

Precast Concrete Structures - 21

SCOPE:

This sub-part provides procedures for being included on the Qualified Manufacturers List (QML) as a fabricator of precast (**not prestressed**) concrete structures for CDOT projects. The precast concrete structures may include, but are not limited to: inlets, manholes, junction boxes, box culverts, modular bridges (3-sided box culvert), pipes, cattle guards, and Type 7 barrier. CDOT will only accept precast concrete structures by a manufacturer listed on the QML. Precast manufacturers of walls and girders will not be required to be on this QML.

1. REFERENCED DOCUMENTS

Where applicable, the latest edition of the following standards shall be considered a part of these requirements.

1.1 CDOT Standard Specifications for Road and Bridge Construction:

- Section 106 - Control of Material
- Section 601 – Structural Concrete
- Section 603 – Culverts and Sewers
- Section 604 – Manholes, Inlets, and Vaults
- Section 606 – Guardrail
- Section 611 – Cattle Guards
- Section 617 – Culvert Pipe
- Section 701 – Hydraulic Cement
- Section 703 – Aggregates
- Section 709 – Reinforcing Steel and Wire Rope
- Section 711 – Concrete Curing Materials and Admixtures
- Section 712 - Miscellaneous

1.2 CDOT Standard Plans (M & S Standards):

M-601-1	Single Concrete Box Culvert
M-601-2	Double Concrete Box Culvert
M-601-3	Triple Concrete Box Culvert
M-601-10	Headwalls for Pipe Culverts
M-603-2	Reinforced Concrete Pipe
M-603-3	Precast Concrete Box Culvert,
M-603-10	Concrete and Metal End Sections,
M-604-10	Inlet, Type C
M-604-11	Inlet, Type D
M-604-12	Inlet, Type R
M-604-13	Inlet, Type 13
M-604-20	Manholes
M-604-25	Vane Grate Inlet with Frame and Concrete Apron
M-606-14	Precast Type 7 Concrete Barrier
M-611-1	Cattle Guard

1.3 AASHTO Standards:

- M 6 Fine Aggregate for Portland Cement Concrete
- M 43 Sizes of Aggregate for Road and Bridge Construction
- M 55 Steel Welded Wire Reinforcement, Plain, for Concrete
- M 86 Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
- M 157 Ready-Mixed Concrete
- M 170 Standard Practice for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- M 206 Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
- M 207 Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
- M 221 Steel Welded Wire Reinforcement, Deformed, for Concrete
- M 242 Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
- M 284 Discontinued**
- R 38 Quality Assurance of Standard Manufactured Materials

1.4 ASTM Standards:

- A 775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars
- C 361 Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
- C 923 Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- C 936 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants
- C 1017 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- C 1478 Standard Specification for Storm Drain Resilient Connectors between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals
- D 3665 Standard Practice for Random Sampling of Construction Materials

2. TERMINOLOGY

- 2.1 See AASHTO M 262 Standard Terminology Relating to Concrete Pipe.
- 2.2 Conventional mix – In this Standard it shall be defined as a Class of concrete in Section 601 of CDOT's Standard Specifications for Road and Bridge Construction.
- 2.3 Dry Cast – In this Standard it shall be defined as zero slump concrete most often used for pipes, box culverts, and manholes.
- 2.4 Manufacturer – A Company which manufactures and supplies Standard Manufactured Materials for the Prime Contractor, Sub-contractor, or CDOT.
- 2.5 Prime Contractor – The Company under contract with CDOT to produce products using precast concrete structures.
- 2.6 Quality System Manual (QSM) – A written document that describes the overall internal quality control operating procedures of a Manufacturer. The QSM documents the internal policies for achieving quality and the assignment of responsibility and accountability for quality control within the Manufacturer's organization. It shall describe the minimum quality control requirements expected of material suppliers who are involved with the Manufacturer's product.

- 2.7 Self-Compacting (leveling) Concrete – In this Standard it shall be defined as a very high slump concrete where the spread is measured using a slump cone. The spread is usually between 22 to 32 inches in diameter. In addition, the mix usually contains a superplasticizer and a viscosity-modifying admixture (VMA). This concrete is usually used for manholes and inlets
- 2.8 Supplier – In this Standard it shall be defined as one who provides materials used in the manufacturing of precast concrete structures. Cement, fly ash, welded wire reinforcement (WWR), and epoxy coated reinforcing bar are among the materials provided to the manufacturer.
- 2.9 Wet Cast – In this Standard it shall be defined as anything other than zero slump concrete. This concrete is usually used for manholes and inlets.

