

**MANUAL
FOR CERTIFICATION OF
PLANTS PRODUCING
PRESTRESSED CONCRETE (PC)
STRAND**

First Edition



MANUAL FOR CERTIFICATION OF PLANTS PRODUCING PRESTRESSED CONCRETE (PC) STRAND

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Note: Substantial guidance has been taken from previous work done by others in similar efforts. The format and content produced by the PTI Committee on Certification of Plants Producing Unbonded Tendons was particularly helpful. Additional value was gained by a study of several other programs including the FIP “Report on Prestressing Steel: 4. Principles of quality assurance with respect to prestressing steels”, the Kontrollradet for betongprodukter “Certification Scheme for Concrete Reinforcement”, and the Svensk Byggstallkontroll “Special rules for manufacturers of prestress reinforcing products”.

The incorporation by reference or quotation of this Manual in any specifications, contract documents, purchase orders, drawings, or job details shall be done at the risk of those making such reference or quotation and shall not subject the Post-Tensioning Institute to any liability, direct or indirect, and those making such reference or quotation shall waive any claims against the Post-Tensioning Institute.

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1.0 INTRODUCTION

1.1 Scope and Purpose

The PTI program for Certification of Plants Producing Prestressed Concrete (PC) Strand has been developed to provide independent certification of a factory's manufacturing capability to produce PC strand. The program includes standardization of the reporting practices and documentation utilized to convey information, including material properties, to the end user, and establishes required testing procedures and specified minimum intervals. The certification of a factory under this program indicates that the factory and personnel are capable of producing PC strand in conformance with this program's requirements. This program includes all types and sizes of uncoated PC strand used in post-tensioned concrete reinforcing applications.

1.2 Limitations

This Certification Program is limited to the evaluation of the procedures and the materials used to produce uncoated PC strand. Procedures and materials utilized to coat the PC strand for use as single strand unbonded tendons are covered under a separate PTI Certification Program and are specifically excluded from this program. Certification under this program in no way addresses a factory's capabilities to coat or sheath PC strand.

The Certification Program extends only to the procedures and materials within the examined factory, and is expressly not intended to cover procedures or events subsequent to shipment of PC strand to fabrication plants or to job sites. Furthermore, while it is intended that the inspections reflect the quality of routine PC strand production for a factory, the PTI certification program is expressly not intended for use in certifying the quality of particular PC strand supplied by a factory or its suitability for use on any particular project. PTI does not approve, endorse, or guarantee any product or construction, or in any way make any warranty regarding products or construction design or methodology, including warranties of quality, workmanship or

safety, express or implied, further including, but not limited to, implied warranties of merchantability and fitness for a particular purpose. THE POST-TENSIONING INSTITUTE SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING CONSEQUENTIAL DAMAGES. Acceptance of PC strand as produced for specific uses and/or projects remains the responsibility of the purchaser.

The certification program is limited as stated herein and does not relate to a number of aspects of a post-tensioned project. For example, a post-tensioned project requires sound design and construction practices, the details of which may vary with the application.

Post-tensioning materials must also be installed, stressed, and finished properly. Any errors or omissions in design or construction utilizing PC strand or its installation, stressing, or finishing are the responsibility of others, and shall not in any way be considered to be delegated to, or made the responsibility of, PTI, the PTI certification Program, the Certifying Agencies, or any of their officers, agents or employees.

2.0 PROGRAM CRITERIA

2.1 Eligibility

Any factory producing PC strand for use in prestressed concrete applications shall be eligible to apply for certification under the PTI Certification Program. Membership in the PTI is not required. Associate A members of the PTI are required to participate in this program.

Each applicant factory must have an appropriate organization with competent technical leadership able to carry out the requirements of this program. The Applicant must possess appropriate equipment operated by knowledgeable personnel in all positions.

Each applicant factory must give the Post-Tensioning Institute's inspection agency reasonable access to the factory where the strand is made, for the inspection and observation of strand in production, methods, testing, and records. Each applicant factory must provide English translation services for the inspection agency, including any required translation of documents.

2.2 Base Materials

2.2.1 Wire Rod Requirements

The base metal shall be carbon steel of such quality that when drawn to wire, fabricated into strand, and thermally treated shall have the properties and characteristics prescribed herein.

2.2.2 Storage

Storage of base materials shall be such that the materials (wire rod and/or wire) are maintained in a protected manner to prevent damage and to maintain the identity and traceability of the source and lot numbers.

2.2.3 Records

Orders for base materials (wire or wire rod) must specifically reference the strand manufacturer's own material specification. Receiving documents for base materials shall be kept on file with accompanying mill certificates.

2.3 Wire

2.3.1 Wire Requirement

The wire from which the strand is to be fabricated shall have a dry-drawn finish.

2.3.2 Splices

During the process of manufacture of individual wires for stranding, welding is permitted only prior to or at the size of the last thermal treatment, for example, patenting or controlled cooling. There shall be no welds in the wire after it has been drawn through the first die in the wire drawing except as provided in Section 2.4.1.

2.4 Stranding & Stress Relieving

2.4.1 Splices

There shall be no strand joints or strand splices in any length of the completed strand. During fabrication of the strand, butt-welded joints are permitted in the individual wires, provided there is not more than one such joint in any 150 ft [45 m] section of the completed strand.

2.4.2 Thermo-Mechanical Processes

After stranding, low-relaxation strand shall be subjected to a continuous thermo-mechanical treatment to produce the required mechanical properties. The process shall be conducted at a constant and controlled range of temperature, speed, and stress to insure proper stress relief. This process shall be defined in the Plant QC Manual and monitored and recorded.

2.4.3 Traceability

The manufacturing process shall be controlled and documented in a manner providing identification and traceability with regard to coil of final product and wire rod heat number and coil used to produce the strand.

2.5 Storage and Packaging of Finished Product

2.5.1 Storage

Products must be stored in a protected manner to prevent damage. The product must be protected from corrosion and damage until the customer takes responsibility of the product. Controlled access and product movement shall be used to minimize the possibility of mixing product types. Procedures shall be described in the Plant QC Manual and documented.

