



**INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS
UNIFORM EVALUATION SERVICES**

**EVALUATION CRITERIA FOR
REINFORCED AND PRESTRESSED PRECAST CONCRETE FABRICATORS**

**EC 022-2014
(Adopted – December 2014)**

1.0 PURPOSE

The purpose of these evaluation criteria is to describe the minimum requirements for IAPMO Uniform ES approval of a fabricator's reinforced and prestressed precast concrete fabricator inspection program in accordance with the 2015 and 2012 *International Building Code*[®] (IBC). By complying with these criteria, fabricators have established they have the necessary personnel, equipment, processes and procedures in place to consistently manufacture products that comply with required quality specifications.

2.0 SCOPE

- 2.1** 2015 and 2012 IBC Section 1705.3 demands special inspection of concrete construction in accordance with the requirements therein. These criteria apply to fabricators of precast concrete components who fabricate under an alternative surveillance program to that described for special inspection as set forth in 2015 IBC Section 1704.2.5.1 and 2012 IBC Section 1704.2.5.2.
- 2.2** These criteria do not apply to the design or performance of finished buildings.
- 2.3** The building official has final authority for approving a fabricator's inspection program and is in no way constrained by these criteria.
- 2.4** **Alternative Programs:** With prior concurrence of IAPMO Uniform ES, alternative programs for approved fabricators of concrete components shall be permitted. These alternative programs may refer to CSA A23.4, MNL-116, QCM-001, and IAS AC157. Alternative programs shall be oriented to requirements set forth in the IBC and corresponding reference standards.

3.0 REFERENCED STANDARDS

IAPMO Uniform ES evaluation criteria for Reinforced and Prestressed Precast Concrete Fabricators are based on and comply with the following references. Unless indicated otherwise, publications listed are current editions.

- 2015 and 2012 *International Building Code*[®] (IBC)
- ACI 318-11, *Building Code Requirements for Structural Concrete and Commentary*, American Concrete Institute
- CSA A23.4, *Precast Concrete - Materials and Construction*, Canadian Standards Association
- *Standard Specifications*, July 1999, State of California Department of Transportation
- MNL-116, *Manual for Quality Control for Plants and Production of Structural Precast Concrete Products*, Precast/Prestressed Concrete Institute.
- ANSI/ISO/ASQC ISO9000, *Quality Management Systems – Fundamentals and vocabulary*
- QCM-001, *NPCA Quality Control Manual For Precast Concrete Plants*, National Precast Concrete Association ANSI/AWS D1.1, *Structural Welding Code—Steel*, American Welding Society
- ANSI/AWS D1.4, *Structural Welding Code—Reinforcing Steel*, American Welding Society
- ISO/IEC Standard 17020, *General Criteria for the operation of various types of bodies performing inspection*, International Organization for Standardization
- ISO/IEC Standard 17065, *Conformity Assessment – Requirements for bodies certifying products, processes and services*, General Criteria for the operation of various types of bodies performing inspection



- IAS AC157, *Accreditation Criteria for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete*, International Accreditation Service.

4.0 TERMINOLOGY

Definitions for the following terms as well as those provided in the IBC and ISO 9000 apply to these evaluation criteria

- 4.1 Accredited Inspection Body:** An agency providing third-party inspection services for fabrication of concrete components and operating in accordance with ISO/IEC 17020. The verification of conformance to ISO/IEC 17020 shall be based on accreditation by an accreditation body recognized as conforming to ISO/IEC 17011.
- 4.2 Approved Fabricator:** A business establishment or individual approved by a building official under guidelines established in 1704 of the IBC or by an equivalent program that meets or exceeds compliance requirements for approved fabricator programs such as those used by IAPMO UNIFORM ES.
- 4.3 Contract Documents:** Work orders, drawings, specifications and other documents detailing a fabricator's deliverables for a project.
- 4.4 Corrective Action:** Actions taken to remedy a problem by removing or restricting its cause.
- 4.5 Quality Assurance (QA):** Monitoring and inspection tasks performed by the accredited inspection body to assure that the material provided and work performed by the fabricator comply with the requirements of the approved Quality Control Plan.
- 4.6 Quality Assurance Plan (QAP):** A document describing how the accredited inspection body maintains detailed monitoring and inspection procedures to verify conformance with the construction documents, referenced standards, and code requirements
- 4.7 Quality Control (QC):** Controls and inspections implemented by the fabricator, to ensure that the material provided and work performed comply with the requirements of the approved construction documents and referenced standards.
- 4.8 Quality Control Plan (QCP):** A document developed by the fabricator describing fabrication and inspection policies and procedures for use in ensuring that product quality complies with construction documents, referenced standards and code requirements.
- 4.9 Quality System Management (QSM):** A systematic approach that involves corporate management in the process of maintaining and improving the quality of products and services.
- 4.10 Specification:** Detailed written requirements a product shall comply with.

