

# Inspection of Prestressed/Precast Concrete Products and Reinforced Concrete Pipe



PENNSYLVANIA DEPARTMENT OF TRANSPORTATION  
BUREAU OF PROJECT DELIVERY  
BRIDGE DESIGN & TECHNOLOGY DIVISION  
STRUCTURAL MATERIALS SECTION

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# PART 1 - INSPECTION OF PRESTRESSED / PRECAST CONCRETE PRODUCTS & CONCRETE PIPE

## SECTION I – INTRODUCTION

The purpose of this publication is to outline general guidelines for the consultant inspectors and Bulletin 15 listed Precast/Prestressed Concrete Fabricators. The intent is to highlight procedures and specification requirements to 1) assist the consultant inspectors to execute the requirements of the inspection agreement and 2) provide general guidelines and requirements to the Fabricators on how to deliver acceptable products to the Department. These guidelines are generally written in the imperative mood. In sentences using the imperative mood, the subject “The Inspector(s)” is implied. Also implied in this language are “shall” or “shall be”, or similar words and phrases.

The word “will” generally pertains to the decisions or actions of the Department and/or the Chief Structural Materials Engineer (SME) or his representatives.

Details in the following sections are intended to illustrate the more important and typical aspects of the inspection requirements. Do not construe them as being all-inclusive. An authorized representative of the Department may monitor the inspection work done by the inspectors at any time.

## SECTION II – GENERAL REQUIREMENTS

### 1. Work Day:

Seek approval for work in excess of 7.5 hours per shift when inspection is anticipated due to either occasional or extended production shifts. Contact the supervisor or a regional Engineer in the Structural Materials Section (SMS) promptly to justify the action. Take a half-hour break at a midway point during each regular shift. A shift is any continuous work period.

### 2. Sampling and Testing:

Witness and/or perform required tests, inspections, examinations and reports. Reinspect, collect samples, and make any special tests or reports when deemed necessary by the SME.

Quality Assurance Testing.

- The inspector shall perform at least 10% of the number of plastic concrete tests performed by the plant or one test per week, whichever is greater.
  - o Perform testing on the same sample tested by the Quality Control personnel used for acceptance.
    - Reject concrete where testing is outside specification limits.
- Perform compressive strength testing at twenty-eight (28) days using the plant’s certified compressive strength testing equipment.
- Document all results in EQMS.
- Report failing test results immediately to the inspection supervisor and regional Structural Materials Engineer.

### 3. References and Equipments:

The consultant inspection agency shall equip each office with the following references and equipments:

- a. Publication 408 (all applicable versions according to contract) and supplements.

- b. Publication 145
- c. Publication 280M (280) (Pipe Plants Only)
- d. Addenda or requirements
- e. Applicable AASHTO, ASTM, ACI and other relevant specifications or publications
- f. Measuring tapes –100 ft tape at each P/S plant, 25 ft tape at each P/C plant
- g. Flashlight
- h. Magnifying glass
- i. Thermometers – concrete and surface
- j. Slump cone
- k. Air meter
- l. Crack comparator (prestressed and pipe plants only)
- m. Digital Camera
- n. Computer
- o. Any other appropriate tools, as required
- p. J-Ring

4. Documentation:

Maintain accurate records of time spent on each project. Prepare complete project records that may be used to facilitate the investigation of defects in concrete items that may develop at a later date. Where applicable, utilize the product pre and post pour sheets herein and/or in EQMS to document all product dimensional review inspections. Do not accept any material which varies from the plans, drawings, specifications or supplements without the written Department approval of the specific variation. Do not approve any deviation from the shop drawings or shop details even when an error is suspected. Report and seek approval from the SME in such an event.

5. Harmonious Relations:

Be courteous and maintain fair and harmonious relations with shop personnel while diligently attending to the required inspection activities.