While it is not possible to entirely eliminate the possibility of mixing products, it is expected that factories in this program will employ material control methods to minimize and document such conditions.

2.5.2 Packaging

Strand shall be protected during shipment against mechanical injury, which includes damage from corrosion, stress corrosion, or hydrogen embrittlement through contact with deleterious chemicals. Packaging shall meet the purchaser's requirements, or in the absence of specific requirements, shall be appropriate for the environment and conditions that are likely to be encountered during shipping.

2.5.3 Marking

Each coil of strand produced shall have two (2) weatherproof and durable tags affixed that indicate the following:

- Coil Number
- Strand Type (i.e. ASTM A-416 – Low Relaxation)
- Grade
- Size
- Manufacturers name or mark
- Factory name or mark

The coil shall also bear the PTI Certification Mark, indicating that the strand was produced at a PTI Certified PC Strand Plant (factory). DO NOT affix the PTI Certification Mark to any coil that is

not manufactured according the minimum standards of this Program.

2.6 Testing of PC Strand

Tests are required to be performed on the finished product(s) at minimum frequency prescribed below. Test required under Section 2.6.1 and 2.6.2 can be performed in-house. Tests required under Sections 2.6.3 and 2.6.4 shall be performed, or observed and confirmed, by an independent laboratory accepted by the Post-Tensioning Institute. Any testing facility used, whether in-house or other, must be identified completely including physical address and contact information.

2.6.1 Mechanical Properties

Mechanical properties of the strand shall be as prescribed in ASTM A-416 Section 6 for Breaking Strength, Yield Strength, and Elongation. Tests shall be performed in accordance with the methods prescribed in ASTM A-416 and shall be performed on at least every 20 ton lot.

2.6.2 Dimensions and Permissible Variations

All samples tested in accordance with 2.6.1 shall be checked to insure that the PC strand meets the dimensional requirements listed in ASTM A-416 Section 7.

2.6.3 Relaxation Properties

The finished strand shall be tested for relaxation at least annually, but also at any occasion of change of manufacturing method or change in type of raw material. The relaxation test shall be performed according to the requirements of ASTM A-416 Section 6.5 and the requirements herein.

The relaxation test shall be performed as a full 1000-hour test within one year prior to initial certification and every third year thereafter. Interim annual relaxation tests may be performed as 200-hour tests with results extrapolated to 1000 hours provided that the previous full 1000-hour test exhibits satisfactory results.

Additionally, previous or current relaxation results of at least three separate tests of full 1000 hours must be available to evidence acceptable history.

Absent three full 1000-hour results, but with compliance on all other criteria, certification shall be provisional for a maximum of three years, at which time compliance is required for future certification.

2.6.4 Stress Corrosion Testing

The potential for stress corrosion shall be evaluated using the accelerated corrosion test per ISO 15630/3-2002. The test shall be performed on each size, grade, and type of strand, using six samples per test. The test solution used shall be Test Solution A. The minimum allowable value is 2 hours, and the average value shall be not less than 5 hours.

Testing for hydrogen induced stress corrosion shall be performed within one year prior to initial certification and at least once every three years thereafter, or on any occasion of change in the type of raw material or manufacturing process.

2.6.5 Reporting

Testing required under Section 2.6.1 and 2.6.2 shall be reported on the model Post-Tensioning Institute Strand Manufacture Certificate showing appropriate heat / coil identification, steel area, and test results. The manufacturer shall include the modulus of elasticity of the strand on the document. The model certificate shall be provided to the post-tensioning system supplier / fabricator as evidence of compliance. Units must be in imperial units and language must be in English. The PTI Certification mark shall be applied to the certificate.

Testing required under Sections 2.6.2, 2.6.3, and 2.6.4 shall be reported in an identifiable manner and the results are to be provided to the post-tensioning system supplier / fabricator. Units must be in imperial units and language must be in English.

In the event that the Institute or its Certifying Agency discovers that falsified test reports or documents have been submitted or used in support of certification, the applicant factory will be de-certified and ineligible for certification for a period of two years thereafter.

2.7 Records

The manufacturer shall produce and maintain for a period of at least five (5) years the following records related to material production:

- Purchasing records showing the purchase of appropriate base materials used in production.
- Product traceability through production and shipping.
- Testing results for tests required under Section 2.6 of this Program, conformities (or non-conformities), and resultant actions.
- Calibration records for all testing and control devices.
- Statistical records of quality performance evidencing the occasion, frequency, and percentage of accepted and rejected final product. Records shall include internal and external occurrences such as on-site lab results and customer responses.
- Suitability and testing of raw materials including quality reports from wire or rod suppliers.
- Management's annual review of manufacturing, testing, and quality processes.
- Procedure for the quarantine and disposal of non-compliant product and records of same.

2.8 Quality Control Program

The Applicant shall produce and maintain a quality control / quality assurance program that includes the following:

- Written procedures and instructions for all manufacturing and testing procedures.
- Named persons having responsibility and authority over manufacturing, testing, and quality.
- Named person as management's representative having authority to coordinate all of the processes.

3.0 PTI CERTIFICATION PROGRAM ADMINISTRATION

3.1 Certifying Agencies

The Post-Tensioning Institute Director of Certification may recommend certifying agencies to the Certification Committee. The Certification Committee may recommend agencies to the Board of Directors for their appointment. Certifying agencies shall be organizations or individuals competent in analysis of the program requirements and compliance by applicants. Certifying agencies shall be responsible for promptly performing inspections, sampling materials, preparing reports, and forwarding reports to the Certification Director. Certifying agencies shall sign a confidentiality agreement with all participating manufacturers.

3.2 Application

An application for participation shall be submitted by the manufacturer on the appropriate form supplied by the Post-Tensioning Institute. The application shall be accompanied by copies of the Applicant's quality program, sample documents as required by section 2.7, sample production test reports, and periodic test results as required by the certification program. The application shall also be accompanied by remittance of the required fees.

Once the application and supporting documents have been reviewed, and any issues have been resolved, a date will be set for the initial inspection.