5.0 CONDITIONS OF CERTIFICATION

- 5.1** A detailed Quality Control Plan (QCP) shall have been developed by the fabricator referencing key Quality Control (QC) procedures that are used for inspecting its fabrication process and fabricated products.
- 5.2** IAPMO Uniform ES and an accredited inspection body shall have evaluated the fabricator's QC capabilities in the fabrication facility(ies) and shall have verified compliance with the description in the fabricator's Quality Control Plan.
- 5.3** The fabricator shall have agreed to permit regular inspections of each fabrication facility without prior notice by the accredited inspection body according to the Quality Assurance Plan (QAP) in order to monitor and assure the effectiveness of the QC program
- 5.4** Whenever IAPMO Uniform ES or a building official informs the fabricator of a concern regarding its failure to comply with a given specification in a fabricated product, the fabricator shall respond and initiate an investigation immediately.

6.0 PREREQUISITES TO CERTIFICATION

6.1 General Requirements

- 6.1.1** The fabricator shall implement a comprehensive Quality Control (QC) System designed for ensuring product compliance with construction document requirements.
- 6.1.2** The fabricator shall provide IAPMO UNIFORM ES with a QAP and QCP documentation developed in collaboration with an accredited inspection body detailing all processes, procedures and activities associated with its QA and QC program that includes the general requirements in this section, data indicated in Sections 6.2 to 6.6, and written procedures described in Section 7.0.
- 6.1.3** The QAP and QCP documentation submitted to IAPMO UNIFORM ES by the fabricator shall be signed and dated by an internal representative of the fabricator's organization and accompanied by confirmation from the authorized representative of an accredited inspection body affirming that documentation is complete and the fabricator is ready for a fabrication facility assessment audit.
- 6.1.4** A joint fabrication facility assessment audit by IAPMO UNIFORM ES and the accredited inspection body is required before a fabricator's QC program can be accepted in order to determine the fabricator's compliance with its QA and QC documentation as well as IAPMO UNIFORM ES and code requirements.
- 6.1.5** After the fabricator's QA and QC program has been approved by IAPMO UNIFORM ES, the fabricator shall agree to submit to regular inspections by the accredited inspection body at intervals determined by IAPMO UNIFORM ES and the accredited inspection body based on the initial fabrication facility assessment audit.

6.2 System Requirements

- 6.2.1** A QC system documented in the QCP shall be in place that details the fabricator's process and procedures for ensuring product compliance with specified criteria.
- 6.2.2** A QCP submitted to IAPMO UNIFORM ES for review shall include the following:
- The fabrication facility name(s), street address(es) and telephone number(s)
 - A facility floor plan with a list of major production equipment referencing their location on the floor plan
 - Names and qualifications of the QC Manager, QC Inspectors and technicians together with an organizational chart describing the relationships between themselves and with plant management
 - A list of items typically produced in the plant and a sample of the plant's Daily Production Log
 - A list of all approved vendors used by the facility that includes QC testing laboratories
 - A list of all testing and measuring equipment used to perform QC functions
 - An example of the data sheet used by management in conducting contract reviews
- 6.2.3** QCPs submitted to IAPMO UNIFORM ES for consideration shall include the following statements:
- All activities within the fabricator's organization shall be directed towards achieving the quality considerations of the IBC and this Evaluation Criteria
 - Contents of the fabricator's QC Program shall be communicated clearly and consistently to all those responsible for their implementation