6. Inspection Responsibilities:

(Table A summarizes the primary inspection roles and responsibilities)

- 6.1. Assure fabricator's conformance with their Quality Control Plan and the Department's specifications, policies and procedures.
- 6.2. Verify that the fabricator has approved shop drawings and or standards before production begins. Notify the fabricator that any work performed prior to receipt of the approved drawings is being performed 'at risk' and may not be accepted. Do not accept such items if they are presented for acceptance prior to receipt of the approved shop drawings.
- 6.3. Assure that only domestic steel is used on Department projects. A mill test report with a statement: "Melted and Manufactured in U.S.A." is acceptable. Require the fabricator to obtain a certified letter from the mills furnishing steel products stating that the steel provided is melted and manufactured in the U.S.A. when the mill test reports leave any doubt as to the steel's origin. Steel provided by a company with a domestic address does not guarantee that it is domestic.
- 6.4. Assure that all materials are from approved sources. Component material certifications will be signed/stamped and dated by the inspector and returned to the fabricator for retention. The inspector shall not stamp the final CS-4171 certification sent to the project with the completed product.

## **SECTION III – INSPECTION OF PRESTRESSED CONCRETE**

Prestressed members are fabricated as shown on the contract plans or the approved shop drawings, unless specific deviations are authorized.

### **STRESSING REQUIREMENTS**

1. The inspector assures:
  - 1.1. That the stress induced in the prestressing steel is measured both by gauges, and by elongation of the tendons and/or load cells as specified in Publication 408.
  - 1.2. That approved certified pressure gauges, load cells, dynamometers or gauging devices are used and re-calibrated at least once a year. Discrepancies between measured elongations and gauging measurements in excess of specifications should be carefully checked and the source of error determined and corrected before proceeding further.
  - 1.3. That copies of reports are reviewed for each manufacturing operation recorded by the fabricator's Quality Control representative.

### **PRETENSIONING**

2. The inspector:
  - 2.1. Checks the casting beds and pallets periodically for deviation from a plane surface.
  - 2.2. Verifies the initial tensioning force.
  - 2.3. Verifies the proper marking of reference points prior to and after the initial tensioning forces have been applied to the strands, i.e., tape on strands and paint marks.
  - 2.4. Notes changes in the ambient temperature and verifies that the proper adjustment is made to elongation for fixed abutment beds.
  - 2.5. Checks for slippage of strand anchorages.
  - 2.6. Checks the actual dimensions of the bed layout and locations of hold-up and hold-down points to see if they agree with the dimensions shown on the approved shop drawings within the allowable tolerances. Approved hold-up and hold-down devices as shown on the shop drawings are attached in such a manner as to maintain the specified center-to-center spacing of strands in both the vertical and the horizontal directions.
  - 2.7. Checks for size and location of mild steel reinforcement and that minimum concrete cover is obtained including hold-down devices remaining in the beams.

### **DETENSIONING**

3. Inspector assures that:
  - 3.1. Forms, over yokes, hold-down, etc., which may restrict either horizontal or vertical movement of Prestressed members are stripped, or at least loosened, prior to detensioning. Detensioning immediately follows the curing period required by the specifications and when test cylinders indicate the required strength is obtained. During detensioning operations the prestressing forces are kept symmetrical about the vertical axis of the member and applied in such a manner as to prevent any sudden (shock) loading.
  - 3.2. All strands are released simultaneously by hydraulic jacking. The total force is taken from the header by the jack, and then gradually released. With this method, some sliding of the members on the beds is inevitable. **OR**

- 3.3. The strands are released by heating and gradually cutting the strands in accordance with the posted pattern. Cutting is performed simultaneously at both ends of adjacent members. Detensioning patterns are approved by the fabricator's Engineer.