3.3 Inspection, Sampling, and Grading

The PTI Certification Program for Plants Producing PC Strand is based on the review of materials, test data, and manufacturing procedures during one scheduled inspection and two unscheduled material tests by a Certifying Agency each year the Factory is involved in the program.

3.3.1 Scheduled Factory Inspection

Certification under this Program is based on a calendar year. During each year a Factory is involved in the Program it will be subject to a scheduled in-depth inspection of its facilities,

records, and materials. The purpose of this inspection shall be to determine whether the procedures of the Factory conform to the requirements of this program. The annual inspection shall cover the items listed in Section 2.0 of this Manual.

3.3.2 Grading

Grading of each of the inspection criteria by the Certifying Agency shall be based on the grading guidelines and forms presented in Appendix A. Grading shall be on a numerical scale which indicates Pass, Marginal, or Unacceptable as indicated below.

- Pass (comparable to a numerical grade equal to or greater than 80)
- Marginal (comparable to a numerical grade equal to or greater than 70 and less than 80)
- Unacceptable (comparable to a numerical grade less than 70)

Passing grades in all seven areas will result in certification. Marginal grades in any of the areas will result in provisional certification and require a passing grade in that area from the next inspection to continue participation. Unacceptable grades in any one area will result in non-certification or decertification of previously certified manufacturers.

3.3.3 Unscheduled Sampling, Testing, and Grading

3.3.3.1 Sampling

Between annual factory inspections, continuing certification will be maintained subject to the sampling of finished production materials by the Certification Agency. Samples will be taken twice per year at times and locations to be determined by the Certification Agency. The Certification Agent or its designated representative may sample the finished product at the Applicant's factory, at the material's Port of Entry into the U.S., or at a designated storage facility. The Applicant shall cooperate fully with the Certification Agency with regards to facilitating the sampling and testing required under this section.

The samples will be divided into three (3) representative lots. One lot will be sent to the Applicant, one to a testing facility chosen by the

Certification Agency and one will be retained for a period of one year by the Certification Agency for retesting and/or dispute resolution.

3.3.3.2 Testing

The samples will be subject to testing per Section 2.6.1 and 2.6.2 of this Manual. Minimum tests results prescribed in ASTM A-416, as applicable to the type and grade of strand as indicated on the products' identifying tag(s) must be achieved and the results should represent the results indicated on the products' mill certificates.

3.3.3.3 Grading

If all test results meet or exceed the acceptable values prescribed in Section 3.3.3.2, and the results closely represent the values listed on the product's mill certificate, the Factory will receive a grade of "Pass". If results meet or exceed the acceptable values but do not represent the values indicated on the mill certificates the factory will receive a grade of "Marginal". If any of the test results fall below the acceptable minimums prescribed in Section 3.3.3.2 the Factory will receive a grade of "Unacceptable".

A "Pass" grade results in continuing Certification under the Program. A "Marginal" grade will result in provisional certification and require a "Pass" grade result from the next material sampling to continue participation. A grade of "Unacceptable" will result in non-certification or decertification of previously certified manufacturers.

3.4 Certification

Once the initial or annual inspection is completed, the inspector will provide a complete report to the PTI Director of Certification. The inspector's evaluation will be reviewed and confirmed by the Director. Any issues raised by the Director's review shall be resolved between the Director and Inspector prior to report to the applicant. The director of Certification will provide a copy of the final report and the results to the applicant. Deficiencies noted in the inspector's report must be addressed by the applicant factory. The applicant factory will provide a written response to the Director of Certification within sixty days of the receipt of the report. Upon successful certification, the manufacturer may use the PTI Certification mark until such time permission is revoked.

3.5 Re-Inspection

Factories which do not pass the initial in-depth inspection, or subsequent inspections, may request re-inspection. Such requests shall be made in writing to the Post-Tensioning Institute within 21 calendar days of receiving the PTI Certifying Agency's evaluation report. It shall include a statement that the deficiencies noted in the previous inspection have been corrected and a detailed explanation of what was done to correct the deficiencies.

Factories which do not pass the material testing prescribed in Section 3.3.3 may request retesting. Such requests shall be made in writing to the Post-Tensioning Institute within 21 calendar days of receiving the PTI Certifying Agency's evaluation report. The request shall include a statement either disputing the results or accepting the results. If the results are disputed the request shall be accompanied by results from the Applicant's tests of the same material, along with a certification from the Applicant that the tests were performed on the samples received from the Certifying Agency. If the results are accepted the request shall be accompanied by a statement of what was done to correct deficiencies and a statement regarding the disposition of the lot in question.

Requests must be accompanied by the re-inspection fee prevailing at that time.

Factories properly requesting re-inspection or testing will be maintained on the PTI List of Certified Factories until the re-inspection report is received by PTI. Copies of re-inspection reports will be issued to the factory per Section 3.4.

3.6 Appeal Procedure

In the event that a dispute arises between the applicant and the Certifying Agency concerning the report, the applicant may appeal the decision to the PTI Director of Certification within 21 days of receiving the Certifying Agency's evaluation report. Applicant shall state in writing its position to the PTI Certification Director. The PTI Certification Director shall refer the matter to an Appeal Board.

The Appeal Board shall consist of five members. Three of the members shall be appointed by the PTI President, two of whom shall be professional members and the third shall be a company

member who serves as chairman. One member shall be a representative designated by the applicant, and one member shall be the principal of the Certifying Agency. Applicant shall be afforded a full opportunity, in person and by counsel if desired, to be heard by and to present any relevant additional evidence to said Appeal Board.

In the case of a conflict of interest that arises due to the PTI President being a principal or employee of the Applicant requesting the appeal, the PTI Vice President shall assume the role of appointing the Appeal Board members listed above.

The PTI president shall not serve on the Appeal Board. No person who is an officer, employee, or is otherwise affiliated with the Applicant shall serve on the Appeal Board.

The decision of the Appeal Board shall be submitted to the applicant and to the Certifying Agency. The Appeal Board's decision concerning the disposition of the evaluation report shall be final.