- The QCP developed by the fabricator and submitted to IAPMO UNIFORM ES for approval shall be internally reviewed and updated as necessary at least once a year
- The fabricator shall notify IAPMO UNIFORM ES in writing before cancelling an inspection agreement with an accredited inspection body
- Within 10 days after being notified, the fabricator shall provide IAPMO UNIFORM ES with copies of any accredited inspection body inspections that have occurred since the last inspection reports were submitted.
- If the facility is closed for an extended, unscheduled period of time, the fabricator shall notify IAPMO UNIFORM ES and the accredited inspection body before resuming operations
- If unannounced inspections have not been conducted by the accredited inspection body for a period exceeding the specified intervals, the fabricator shall notify IAPMO UNIFORM ES in writing
- When contacted by IAPMO UNIFORM ES or a building official, the fabricator shall address any concerns about product non-compliance immediately

6.2.4 To insure that the requirements in these Evaluation Criteria have been incorporated into the fabricator's quality system management, fabricators shall provide IAPMO UNIFORM ES with a comprehensive QCP that includes a cross-referencing matrix correlating the two, signed and dated by the authorized representative.

6.2.5 An authorized representative of an accredited inspection body shall confirm reviewing the cross-referencing matrix to affirm that it has examined the fabricator's QCP and that it contains the necessary details providing adequate QC.

6.3 Inspection Requirements

6.3.1 The services of an accredited inspection body specifically accredited for inspecting reinforced and prestressed precast concrete shall be retained for each facility.

6.3.2 An assessment is required by IAPMO UNIFORM ES conducted together with the accredited inspection body at each facility before a fabricator can be approved. The assessment is required to determine compliance with the QCP and to evaluate the accredited inspection body's approach to verifying continued facility compliance.

6.3.3 QA Inspections performed by the accredited inspection body shall occur at the intervals determined as described in Section 6.1.5 and the QAP, and shall include, at minimum:

- Required inspection tasks set forth in the applicable referenced standards.
- Review of documentation, test reports, and inspection records.
- The submittal of an inspection report to IAPMO Uniform ES and the fabricator after completing the tasks

6.4 Personnel Requirements

Employees with adequate training and experience shall be assigned by the fabricator to perform its fabrication and QC functions.

6.4.1 Fabrication of concrete components shall be performed by fully trained individuals who have adequate experience and training to understand the crucial importance of producing components that meet the fabrication plans in every detail:

- Steel Reinforcement Technicians shall be trained in positioning reinforcing steel
- Welders shall be certified in accordance with the requirements of ANSI/AWS D1.1 or ANSI/AWS D1.4, as applicable

- Concrete placement personnel shall be trained to adequately consolidate the concrete in the forms
- All fabrication personnel shall understand the nature of prestressing concrete

6.4.2 Quality Control Inspectors (QCI) shall be employed by the fabricator. The inspectors must be:

- Certified as Grade II or equivalent Concrete Construction Inspectors by the American Concrete Institute (ACI), or equivalent as determined by IAPMO Uniform ES
- Where in-house QC testing is required, certified as Grade II or equivalent Concrete Laboratory Testing Technicians by the American Concrete Institute (ACI), or equivalent as determined by IAPMO Uniform ES
- Able to demonstrate competency with regards to in-house concrete testing procedures and results as well as in the inspection of concrete mix design, formwork and steel placement for reinforced and prestressed precast concrete products

6.4.3 The fabricator shall employ a Quality Control Manager (QCM) who :

- Is a Precast/Prestressed Concrete Institute (PCI) Level II technicians/inspector, special inspector certified for Reinforced Concrete, or equivalent as determined by IAPMO Uniform ES
- has a minimum of five years reinforced concrete production experience
- is a registered design professional (unless one of these is employed or contracted by the fabricator to assist with technical issues and make regular fabrication facility visits to ensure product design conformity)
- has overall responsibility for insuring the quality of reinforced and prestressed precast concrete products
- is responsible for maintaining, implementing and monitoring the fabricator's QCP including implementation of corrective actions and ensuring the performance and documentation of periodic internal audits and management reviews
- is responsible for maintaining all QC documentation

6.5 Production Requirements

6.5.1 All structural welding performed by the fabricator shall be done in a manner that complies with ANSI/AWS D1.1 or ANSI/AWS D1.4.

6.5.2 All activities including assembling forms, placing reinforcement, welding, pre-stressing and curing shall be documented in a Daily Production Log.