## **FORMS**

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4. The Inspector checks:
  - 4.1. That unless otherwise specified, only steel forms and steel or concrete bottom forms are used for standard members. Voids for beams are polystyrene.
  - 4.2. The forms, bulkhead, spacers, spreader bars, and other equipment having a bearing upon the accuracy of dimensions of the completed beams. The inspector informs the producers of any discrepancies observed and overviews the necessary corrections.
  - 4.3. The alignment of forms before and during the casting operation. Joints between soffit, side forms and bulkheads are tight and leak proof. Plugging of holes and slots in the forms is neatly done so that the finished member has a favorable appearance.
  - 4.4. The void forms are anchored firmly and securely braced in their final position. The thickness of the bottom layer of concrete shall be checked before placing the voids.
    - 4.4.1. The position of the void is maintained both vertically and laterally during concrete placement. The concrete cover over each void is measured as soon as the surface is finished to discover any dislocations of the voids, with suitable gauges or probes.
    - 4.4.2. The air vents are installed prior to concreting.
    - 4.4.3. Forms are treated with an approved form release agent.
  - 4.5. Any strand or reinforcement found contaminated with a bond breaking substance is properly cleaned prior to placing concrete.

## **PRESTRESSING STEEL**

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5. The inspector checks that:
  - 5.1. Prestressing steel is domestic and free of deleterious materials such as grease, oil, wax, rock, clay, dirt, paint and loose rust. Strands which exhibit rust that cannot be removed by wiping with a dry cloth are not used.
    - 5.1.1. Prestressing tendons or strands having kinks, bends, nicks or other defects are not used.
    - 5.1.2. Tensioned strand are not subjected to excessive temperatures produced by torches, welding equipment or sparks.
    - 5.1.3. Strands are positioned as shown on the shop drawings.
  - 5.2. Ducts or voids provided in the concrete for longitudinal post-tensioning tendons are formed by means of flexible PVC or metal conduit, metal tubing or other approved means or void forms are completely sealed against leakage of mortar and properly anchored in position. Lateral post tensioning tubes shall be non-flexible PVC material or other material if approved by the Engineer.
  - 5.3. No more than one approved splice per strand is used.
    - 5.3.1. Multiple strand tensioning has all of the strands spliced or no more than 10% of them. If all of the strands are spliced, the average splice slippage should be considered in computing the elongation. If 10% or less are spliced, no slippage allowance is required.
    - 5.3.2. Splices are not located within the concrete members.

## **REINFORCING STEEL**

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6. The inspector checks that:
  - 6.1. Steel reinforcement is domestic and the designated size and grade is according to the shop drawings and properly positioned in the members.
  - 6.2. Reinforcement is adequately secured.
  - 6.3. Reinforcement bars are prefabricated into cages by welding or tying. Undercutting is not present. Reinforcing bars shall not be welded without an approved procedure. (See Section VI.)

## **BEARING**

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7. The inspector checks that:
  - 7.1. The bearing areas on members are true and flat.
  - 7.2. Beam daps meet the dimensional requirements and tolerances.

## **CONCRETE MIX**

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8. The inspector checks that:
  - 8.1. The fabricator's mix designs are approved.
  - 8.2. Aggregates are stockpiled and moistures controlled to keep the material above SSD.
  - 8.3. Cement conforms to Publication 408, section 701.
  - 8.4. Water conforms to Publication 408, Section 720.1.
  - 8.5. Admixtures conform to Publication 408, Section 711.3.
  - 8.6. Calcium chloride is not used.

## **BATCHING MATERIALS FOR CONCRETE**

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9. The inspector assures that aggregates, cement, pozzolans, water and chemical admixtures are proportioned in accordance with the concrete mix design.

## **CONCRETE TESTS**

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10. The inspector assures that:
  - 10.1. General tests, i.e., slump, air and temperature are conducted on the same batch of concrete, independently from the plant's quality control tests. The inspector performs 10% air and slump testing, and molds two 28-day cylinders per test based on the frequency of testing conducted by the plant, or one test per week at a minimum. Four inspection cylinders per test will be molded at prestressed facilities.
  - 10.2. Compression tests of molded cylinders are used to determine the time of detensioning in addition to the 28-day concrete strengths.
  - 10.3. Samples are carefully selected and are representative of all the concrete placed in the beam. Samples are taken approximately from the middle third of the batch or from a chute which is under full flow of concrete.
  - 10.4. Cylinders are made, marked and handled in accordance with the approved Quality Control plan and Pennsylvania Test Method 631.
  - 10.5. Cylinders are marked in accordance with PTM 631 and the approved Quality Control plan and stored adjacent to the casting bed during accelerated curing and then follow the product for the full curing and storage cycles.
  - 10.6. The compressive strength of the concrete at stress transfer is determined by testing cylinders cured with the concrete members. Cylinder molds are required to be steel to prevent deformation during accelerated curing.