The applicant shall bear the costs of conducting a review including the Appeal Board's meeting costs, if meetings are required.

3.7 Renewal

The PTI Certification Program operates on a calendar year basis. During December of the year in which the initial Certificate of Certification was issued and each subsequent year, each certified factory shall submit a written request for renewal of certification to the Post-Tensioning Institute on the form provided by PTI for that purpose. The application for renewal shall be accompanied by test data required by this manual if any material or process was modified since the last inspection. The certification fee as set for the coming year shall accompany the request. Factories requesting renewal of certification will be maintained on the PTI list of certified factories until such time that future inspection evaluation reports may necessitate a change. Factories not requesting renewal of certification during December will automatically be dropped from the list of PTI Certified Factories on December 31st.

3.8 Grievance Procedure

All participants in this Program shall be subject to inspection, sampling, testing, grading and notification over and above that set forth in Section 3.3 based on written complaints from any person identifying him or herself, which come to the attention of PTI, and which pertain to the subject matter of the Certification Program criteria and which appear to have a reasonable basis. PTI shall deal with all such complaints within a reasonable time. All other procedures set forth in Sections 3.3, 3.4, 3.5 and 3.6 shall pertain to complaints instituted hereunder.

The costs of any additional inspection(s), material sampling, or testing resulting from the provisions of this section are to be paid by the Participant at the rate(s) prevailing at the time.

3.9 Fees

Fees to be paid by the Applicant for participation in the PTI Certification Program are set by the PTI Board of Directors to cover the costs of maintaining the program. The current fee schedule is available upon request from the PTI office.

3.10 Changes

The PTI Certification Committee shall periodically review the contents of this Manual to determine if the procedures can be improved. If the Committee deems that changes in the procedures should be made, the Committee shall recommend to the PTI Board of Directors that specific changes be made. If the Board of Directors Approves the changes, a notification shall be sent to all participating factories, and the changes shall be put into effect 60 days after the approval date. Changes will not effect certification in effect prior to the effective date, but will be considered when subsequent inspections are made.

3.11 List of PTI Certified Strand Producing Factories

The Post-Tensioning Institute shall publish semi-annually a current list of Certified Factories Producing PC Strand. The list shall be based on evaluation reports received from the Certifying Agencies indicating which factories have met the criteria for a PTI Certified PC Factory.

4.0 Quality Issue Reporting

Users of Prestressed Concrete Strand may occasionally report quality issues regarding Certified PC Strand Factories to the Director of Certification. Such reports will be confidential. The Director of Certification may require the subject factory to make a formal response to the Certifying Agency regarding corrective actions. The Certifying Agency may require additional testing of randomly sampled materials from the subject factory.

APPENDIX A

GUIDELINES FOR GRADING

The following guidelines are to be used in conjunction with the factory grading checklist during on-site factory inspections.

Section 2.2 Base Materials

- 2.2.1 **Wire Rod Requirements** – Compliance with this Section is required to receive a “Pass” grade
- 2.2.2 **Storage** – Storage of base materials in protected area(s) will result in higher grades
- 2.2.3 **Records** – Organized, complete, and traceable record keeping will result in a higher grade

Section 2.3 Wire

- 2.3.1 **Wire Requirement** – Wire must have a dry drawn finish to receive a “Pass” grade, otherwise an “Unacceptable” grade will be issued.
- 2.3.2 **Splices** – Material inspected must conform to this Section to receive a “Pass” grade.

Section 2.4 Stranding & Stress Relieving

- 2.4.1 **Splices** – Strand joints or splices on inspected material will result in an “Unacceptable” grade
- 2.4.2 **Thermo-Mechanical Process** – Processes that are tightly controlled and performed at 734°F [390°C] will receive a higher score.
- 2.4.3 **Traceability** – Organized and traceable processes will result in a higher score.

Section 2.5 Storage & Packaging

- 2.5.1 **Storage** – Storage of the finished strand in protected area(s) and inspection at regular intervals will result in a higher score.
- 2.5.2 **Packaging** – Packaging will be compared with the method of delivery and distance in transit to predict that the method used will result in proper protection of the strand. Failure to adhere to purchasers requirements may result in a grade in the “Unacceptable” to “Marginal” range.
- 2.5.3 **Marking** – Weather proof and durable tags showing all required information will result in a higher score. Missing tags, tags with missing information, or the use of non-durable tags may result in a score in the “Marginal” or “Unacceptable” range.

Section 2.6 Testing of Finished Product

The lowest score received in any of the sub-sections below will be carried forward as the recorded grade for this Section (i.e. – It takes a grade of “Pass” in all of the areas to receive a “Pass” grade for this Section).

- 2.6.1 Mechanical Properties** – Strict adherence to minimum required values and intervals must be maintained in finished product shipped to customers. Testing that reveals inconsistent product may receive a lower score.
- 2.6.2 Dimensions** – Strict adherence to dimensions and tolerances must be maintained in finished product shipped to customers. Inconsistency in product dimensions may result in a lower score.
- 2.6.3 Relaxation Properties** – The score should reflect the consistency of test results and the testing frequency. Failure to meet minimum intervals and strict adherence to Section 2.6.3 may result in a grade in the “Unacceptable” range.
- 2.6.4 Stress Corrosion Testing** – Tests that indicate values below the required minimum or average results will result in an “Unacceptable” score for this section.
- 2.6.5 Reporting** – Evidence that shows probability that the information is being correctly reported to the customer, along with consistent and comprehensible reporting using the model form provided will result in a higher score.

Section 2.7 Records

Consistent, comprehensible, and traceable reporting will result in a higher score.

Section 2.8 Quality Control Program

Complete and concise programs that production employees are familiar with will receive a higher score.

