyrex beaker, approximate O.D. 105 mm, height 145 mm, is thoroughly coated with 100 ± 10 g of corrosion preventative coating material. The coated beaker is filled with approximately 900 cc of distilled water and heated in an oven at a controlled temperature of 100°F ± 2°F for 4 hours. The water extraction is tested by the noted test procedure for the appropriate water-soluble ions. Results are reported as ppm in the extracted water.