- 10.7. Cylinder molds are stripped at the same time as member forms are stripped.
- 10.8. Slump and air content tests are made in accordance with the Quality Control plan. Slump flow and J-ring tests are performed whenever Self Consolidated Concrete (SCC) is used. Stability of the mixture is visually assessed. Mixtures having a visual stability index greater than 1.0 are rejected.
- 10.9. Test results are entered in EQMS.

## **PLACING CONCRETE**

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- 11. The inspector checks that:
  - 11.1. Concrete is deposited as nearly as possible in its final position, except when SCC is used. Concrete that has reached initial set is not to be re-vibrated.
  - 11.2. Maintain the concrete temperature within 50F to 90F at the time of placing.

## **VIBRATION OF CONCRETE**

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- 12. The inspector checks that:
  - 12.1. Concrete in members is compacted by the use of external and/or internal mechanical vibrators. SCC mixtures which were not qualified for vibration during the trial batching and evaluation phase may not be vibrated.
  - 12.2. Vibration is not prolonged until it caused segregation of the materials.
    - 12.2.1. Sufficient vibrators to complete the compaction are used.
    - 12.2.2. Vibration is performed at the point of deposit and in the area of freshly deposited concrete. The internal vibrators are moved about in the freshly deposited concrete and across the junctions between succeeding batches of concrete so that the entire mass will be thoroughly and uniformly compacted. Internal vibrators are not pushed rapidly but allowed to work themselves into the concrete mass and withdrawn slowly to avoid the formation of air voids. Cold joints in the concrete are not accepted. If delays are encountered, concrete which has set so long that it will not receive a vibrator easily is to be completely removed from the form, if possible, or the member rejected.

## **FINISHING OF CONCRETE**

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- 13. The inspector checks that:
  - 13.1. After the concrete has been placed and before initial set, the beam is finished with a stiff wire bristle broom flat tine wire broom or template in a transverse direction to produce not less than 4 scores per inch, to achieve a final texture from 1/16 inch to 3/16 inch in depth. Verifies that when manual techniques are used, concrete is not penetrated to depths where the brooming or tining operation pulls coarse aggregate to the surface.

## **CURING OF CONCRETE**

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- 14. The inspector checks that:
  - 14.1. Special attention is given to the proper curing of all fresh concrete. Concrete is protected so that moisture is not lost during the early stage of hydration.
    - 14.1.1. The curing procedure is established and carefully controlled. Concrete is kept continuously moist until the conclusion of the specified curing period.

- 14.2. After placing and vibrating, the concrete is required to attain initial set before steam is applied so that the concrete has sufficient strength to resist cracking due to thermal expansion. The length of the delay period between the finishing of the concrete and the application of the steam varies according to the mix design.
- 14.3. Steam curing is completed under a suitable enclosure to contain the live steam and minimize moisture and heat losses.
- 14.4. Recording thermometers showing the time-temperature relationship throughout the entire curing period are located at a spacing not to exceed 100' of the bed. The ambient temperature is verified with hand thermometers. Temperature recording charts are retained as a part of the permanent records.