APPENDIX B – Application and Contract
PTI PC STRAND PLANT CERTIFICATION APPLICATION

Date: _____

1. **Applicant (Company) Name** _____

Factory _____ Address: _____

Factory _____ City, _____ State, _____ Postal _____ Code: _____

Factory _____ Country: _____

Factory _____ Phone _____ Number _____ Fax: _____

Applicant is _____ is not _____ a PTI member

2. **Name of Person to Contact** _____

Contact Mailing Address: _____

Contact City, State, Postal Code: _____

Contact Country: _____

Contact Phone Number _____ Fax: _____

3. **Description of product(s) and Trade Name(s)** _____

4. **Data Submitted** (please indicate): Enclosed _____ Under Separate Cover _____

Please list data submitted _____

5. **Fee:** Check or money order (in U.S. dollars) enclosed in the amount of _____

Application will not be processed until check or money order and all information required by PTI are received. In addition, applicant must be in good financial standing with PTI.

Proposed Fee	1st Year Application (or Re-application for Decertification)**	Subsequent Years (Renewals)
Domestic Member Plants	\$7,500	\$6,000
Domestic Non-Member Plants	\$10,000	\$9,000
International Member Plants	\$13,500	\$12,000
International Non-Member Plants	\$15,000	\$14,000
<i>**Note: 1st year fee includes allocated program development costs.</i>		

PTI PLANT CERTIFICATION CONTRACT

This agreement is entered into by and between the Post-Tensioning Institute (PTI) and _____ (PARTICIPANT) with respect to factory(s) described in Exhibit A attached hereto.

WHEREAS:

- A. PTI has developed and published its Manual for Quality Control and Certification of Plants Producing PC Strand for Post-Tensioning Applications (Manual); and
- B. PTI has adopted a program for Certification of Plants Producing PC Strand for Post-Tensioning Applications; and
- C. PTI and PARTICIPANT desire to review the PARTICIPANT'S compliance with specified provisions of the Standard through a series of voluntary inspections;

NOW THEREFORE, in consideration of the payment of fees by PARTICIPANT to PTI, and in consideration of PTI's agreeing to administer the certification program, it is hereby agreed as follows:

1. **Plants:** This agreement applies to the PARTICIPANT'S factories listed in Exhibit A.
2. **Fees:** Fees are charged to PARTICIPANT on a per factory basis, as set by the PTI Board of Directors and are payable by PARTICIPANT in advance.
3. **Inspections, Grading, and Certification:**
 - (a) Inspections will be conducted by a Certifying Agency appointed by PTI. PTI retains sole authority in the appointment of the Certifying Agency.
 - (b) Inspections, grading, and certification shall be conducted as described in the Manual which is incorporated herein by reference.
 - (c) Inspections will be conducted on dates scheduled by the Certifying Agency.
 - (d) PARTICIPANT agrees to cooperate fully with the PTI appointed Certifying Agency and its employees.
 - (e) Immediately following inspections, the inspector will be available for consultation with factory management.
4. **Confidentiality:** Except as required by legal order or otherwise required by law, neither PTI nor the inspecting agency nor any of its employees shall reveal any data or grading with respect to any factory inspected at PARTICIPANT'S request, other than PARTICIPANT'S authorized representatives, except with PARTICIPANT'S written consent
5. **Term:** This contract shall become effective on the first day of the month following payment of inspection fees. Contracts are for a maximum of one year and expire on December 31 of each year. Renewal shall be in accord with the Manual.
6. **Application:** Application for certification shall be made in such form as PTI may from time to time prescribe.
7. **Certification, Certificate, and Certification Mark upon Certification:**
 - (a) PARTICIPANT shall receive a Certification Certificate.
 - (b) PTI will grant PARTICIPANT the right to use, in conformance with this agreement, the appropriate Certification Mark for use on stationary and for advertising purposes.
 - (c) It is understood by PARTICIPANT that in issuing a certificate and Certification Mark and authorizing its use, PTI does not approve, endorse, or guarantee any product, system, or construction,

or in any way make any express or implied warranties in connection with any product, system, or construction.

(d) The Certificate and Certification Mark remain the property of PTI and must be surrendered by PARTICIPANT immediately in the event of decertification or voluntary withdrawal from the program and any use of literature, documents, or any other items bearing the Certification Mark must immediately cease.

(e) PARTICIPANT agrees that certification is limited to manufacturing procedures and materials essentially identical to the specimens tested in support thereof.

8. **Agreement Compliance:** PARTICIPANT promises to abide by the terms of this agreement. PARTICIPANT understands that PTI reserves the right to change the terms and conditions governing certification and use of Certification Marks from time to time, and PARTICIPANT shall abide by such changed provision upon receipt of notice thereof or otherwise completely withdraw from the certification program by surrendering its certificates and foregoing the right to use the Certification Mark. Violation of the Agreement, or any part thereof, including, without limitation, any misrepresentation by PARTICIPANT or misuse of the Certification Mark, constitutes grounds for PTI to withdraw PARTICIPANT’S privilege to participate in the Certification Program. In the event PARTICIPANT is notified in writing by PTI that such withdraw has occurred, PARTICIPANT shall immediately surrender its certification and cease using the Certification Mark or facsimile thereof in any way.

9. **Indemnification and Waiver of Claims:** PARTICIPANT agrees to indemnify, hold harmless and defend PTI from any and all liability, loss, expenses, or damage, including court costs and attorney’s fees, PTI may suffer as a result of any matter arising from any action undertaken by PTI pursuant to this agreement, including, without limitation, any claims, demands, costs, or judgments against it arising from the testing or certification of PARTICIPANT’S systems by PTI, or from PARTICIPANT’S use of the Certification Mark, or from the use or operation of the certified systems or any certificate issued under this application whether the liability, loss, expense, or damage is caused by, or arises out of negligence by PTI or its officers, agents, employees, or otherwise. PARTICIPANT further agrees that it hereby waives any claim it may have against PTI arising from any action undertaken by PTI pursuant to this agreement, including, without limitation, the accidental or negligent release of data by PTI or from the negligent performance of tests by PTI.

10. **Affidavit:** PARTICIPANT agrees to submit an affidavit that all statements in this application and its submitted materials are true.

11. **Choice of Law:** Any disputes arising under this agreement shall be governed by the law of the state of Illinois.

IN WITNESS THEREOF, the parties have executed this contract the day and year first above written.