3. SIGNIFICANCE AND USE

- 3.1 This procedure specifies requirements that should be followed by the Manufacturer in implementing an effective Quality Control (QC) system. This is accomplished by a certification system that evaluates quality control practices and specification compliance tests performed by the Manufacturer according to their quality control plans.
- 3.2 This Standard specifies requirements and procedures for a certification system that shall be applicable to all Manufacturers providing precast concrete structures. These provisions initially apply to the plant manufacturing the precast concrete structures. These provisions subsequently apply to the Contractor, after delivery of the precast concrete structure to the Contractor, for use on CDOT projects.

4. SAMPLING

- 4.1 All test samples required by this Standard shall be obtained using stratified random sampling techniques. Stratified random sampling should be performed in accordance with ASTM D 3665. The use of a stratified random sampling procedure is mandatory to the establishment of a valid QC program. All random QC sample locations shall be properly documented.

5. TESTING REQUIREMENTS

- 5.1 Testing required for this Standard shall be performed by certified personnel or in accredited laboratories through appropriate QC Certification programs. Any satellite laboratory of a Manufacturer that performs required testing under this Standard shall be identified in the submitted Quality System Manual (QSM) (Section 9).
- 5.2 As a minimum, the certification program used shall include the following;
- 5.2.1 Training in AASHTO, ASTM, or ACI test procedures.
- 5.2.2 Demonstration of proficiency in each required test.
- 5.2.3 Demonstration of ability to properly document test results.

6. SUPPLIER REQUIREMENTS

- 6.1 Cement, fly ash, and concrete admixture suppliers shall be on CDOT's Approved Product List (APL) prior to use by the manufacturer. The APL along with instruction for completing CDOT Form #595, Pre-Approved Product Evaluation Request & Summary, can be found at: <https://www.codot.gov/business/apl> The Form 595 is designed as a PDF Writable form, which must be completed by the supplier or their Product Representative. The completed form shall be returned to CDOT's Product Evaluation Coordinator as an e-mail attachment.
- 6.2 The cement and fly ash suppliers shall follow the procedures described in the CDOT approved quality control plan as required in CP 11 Part I, Sub-Part 3 and 4 respectively.
- 6.3 The steel supplier shall provide a copy of the Mill Test Report with each delivery which complies with CDOT's Buy America Requirement found in Subsection 106.11 of CDOT's Standard Specifications for Road and Bridge Construction.

7. CURRENTLY CERTIFIED MANUFACTURERS

- 7.1 A manufacturer, regardless of their current casting process, which has been certified for the past three consecutive years under the American Concrete Pipe Association (ACPA) for all pipe products, dry cast box culverts, and manholes, or under the National Precast Concrete Association (NPCA) for all pipe products, manholes, modular bridges, and other wet cast products, will be placed on the QML after submitting all of the following:
- The certificate from the current year and the preceding three consecutive years of evaluations from NPCA or ACPA,
 - The score summary sheets from the current year and the preceding three consecutive years of evaluations from NPCA or ACPA,
 - The Quality System Manual as outlined in Section 9 of this Standard.
- 7.2 A manufacturer, regardless of their current casting process, which has been certified for less than three consecutive years under the American Concrete Pipe Association (ACPA) for all pipe products, dry cast box culverts, and manholes or under the National Precast Concrete Association (NPCA) for manholes, modular bridges, and other wet cast products will be on probation and placed on the QML after submitting all of the following:
- The certificate from the current year along with any preceding years of evaluations from NPCA or ACPA,
 - The score summary sheets from the current year along with any preceding years of evaluations from NPCA or ACPA,
 - The Quality System Manual as outlined in Section 9 of this Standard.
- 7.2.1 The probation period will be for three consecutive years after being placed on the QML.

8. DECERTIFICATION

- 8.1 If the manufacturer becomes decertified after being placed on the QML, the manufacturer will be removed from the QML until successfully completing and submitting to CDOT the requirements within this Standard. The manufacturer may apply for reinstatement on the QML no sooner than six months after removal from the QML.
- 8.2 If the manufacturer becomes decertified due to a structural failure of a product during the probationary period, the manufacturer will be removed from the QML until successfully completing and submitting to CDOT the requirements within this Standard. A structural failure will be determined by the Engineer in accordance with the FHWA Report Number FHWA-IP-86-2 "Culvert Inspection Manual." The manufacturer may apply for reinstatement on the QML no sooner than three years after removal from the QML.