## **INSPECTION OF COMPLETED MEMBERS**

15. The inspector assures that:
  - 15.1. Members are fabricated within specified tolerances. Post-pour dimensional checks by the inspector must be performed on a minimum of 25% of completed members. When dimensional deviations exceeding the allowable tolerances are found, 100% of the completed members produced for that structure must be inspected, or as required by the Engineer.
  - 15.2. "Bug-holes" are not excessive in number and/or size.
  - 15.3. Department approval is obtained before repairing any members not covered by the procedures listed in the appendix of this document.
  - 15.4. The depressions left in the bottom of pretensioned members with draped strands after removal of the hold-down devices are cleaned of oil or grease and the depressions are completely filled with an approved mortar or Bulletin 15 repair material in the plant, prior to storage.
  - 15.5. Patching is performed in accordance with approved procedures. Affected concrete is removed down to sound concrete and the patch is well bonded. Patching is done prior to storage. Mortar repairs are moist cured. Bulletin 15 repair materials are cured according to the manufacturer's recommendations.
  - 15.6. All temporary lifting or handling devices, which are for in-plant use only, must be patched prior to shipping. Patching must be performed using appropriate Bulletin 15 approved materials.
  - 15.7. If temporary lifting or handling devices are deemed necessary to be used during shipping to and/or handling at the job site, they must be detailed on the approved shop drawings.
    - 15.7.1. These temporary lifting or handling devices shall be patched at the job site using appropriate Bulletin 15 approved materials.

## **TRANSPORTATION AND STORAGE**

16. The inspector checks that:
  - 16.1. Prestressed concrete beams are transported in an upright position in accordance with specifications.
  - 16.2. Storage areas are flat and firm, and beams are not twisted.
  - 16.3. Prior to storage, beams are given a complete inspection for tolerances, camber, cracks, bearing area, stirrup placement, alignment, recessed strand areas are patched, open drains, patched vents, etc. Verification of camber must be performed not more than two weeks prior to shipment.
  - 16.4. Necessary corrections are made prior to inspector approval for partial payment or shipment.
  - 16.5. The inspector's stamp of approval is placed on each accepted beam. Indelible ink is used for stamping
  - 16.6. Rejected members are properly identified.

## **DEFECTIVE BEAMS**

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17. The inspector assures that:

- 17.1. If the product does not meet the specifications, the beams are placed in an unacceptable status, and a Quality Report is issued to the fabricator.
- 17.2. Reports are promptly issued for any damaged or defective beam to both the SME and their supervisor. There are a number of reasons that a beam to be declared defective, including:
  1. Cracks which exceed allowable types and limits.  
(Refer to the "Acceptance and Repair Procedures for Prestressed Beams with Cracks" in the Appendix)
  2. Dimensional deviations beyond accepted tolerances.
  3. Damage beyond preapproved limitations.
  4. Other specification non-conformances.

The inspector notifies the fabricator (Quality Report to Quality Control Manager) of the specific non-conformance or deviation.

## **RECORD KEEPING**

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The fabricator is responsible for maintaining a minimum number and type of records or other documentation as indicated in the Quality Control guidelines. The inspector periodically reviews records for verification and conformance to the approved QC plan.

## **SECTION IV - CONCRETE PIPE – (Refer also to Publication 280)**

1. Reinforced Concrete Pipe:

- 1.1. Applicable Specifications  
Publication 280  
Publication 408, Section 601.2.a  
AASHTO T280 (3 Edge Bearing Strength Test)

1.2. General

Pipe producers who obtain/maintain the American Concrete Pipe Association's Q-cast certification or the National Precast Concrete Association's Pipe Plant certification are approved to produce all sizes of pipe, except special design pipe. For all other Bulletin 15 approved plants, the following pipe will require inspection during the manufacturing operation unless waived by the SME.

- Special design pipe.

Concrete placement and pipe forming are accomplished by either traditional wet cast or machine made dry cast processes. For machine made pipe, the three principal methods of manufacture involve mechanical compaction, vibration, or centrifugation. In addition, some machine processes employ combinations of packing and tamping, vibration and centrifugation. Wet cast pipe is usually manufactured by conventional methods of concrete placement, with the addition of vibration to assure proper compaction.

1.3. Inspection

- 1.3.1. The inspector assures that the fabricator is producing in accordance with the approved Quality Control plan and mix design(s).