Post-Tensioning Institute

Participant Company _____

By _____

By _____

Title _____

Title _____

Signed and Sworn to Before me

this ____ day of _____, 20____

Notary Public

EXHIBIT A – LIST OF PLANTS SEEKING CERTIFICATION

The following is a list of the applicant’s factory(s) seeking certification, including address, phone number, and contact person.

1. Factory Address: _____

Factory City, State, Postal Code: _____

Factory Country: _____

Factory Phone Number _____ Fax: _____

Factory Contact: _____

2. Factory Address: _____

Factory City, State, Postal Code: _____

Factory Country: _____

Factory Phone Number _____ Fax: _____

Factory Contact: _____

3. Factory Address: _____

Factory City, State, Postal Code: _____

Factory Country: _____

Factory Phone Number _____ Fax: _____

Factory Contact: _____

4. Factory Address: _____

Factory City, State, Postal Code: _____

Factory Country: _____

Factory Phone Number _____ Fax: _____

Factory Contact: _____

APPENDIX C – Confidentiality Agreement

CONFIDENTIALITY AGREEMENT

This agreement, dated as of this _____ day of _____, 20____, by and between “Certifying Agency” and _____ (“PARTICIPANT”).

Whereas, during the course of the Post-Tensioning Institute’s (“PTI”) inspection program for Certification of Plants Producing PC Strand (“Certification Inspection”) the Certifying Agency reviews PARTICIPANT’S compliance with specified provisions of the *PTI Manual for Quality Control and Certification for Plants Producing PC Strand* (“Manual”);

Whereas, such review of compliance requires Certifying Agency to examine and review files, data, documents and other materials of PARTICIPANT which are, in PARTICIPANT’S sole judgment, confidential and proprietary or trade secret information (“Information”);

Whereas, the certification program requires execution of an agreement between PTI and PARTICIPANT which prohibits revelation of any data or grading with respect to any factory visited during a Certification Inspection; and

Whereas, the parties desire to clarify their rights and obligations respecting Information;

Now therefore, in consideration of the mutual promises set forth below and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties agree as follows:

1. The Certifying Agency shall not copy or remove from PARTICIPANT’S premises any Information examined or otherwise revealed to it during a Certification Inspection without the express written permission of PARTICIPANT.
2. The Certifying Agency agrees not to reveal for any purpose, or use, for purposes other than the Certification Inspection, at any time, any and all Information examined or otherwise revealed to it during a Certification Inspection without the express written permission of PARTICIPANT.
3. The term “Information” shall not include general knowledge of materials, processes, data, or information which comes into the public domain not due to the fault of the Certifying Agency.
4. Any amendment or waiver of the terms of this Agreement shall be made only in writing executed by the parties. Any waiver of the terms of this Agreement shall not act as a subsequent waiver of the same or similar terms. Any disputes arising under this Agreement shall be governed by the laws of the State of _____.

In witness whereof, the parties have executed this agreement as of the date set forth above.

Certifying Agency

Participant

APPENDIX D – Application for Renewal

PTI CERTIFICATION RENEWAL APPLICATION FOR PLANTS PRODUCING PC STRAND FOR POST-TENSIONING APPLICATIONS

Date: _____

1. **Applicant (Company) Name** _____

Factory Address: _____

Factory City, State, Postal Code: _____

Factory Country: _____

Factory Phone Number _____ Fax: _____

Applicant is _____ is not _____ a PTI member

2. **Name of Person to Contact** _____

Contact Mailing Address: _____

Contact City, State, Postal Code: _____

Contact Country: _____

Contact Phone Number _____ Fax: _____

3. **Description of product(s) and Trade Name(s)** _____

4. **Nature of modification(s)** since the last inspection (if none, so state): _____

5. **Renewal** covers all of applicant's factories listed in Exhibit A for the calendar year _____

6. **Fee:** Check or money order (in U.S. dollars) enclosed in the amount of _____
Application will not be processed until check or money order is received. In addition, applicant must be in good financial standing with PTI.

Firm Name

Signature of Proprietor, Partner, or Authorized
Officer and Title

EXHIBIT A – LIST OF PLANTS SEEKING RENEWAL OF CERTIFICATION

The following is a list of the applicant’s factory(s) seeking certification, including address, phone number, and contact person.

- 1. Factory Address: _____
Factory City, State, Postal Code: _____
Factory Country: _____
Factory Phone Number _____ Fax: _____
Factory Contact: _____

- 2. Factory Address: _____
Factory City, State, Postal Code: _____
Factory Country: _____
Factory Phone Number _____ Fax: _____
Factory Contact: _____

- 3. Factory Address: _____
Factory City, State, Postal Code: _____
Factory Country: _____
Factory Phone Number _____ Fax: _____
Factory Contact: _____

- 4. Factory Address: _____
Factory City, State, Postal Code: _____
Factory Country: _____
Factory Phone Number _____ Fax: _____
Factory Contact: _____