9. MANUFACTURER'S QUALITY SYSTEM MANUAL (MINIMUM REQUIREMENTS)

- 9.1 On an annual basis, at a minimum of one month prior to producing any precast concrete structure for a CDOT project, one complete printed and bound original, and one complete electronic copy of the Manufacturer's Quality System Manual (QSM) shall be submitted for review and approval to CDOT's Product Evaluation Engineer (303) 398-6505 within the Staff Materials & Geotechnical Branch at 4670 North Holly Street, Unit A, Denver, Colorado 80216-6408. CDOT's approval of the QSM is intended only to indicate that the QSM is in conformance with the minimum QC requirements set forth in this Standard. Once the manufacturer is approved and on the Qualified Manufacturers List (QML), the QSM provisions will remain in effect for a maximum period of one calendar year, unless revisions are determined to be necessary by the Quality Control Manager or requested by CDOT, or if the manufacturer is decertified. If any revisions are made to the current year QSM, such revisions shall be submitted to CDOT in both printed and electronic format for review and approval. Guidelines for preparing a QSM may be available from the National Precast Concrete Association (NPCA) or the American Concrete Pipe Association (ACPA).
- 9.2 The Manufacturer's QSM may be maintained in electronic format. However, one or more copies of the QSM shall be maintained by the Manufacturer's QC Manager in a printed and bound format (3-ring binder or other). The QSM shall be available to all of the Manufacturer's employees. Each document in the QSM shall indicate its preparation date and all pages of the QSM shall be numbered. If a document is revised, the date of revision shall be indicated on the document and recorded in a table of revisions.
- 9.3 The Manufacturer's QSM shall be formatted to provide numbered sections which meet the following order, format, and content:
- 9.3.1 Manufacturer's quality policy or mission Statement endorsed by the company's Chief Executive Officer.
- 9.3.1.1 The quality policy / mission statement shall indicate support of top management to enforce the QC requirements contained in the QSM.
- 9.3.2 The QSM shall include the address and telephone numbers of applicable personnel at the manufacturing facility.

- 9.3.3 The QSM shall include a brief listing and description of all the precast products being manufactured at the facility.
- 9.3.4 The QSM shall present and define any significant terms used throughout the QSM.
- 9.3.5 For all manufactured items addressed in the QSM, the applicable AASHTO, ASTM, or CDOT specification shall be identified.
- 9.3.6 The QSM shall present the personnel structure established to implement the Manufacturer's quality system. The specific roles and responsibilities of all QC personnel shall be documented as follows:
- 9.3.6.1 The QSM shall contain an organizational chart. The chart shall indicate a clear separation between the QC personnel and the production personnel. The QC Manager shall be allowed direct access to top management, independent from production.
- 9.3.6.2 Each facility shall have a Quality Control Manager who has the overall responsibility for implementing the requirements of the QSM. At least one QC Manager shall be on-site during production. The QC Manager shall review the established QC system annually in order to satisfy this requirement, or if changes in the manufacturing process(s) occur, or whenever technical or CDOT information indicate a trend in reduced quality.
- 9.3.6.3 Each facility shall have at least one Quality Control Technician to perform QC sampling, testing, and inspection. At least one QC Technician shall be on-site during production. The QC Technicians shall be familiar with the tests they perform and have sufficient authority to assure corrective actions are carried out when necessary. The QSM shall indicate the line of authority of the QC Technicians, which shall demonstrate their authority to require corrective action. The QSM shall designate the certified QC Technicians at the facility and laboratory involved in the production or testing of the precast concrete structures.
- 9.4 The QSM shall contain a description of the certifications required and attained and years of experience for each QC Manager and QC Technician. All QC sampling, testing, and inspection personnel shall be certified by ACI Concrete Field Technician Level 1 or higher. Plants certified by NPCA shall have at least one QC Manager and at least one QC Technician who has successfully completed the NPCA's Production and Quality School or ACPA's approved equivalent. The QSM shall also include periodic auditing of each QC technician's ability to satisfactorily perform the required tests. Retraining shall be provided when the test method is revised.
- 9.5 The QSM shall provide for specific training for frontline production personnel in the safe and correct operating procedures implemented to ensure the required quality of all precast concrete structures.
- 9.6 The Manufacturer shall maintain its own accredited or qualified laboratory to perform QC testing. The QSM shall include the address and telephone numbers of a designated backup accredited or qualified laboratory. The laboratory shall meet the minimum accreditations or qualifications obtained through one or more of the following programs depending on the casting process:

- 9.6.1 For “dry” cast plant laboratories:
 - 9.6.1.1 National accreditation programs such as AASHTO Accreditation Program or American Association for Laboratory Accreditation.
 - 9.6.1.2 Either the Manufacturing industry’s American Concrete Pipe Association’s Q-Cast program or the National Precast Concrete Association Certification program.
- 9.6.2 For “conventional”, “wet”, or “Self-Compacting” cast plant laboratories:
 - 9.6.2.1 National accreditation programs such as AASHTO Accreditation Program or American Association for Laboratory Accreditation.
 - 9.6.2.2 The Manufacturing industry’s National Precast Concrete Association Certification program.
- 9.7 The QSM shall contain an inventory of the major equipment used for sampling and testing along with associated calibration equipment used for each required test procedure. The QSM shall assign a unique identification number to each piece of testing equipment. The QSM inventory for each major piece of equipment shall include the following information:
 - 9.7.1 The name of each major piece of equipment, date placed in service, manufacturer, model and serial number. The QSM shall include the location where the instructions for use and operation of each major piece is stored if not included in the QSM.
 - 9.7.1.1 For each major piece of equipment, the QSM shall include the interval of calibration or verification, a reference to the calibration or verification procedures used, and the location where the current calibration or verification records are stored. The QSM shall describe the methods for ensuring that the calibration and verification procedures are performed at the specified intervals.
- 9.8 The QSM shall identify all types of supplier delivered materials used for the production of precast concrete structures.
 - 9.8.1 The QSM shall contain a copy of the signed certification from each steel supplier that all steel products delivered to the manufacturer will be from products manufactured in the United States of America as stipulated in Section 6 of this Standard.
 - 9.8.1.1 The QSM shall include the manufacture’s process for tracking and submitting the Mill Test Reports on reinforcing steel permanently incorporated into each segment of precast concrete box culverts delivered to a CDOT project.
 - 9.8.2 The QSM shall contain a description of the specification requirements for all supplier delivered materials.
 - 9.8.3 The QSM shall contain a description of the certification and test reports delivered by the supplier and a location where these records are stored.

- 9.8.4 The QSM shall include all QC testing of the supplied materials and shall contain a statement that no raw materials shall be used unless they are on the APL or they have been tested and meet all appropriate CDOT, AASHTO, or ASTM specifications.
- 9.8.5 All supplier delivered materials shall be properly stored to prevent damage, contamination, or other alterations prior to use in production. The QSM shall include procedures for the adequate storage of supplied materials.
- 9.9 The QSM shall describe the procedure and frequency for inspection and selection of material samples during production. Sampling shall be performed on a stratified random procedure in accordance with ASTM D 3665. All random QC sample locations shall be properly documented and these procedures shall be included in the QSM.
- 9.10 The QSM shall contain descriptions and examples of the test report forms used by the manufacturer. The QSM shall identify the individual(s) responsible for maintaining all test records and reports along with the location where the reports are stored.
- 9.10.1 The test reports shall be maintained and available for inspection for a minimum of three years.
- 9.11 The QSM shall contain a description of the procedures used to identify and document all material or test results that do not conform to specification requirements. The QSM shall contain provisions for resolving non-conforming material or test results.
- 9.12 The QSM shall include drawings, with dimensions, of the forms used to produce precast concrete structures for CDOT.
- 9.12.1 Drawings and dimensions for precast modular concrete bridges will not be required with the QSM. However, they shall be submitted to Staff Bridge in accordance with Subsection 105.02 of the Standard Specifications.
- 9.13 The QSM shall describe the method used to permanently mark the precast concrete structure in accordance with the appropriate AASHTO or ASTM standard.
- 9.14 The QSM shall describe procedures used to properly handle, store, and ship precast concrete structures.

10. CERTIFICATE OF COMPLIANCE

- 10.1 The manufacturer shall prepare a standard Certificate of Compliance (COC) for each precast concrete structure delivered to a CDOT project. The COC shall contain all of the required information as stipulated in the CDOT Special Notice to Contractors. The COC shall include all necessary information to properly identify each precast concrete structure represented by the COC. The COC shall include a statement as to whether the element(s) being shipped complies with the Buy America Requirements found in Subsection 106.11 of CDOT's Standard Specifications for Road and Bridge Construction.

11. MANUFACTURING FACILITY INSPECTION AND CERTIFICATION

- 11.1 Manufacturing facilities producing precast pipe and box culvert shall meet the minimum industry standards, and be annually inspected and certified by the ACPA. Manufacturing facilities producing manholes shall meet the minimum industry standards, and be annually inspected and certified by either the ACPA or the NPCA. Manufacturing facilities producing precast pipe, modular bridges, and other precast concrete structures shall meet the minimum industry standards, and be annually inspected and certified by the NPCA. A copy of the certification shall be submitted to CDOT as part of the QML process.
- 11.2 Failure in one or more Sections or Sub-sections listed in this Standard may result in an accelerated inspection program. Any additional failures to meet these minimum requirements shall result in the decertification of the plant and the plant will be removed from the QML. The manufacturer may apply for reinstatement on the QML no sooner than six months after removal from the QML as stipulated in Section 8 of this Standard.
- 11.3 Within two months after submitting all required information, CDOT will notify the manufacturer of precast concrete structures whether or not the manufacturing facility's application for the Qualified Manufacturers List has been granted.
- 11.4 CDOT or CDOT representative will randomly inspect the operations or perform quality assurance testing each plant on the QML a minimum of once every 5 years. Additionally, CDOT may inspect the operations or perform quality assurance testing at any time.

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