6.5.3 QC inspections, any difficulties or deficiencies, testing, and repair work shall also be noted in the Daily Production Log.

6.6 Testing Requirements

6.6.1 All in-house test procedures shall be fully documented by the fabricator.

6.6.2 All in-house test equipment shall be calibrated to be consistent with nationally recognized standards of measurement.

6.6.3 QC tests conducted in-house by the fabricator shall be routinely verified by comparing results with reports by an independent testing laboratory.

6.6.4 Test reports shall include information required by the relevant test standard, the UES Test Report Requirements in Procedure ES-025, and Annex A. Additional documentation required includes:

- For independent testing laboratories, an accreditation certificate for the testing laboratory showing testing is consistent with ISO/IEC Standard 17025, issued by an accreditation body conforming to ISO/IEC 17011

6.7 Certificate of Recognition

Upon successful compliance to the requirements of this criteria, IAPMO UES shall issue a certificate of recognition containing the following items:

- Name of fabricator
- Location of fabricator
- Structural steel processes recognized
- Name of inspection body
- List of applicable standards used in the certification
- Date of issue and expiration date

7.0 DOCUMENTATION

The fabricator shall provide IAPMO UNIFORM ES with the QCP for all processes described in this section.

7.1 General Processes

7.1.1 Reviewing new contract documents to ensure that resources are available for fulfillment.

7.1.2 Implementing the fabricator's quality control functions including guidelines for:

- Approving documents
- Ensuring only the most recently approved documents are used
- Ensuring access to documents wherever needed for implementing the QC system

7.1.3 Ensuring compliance with specifications for all products purchased and raw materials received.

7.1.4 Ensuring that any subcontracting work is performed by approved fabricators capable of fulfilling the terms of their agreements.

7.1.5 Maintaining the ability to quickly associate finished products with:

- Raw materials used
- QC personnel responsible for oversight
- Product plans and specifications
- QC documentation

7.1.6 Ensuring awareness and supporting implementation of the QC system with:

- Training methods for employees whose activities can directly impact product quality
- Provisions for updating and sustaining existing levels of employee competence

7.2 Production Control Processes

7.2.1 Placing reinforcing steel:

- Ensuring that reinforcing steel is contamination-free
- Performing splicing, welding and tying
- Straightening strands and preventing slack when applying the initial pre-stressing load.
- Applying final prestressing load.
- Evaluating stresses and lengthening in concrete members resulting from prestressing
- Determining the concrete compressive strength before detensioning
- Performing detensioning in a way that minimizes shock or loading and any eccentricity around the member's vertical axis

7.2.2 Preparing concrete for use:

- Verification of the concrete mixture design. The batching, mixing equipment, construction methods and curing environment at the fabrication facility shall be sufficient to produce the design mixture
- Blending the concrete mixture to achieve a uniform distribution of constituents
- Ensuring consistency of batching and use of equipment, as well as construction methods and the curing environment used

7.2.3 Concrete Placement:

- Transferring concrete from the mixer to the forms
- Preventing course aggregate from separating in the mix
- Consolidating the concrete

7.2.4 Concrete Curing:

- Creating optimum curing conditions
- Curing conditions and duration for the concrete member.
- Curing of the concrete strength test specimens, including field or laboratory environment.

7.2.5 Finalizing the Concrete:

- Finishing formed and unformed surfaces
- Finishing composite surface members
- Filling-in small defects
- Prestressing operations

7.2.6 Handling of non-conforming products:

- Identifying and documenting product deficiencies
- Determining and performing any corrective actions
- Determining disposal methods

7.2.7 Labeling, handling and storage requirements for raw materials and completed concrete products**7.3 Inspection Control Processes****7.3.1** Reinforcing and Prestressing Steel:

- Inspection method and frequency for assuring proper placement
- Inspection method and frequency for assuring non-contamination
- Method for determining desired stressing and elongation

7.3.2 Method and frequency of inspection for ensuring use of the correct concrete design mix, including:

- Aggregates -- sieve analysis, unit weight and moisture content
- Concrete slump, air content and density
- Concrete and ambient temperatures required for placement
- Concrete compressive strength requirements

7.3.3 Method and frequency of inspection for ensuring proper curing conditions of the concrete members.

- 7.3.4** Instructions for properly calibrating measurement and test equipment with traceability to nationally recognized industry standards.