- 1.4. Sampling
  - 1.4.1. The number of samples required for testing will be determined by those presented for acceptance at the time of testing. One percent (1%) of each lot manufactured by the producer must be tested.
- 1.5. Testing
  - 1.5.1. Testing requirements are as specified in Section 601.2.a. of Publication 408 and the approved Quality Control plan. The testing method of three-edge bearing testing is as described in AASHTO T280 and Publication 280. If a specimen fails a proof load test, two additional samples from the same date of manufacture have to be selected for testing. If both of the additional samples pass, the pipe lot is considered acceptable. If either of the additional samples fail, the date of manufacture is rejected and each date of manufacture represented in the inventory of that particular lot must be sampled (2 pieces) and tested for compliance.
- 1.6. Wire Fabric
  - 1.6.1. Wire cage samples 2'x2' should be tested by the Laboratory Testing Section (LTS) twice each year. Verify domestic source of the wire.
  - 1.6.2. Samples of circumferentially welded cages should be sampled and submitted for testing by LTS each year. A minimum of ten samples of each wire size of each size sampled are required. Do not select samples with visible undercut or other defects unless these are representative of what is being used in production.
- 1.7. Repairs
  - 1.7.1. Repairs are performed as specified in the appendix of Publication 280.

2. Elliptical Reinforced Cement Concrete Pipe

- A Applicable Specifications  
AASHTO T280  
Publication 280  
Publication 408, Section 601.2(a) 3.a
- B Inspection
- C Sampling
- D Testing, and
- E Wire Fabric/Welded Wire Reinforcement

These subsections are the same as in 1. (Reinforced Concrete Pipe)

**SECTION V – PRECAST CONCRETE UNITS**

General – Precast inspector should study the following subsections of Section III, (Inspection of Prestressed Concrete)

- 6. Reinforcing Steel – and as modified to include:
  - 6.4 Adequately and rigidly secure box culvert post tensioning ducts from movement during concrete placement. Movement or internal bowing (sway) of post tensioning ducts may require re-drilling of duct to provide proper post tensioning. Any internal movement, bowing or sway of post tensioning ducts requires the acceptance for use by the Structural Materials Engineer. A #8 or #9 rebar may be pushed through the bowed post tensioning duct, in the presence of the Inspector or Designee, to determine acceptability of the bowed duct. Findings must be submitted to the Structural Materials Section for review/consideration.

8. Concrete Mixes
9. Batching Materials for Concrete
10. Concrete Tests
11. Placing Concrete
12. Vibration of Concrete
13. Finishing of Concrete
14. Curing of Concrete
15. Inspection of Completed Products – and as modified to include:
  - 15.7 When dimensional deviations (deviations at or exceeding the dimensional tolerance limits) are found, perform dry fitting of two (2) adjacent pieces (at a minimum) for 100% of the structure, or as required by the Structural Materials Engineer. The Structural Materials Section recommends performing dry fitting of all box culvert sections to alleviate concerns with box culvert placement in field.
16. Transportation and Storage – and as modified to include:
  - 16.7 Handle and store precast reinforced concrete box culvert segments so that damage will not occur to the concrete or reinforcing steel. Provide suitable lifting devices for handling and installing precast reinforced concrete box culvert segments. Galvanize metal devices as specified in Section 1105.02(s). Prior to shipping, verify gasket material is sufficiently adhered to the joint. Additionally, verify gaps are not present between strips of adjacent gasket material. If gaps are present, a minimum of 6 inches must be replaced to assure material is tight.
  - 16.8 Replace precast reinforced concrete box culvert segments damaged by improper storing, handling, transporting, or erection when it cannot be repaired in the field as per Publication 145 or according to an approved repair procedure. Submit repair procedures beyond the scope of Publication 145 to the Structural Materials Engineer for evaluation and disposition.
  - 16.9 The Representative will inspect the segments at the site for possible damage and cracking during shipment and for tolerances and other dimensions required for acceptance.
  - 16.10 Do not ship segments until the 28-day minimum compressive strength is attained.
  - 16.11 Provide 24-hour advance notice of loading and shipping schedule. Have the Department Representative review Form CS-4171, verify product is properly marked in accordance with Pub. 408, Section 714.6(d) and properly stamp segments with indelible ink before shipping. Do not ship unapproved items.