APPENDIX E

Sample Mill Certificate Form

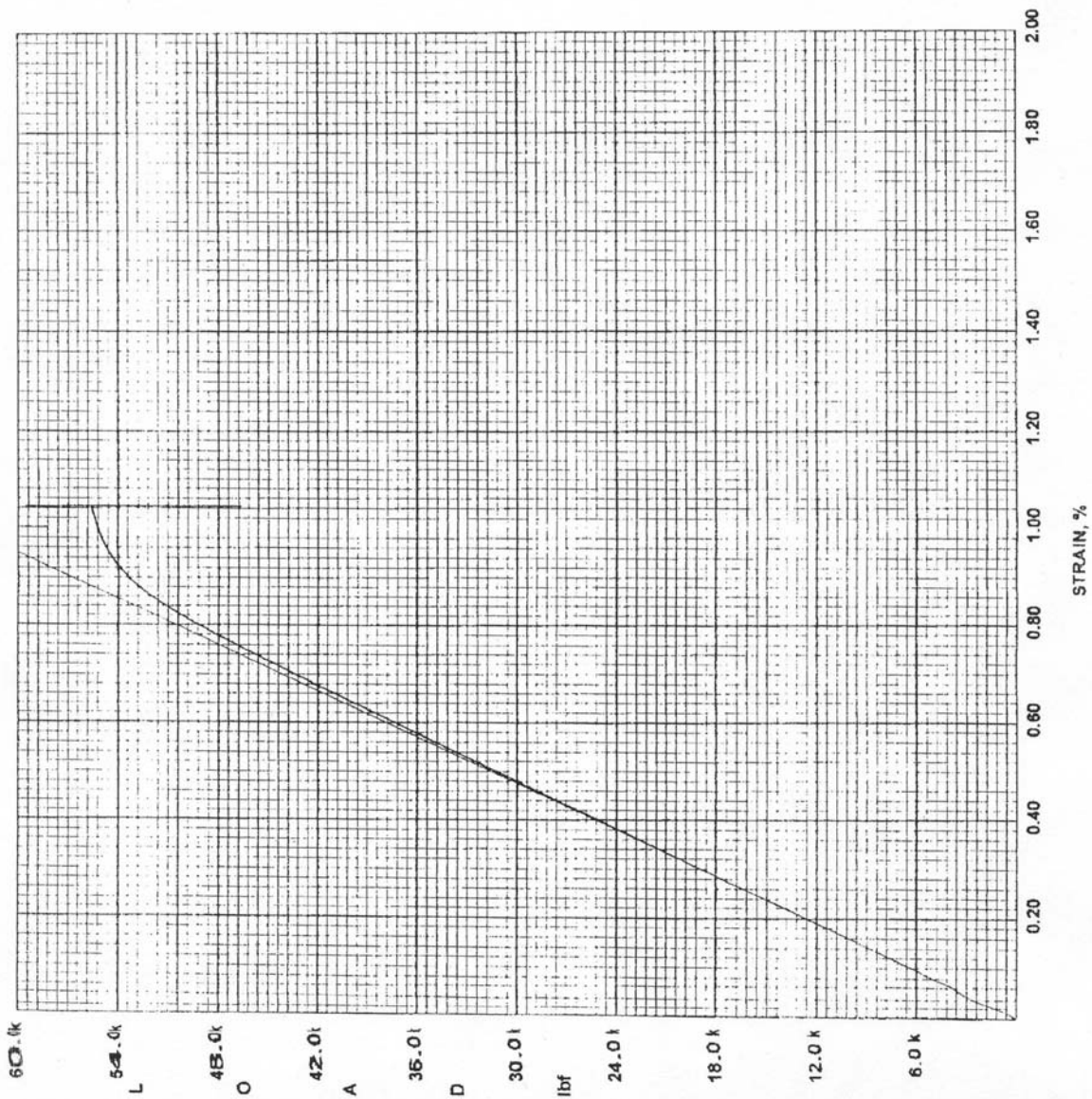
P C Strand (ASTM A416)

Reel Number
 Size
 Grade
 Lay Length
 Tested By

Carbon %
 Manganese %
 Phosphorus %
 Sulfur %
 Silicon %

Sample:

Avg. Strand Diam., in:
 Area, in²:
 Difference (CW - OW), in:
 Ultimate, lbf:
 Yield Load, lbf:
 Modulus, Mpsi:
 Yield Tensile Ratio, %:
 TE, %:



APPENDIX F

Accelerated Corrosion Test

Ammonium Thiocyanate Test on Tensioned Strand Sample

1. Introduction: In the late 1970s, the International Stressing Federation (ISF) elaborated a corrosion test representative of the phenomena which play a determinant part in fractures by cracking stress corrosion and, consequently, detecting products the use of which, in traditional conditions, presents notable risks.

The corrosion test defined to be reproducible, easy to be usually carried out and representative of tensioned strand behavior in front of brittling by hydrogen induced in steel after stress corrosion reactions, which is a prime factor of the resistance to cracking stress corrosion. The test is in no means geared towards the medium to which tensioned steel are practically exposed, but the intrinsic tensioned steel brittling reactions to induced hydrogen.

2. Brittling by Hydrogen: The test renders the steel brittle due to the decrease of its tensile properties. As the test name indicates, the brittling is caused by induction of hydrogen molecules in the steel. These hydrogen molecules either settle in the molecular network (H), or settle in micro-cavities of the molecular network (H₂) under pressures that can be quite considerable.

Hydrogen induction in fractures disrupts the tensile properties of the steel, thus favoring propagation of the cracking. In order for the test to be successful, hydrogen is indispensable. Indeed, as its molecule originates from the reduction reaction of H⁺ ions, and other ions such as selenium and arsenic esters, sulfates and hydrosulfates, its induction into tensioned steel is greatly facilitated. Conjunctionally, cathode and anode polarization accelerates the steel's reaction to induction.

3. Test Described in the International Standards (ISO 15630/3-2002)

“ISO/FDIS 15630-3 – Steel for the reinforcement and prestressing of concrete – Test methods”

10. Stress corrosion test in a solution of thiocyanate

10.1. Principle of test: The test determines the time to fracture of a test piece maintained at a constant tensile force and immersed in a solution of thiocyanate (see 10.3.5), at a given temperature.

10.2. Sample and test piece The general provisions given in clause 4 apply to the sample which should provide not less than 6 test pieces for the stress corrosion test and 2 test pieces for the determination of $F_{m,m}$ (value of the maximum force) by a uniaxial tensile test when the initial force F_0 is expressed as a percentage of $F_{m,m}$, e.g. 80% $F_{m,m}$. The length of the test piece L_I shall be sufficient to ensure that any bending from the anchorage is minimized and should be preferably twice the length of L_0 (gauge length).

10.3 Test equipment

10.3.1 Frame A stiff frame shall be used. Loading shall be applied by a lever apparatus or by a hydraulic or mechanical device acting on a closed frame in either horizontal or vertical orientation.

10.3.2 Force measuring device A force measuring device with an accuracy of at least $\pm 2\%$ shall be used and calibrated in accordance with ISO 7500-1.