7.4 Documentation Control Processes

- 7.4.1** Monitoring the effectiveness of the QC System, including audit content and frequency and the means of documentation.

- 7.4.2** Maintaining the ability to access, archive and update QC records for at least two years, including:

- Internal QC audits and inspection reports and forms
- Vendor mill test documentation and compliance certificates for raw materials received
- Inspection summaries submitted by the accredited inspection body
- Vendor and subcontractor reviews and employee training documentation

Annex A

Test Report Content

- 1.0** The services performed by the testing laboratory shall be documented by a retrievable report that accurately, clearly, objectively, and unambiguously presents measurements, observations, examinations, and test results in accordance with the reporting requirements of test method(s). Each test or inspection report also shall include the following unless the code, evaluation criteria, or the test standard requirements specify otherwise:
 - 1.1** A title, for example, "Report of Compressive Strength Tests."
 - 1.2** The name, address, and contact information of the laboratory.
 - 1.3** A unique identification of the report (such as report number), the issue date, a sequential number for each page, and the total number of pages.
 - 1.4** The name and address of the client.
 - 1.5** Description of, condition of, and clear identification of the item tested.
 - 1.6** Quantity of tests conducted.
 - 1.7** Date test(s) were conducted.
 - 1.8** Identification of test standards or description of any non-standard methods used.
 - 1.9** Any deviations from, additions to, or exclusions from, the test standard and any other information relevant to the specific test, such as environmental conditions.
 - 1.10** Measurements, observations, examinations, and test results, supported by tables, graphs, sketches, and photographs, as appropriate, including a description of the failure mode or condition of item at conclusion of the tests.
 - 1.11** Conclusions or summary statements, including, when applicable, a statement indicating whether the product passed or failed the test.
 - 1.12** A statement that the results apply only to the items tested.
 - 1.13** A statement that the report shall not be reproduced, except in full, without the prior written approval of the laboratory.
 - 1.14** Name(s) of individual(s) performing the tests.
 - 1.15** A signature and title, or an equivalent identification, of the person(s) accepting responsibility for the content of the report on behalf of the laboratory.
 - 1.16** Identification of results obtained from tests subcontracted by the laboratory to others. The laboratory shall not represent the services of others as its own.
- 2.0** Each test report, where necessary for the proper interpretation or understanding of the report, shall include the following:
 - 2.1** Project title and reference designation.
 - 2.2** Reference to relevant code, evaluation criteria, or other requirement(s).
 - 2.3** A statement indicating compliance with relevant code, evaluation criteria, or other requirement(s).
 - 2.4** Other reporting requirements of the evaluation agency, the client, or relevant authority.
- 3.0** Test reports presenting results shall include the following with respect to sampling:
 - 3.1** Date of sampling or date sample received, as appropriate.
 - 3.2** Clear identification of the material sampled including manufacturer, brand name, lot number, source, or similar unique information, as applicable.
 - 3.3** Sampling location, where relevant, using an explicit description, diagram, sketch, or photograph, as applicable.
 - 3.4** Identification of sampling methods used, or sampling plan or procedure if a non-standard method was used.
 - 3.5** Deviations from, additions to, or exclusions from standard sampling methods or predetermined sampling plans or procedures.
 - 3.6** Details of environmental conditions present during the sampling such as rain or freezing weather that may have affected the testing of the sample or the interpretation of the test results.
 - 3.7** If assemblies are tested (structural assemblies, etc.), identification of the assemblies, preferably with illustrations. The report shall identify the parties constructing the assemblies and shall also address witnessing and/or verifying the construction.
- 4.0** When interpretations of tests are included in the report, the basis for the interpretations shall be clearly explained. Interpretations commonly include determination of compliance or noncompliance of the results with requirements of the test method or evaluation criteria.
- 5.0** Material revisions or additions to a report after initial issue shall be made in a further document clearly indicating the revised information and clearly referencing the original report identification. Such revisions or additions shall meet the relevant requirements of Section 2.0.
- 6.0** Transmission of test reports by electronic means shall follow documented procedures to ensure that the requirements of this evaluation criteria are met and that confidentiality is preserved.