10.3.3 Time measuring device The time shall be measured with a resolution of at least 0.01 hour (decimal hours) The time measuring device shall be equipped with an automatic control to stop and retain or record the time at fracture with an accuracy of ± 0.1 hour. Alternatively, the time to fracture shall be the last manually recorded time prior to fracture.

10.3.4 Cell containing the test solution The cell containing the test solution should preferably be cylindrical and sealed at both ends. It shall have a minimum inner diameter, D_c , in accordance with the following formula: $D_c \geq \sqrt{(200 + d) \times d}$ (all dimensions in mm) Recommended inner diameters, D_c' , are given in Table 5.

Table 5 – Recommended inner diameters, D_c' , of the test cell Diameter of the test piece, d
Recommended values of D_c $d \leq 19$ Min. 70 $19 < d \leq 50$ Min. 100 The cell length shall be sufficient to

accommodate a test length, L_o , of at least 200mm. The cell shall be manufactured from a material which is chemically resistant to the test solution at 50° C. The cell shall be kept closed during the test and admission of air shall be avoided.

10.3.5 Test solution The test solution can be selected from one of the two specified below which present respectively a high and low concentration of thiocyanate: - Solution A (used by ISF): aqueous solution of ammonium thiocyanate prepared by dissolving 200g of NH_4SCN in 800ml of distilled water or demineralized water. The ammonium thiocyanate shall be of analytical grade containing at least 99% of NH_4SCN and a maximum of 0.005% Cl^- , 0.005% of SO_4^{2-} , and 0.001% S^{2-} . - Solution B: aqueous solution of ammonium sulfate (K_2SO_4), potassium chloride (KCl) and potassium thiocyanate (KSCN) prepared with distilled water or demineralized water. Test solution B shall contain 5g of SO_4^{2-} , 0.5g of Cl^- , and 1g of SCN^- . The electrical conductivity of the water used for the preparation of solutions A and B shall not exceed $20\mu\text{S}/\text{cm}^{-1}$. Test Solution A is recommended by the ISF

10.4 Test procedure

10.4.1 Provisions concerning the test pieces The test pieces shall be cleaned by wiping with a soft cloth and degreased, e.g. with acetone (CH_3COCH_3) and dried in air. The test piece shall be protected from corrosion by varnish or similar means in the zone where the test piece enters the test cell and for at least 50mm into the inner part of the cell. The test length (L_o) is the length of the test piece in contact with the solution.

10.4.2 Application and maintenance of force The test piece is placed in the tensioning frame and the cell placed on the test piece. Force shall be applied to the test piece until F_o is reached. The indicated for F_o shall be maintained and, if necessary, adjusted at appropriate intervals during the test. The value for F_o shall be recorded at time, T_o , and shall be confirmed and, if necessary, adjusted at appropriate intervals during the test.

10.4.3 Filling of the cell Upon completion of loading, the cell shall be sealed to prevent leakage and a volume, V_o , of the test solution, which shall be a new one for each test, preheated to a temperature between 50° C and 55° C introduced into the cell. V_o shall be at least 5ml per cm^2 of surface area of the test piece along the test length, L_o . Filling of the cell shall be finished within one minute and then the time measuring device set to the starting time, T_o . The solution shall not be circulated during the test.

10.4.4 Temperature during the test Within the interval T_o and $(T_o + 5)$ min., the temperature of the test solution shall be adjusted to $(50 \pm 1^\circ)$ C for wires and strands, and $(50 \pm 2^\circ)$ C for bars and shall be maintained in the relevant range throughout the test.

10.4.5 Termination of the test The test shall be considered to have reached completion either on fracture of the test piece or at an agreed time, T_a . In the case of strand, the test shall be considered to have reached completion when at least one wire has broken. If fracture of the test piece occurs outside the test length, L_o , the test shall be considered as invalid. The time to fracture, T_{fi} , shall be measured and recorded to the nearest 0.1hour. If fracture has not occurred within the time, T_a , the result shall be recorded $T_{fi} > T_a$.

10.4.6 Termination of median lifetime to fracture (T_{fm}) When all the test pieces in the series have been tested, the results, T_f , shall be ordered according to the values of lifetime to fracture. The median value (T_{fm}) is that in the middle of this ordered series”.

4. Corrosion Test Results in compliance with PREN10138 Specs:

European standardization, in consultation with other countries, brought about the establishment of the following acceptable test results determining test compliance:

- Number of tested pieces: 6
- Mono-wires:
 - Minimum test duration: 2 hours
 - Average minimum test duration: 5 hours
- Small diameter strand (diameter < 0.126 in.)
 - Minimum test duration: 1 hour 30 minutes
 - Average minimum test duration: 5 hours
- Big diameter strand (diameter > 0.126 in.)
 - Minimum test duration: 2 hours
 - Average minimum test duration: 5 hours

5. Example of Corrosion Test Results from Subject Factory

1. Mono-wires

Number Tests	Diameter	Grade	Min. Test Time	Max. Test Time	Average Failure
2	4mm	270k	8h20'	9h12'	8h30'
8	5mm	250k	2h25'	17h10'	10h35'
6	5mm	270k	8h20'	16h10'	13h40'
4	7mm	250k	26h20'	49h05'	38h05'
8	8mm	250k	3h20'	+354h	> 45h

2. Small diameter strand (diameter < 0.126")

Number Tests	Diameter	Grade	Min. Test Time	Max. Test Time	Average Failure
36	1/5"	310k	2h30'	7h15'	3h50'
6	1/4"	300k	5h20'	11h30'	7h55'
11	1/4"	270k	3h25'	108h20'	21h59'
18	5/16"	270k	4h05'	20h30'	14h20'

3. Big diameter strand (diameter > 0.126")

Number Tests	Diameter	Grade	Min. Test Time	Max. Test Time	Average Failure
22	3/8"	270k	5h25'	34h05'	13h27'
21	1/2"	270k	3h20'	45h30'	16h14'
3	1/2"	270k	10h30'	43h55'	25h40'
7	0.6"	250k	3h10'	> 69h	> 25h
14	0.6"	270k	3h35'	52h55'	16h35'