## **SECTION VI – WELDING**

Welding shall only be performed when approved by the Department. Manual welding of reinforcing steel shall be performed using either shielded metal arc welding (SMAW), gas metal arc welding (GMAW), or flux cored arc welding processes (FCAW). Welder and procedure qualification must be performed in accordance with AWS D1.4-2005.

Precast/Prestressed plants must submit a weld procedure specification (WPS) to the Chief Structural Materials Engineer for approval, (see Appendix D). Procedure Qualification shall be performed by independent laboratories. The following is a summary of the Department's interpretation of the Welder and WPS qualification requirements for lapped reinforcement (either tack or permanent welds).

- Tack welds are required to meet the requirements of permanent welds.
- Refer to Figure 3.4 in AWS D1.4 – Lap Joint (single flare bevel groove weld)

### **1. Welder Qualification for Lap Joint**

- Section 6.3.3.2 – (2) The joint assembly to qualify an indirect butt joint flare groove weld test made using FCAW, GMAW or SMAW shall be a double flare-bevel-groove and flat bar as shown in Figure 6.6(B)
- Table 6.3 – Two test assemblies and two macro-etch specimens (one per assembly) are required
- The qualification test assembly for the indirect butt joint is Figure 6.6(B) – two plates and a rebar
- The smallest bar size used for the welder qualification, qualifies the welder for that bar size and any larger. (Section 6.3.2.2)

## 2. WPS Qualification

- The production joint to be welded is described as a ‘direct lap joint’ in Section 3.6.1 of AWS D1.4.
- Refer to Table 6.2 of AWS D1.4 for the number and types of tests for WPS qualification. Because lap joints are not described, the Department has determined that the closest joint is the Indirect Butt joint shown in figure 6.5D (Two rebars, joined at their butt ends and confined between two other rebar (thus allowing a tension test with no eccentricity.) Two test assemblies (minimum) are required with two tension tests and two macro-etch tests performed.
- The largest bar size to be production welded shall be used for qualification. (reference 6.2.1)
- WPS qualification shall be performed using a steel that has a carbon equivalent at least equal to the highest CE to be encountered in production. The WPS is then qualified for the highest CE value qualified and all lower values (reference 6.2.1.2)

## SECTION VII - MIX DESIGNS: APPROVAL, REVISIONS AND SUBSTITUTIONS AND TOLERANCES

Concrete may be supplied either by a Bulletin 42 approved Redi-Mix supplier or by the precaster. In either case, the mix design must be submitted for approval. District approved mix designs may be approved for use with the approval of the Structural Materials Engineer.

Mix design revisions:

### Conventional ‘slump’ Mixtures:

Mix designs must be resubmitted when sources of supply are changed, including when the aggregate sources are re-qualified. The following will require new trial batching, evaluation and approval:

- Changes in the specific gravity of any aggregate greater than 0.04
- Addition of a ‘higher’ water cement ratio for any given mix design.
- A change in or addition of any admixture other than the air-entrainment
- A change in any aggregate, cement or pozzolan sources

If during construction unforeseen conditions arise, (ie. Aggregate or cement source is removed or becomes unavailable), the Department may provide approval for the precaster to trial batch and resume production at their risk, subject to maintaining uniformity of color (where necessary, ie exposed surfaces), and meeting all other requirements including 28-day strength.

### Self-Consolidating Concrete Mixtures:

Due to the extensive time frame to evaluate self-consolidating concrete mixtures for freeze-thaw, rapid chloride permeability, etc., the Department may allow substitution of the following components to maintain production until all required testing can be completed.

- Cement: If same type, Type 1 to 2, or Type 1 to 3
- Pozzolan – Same type, quantity and with similar chemistry

Any other substitutions will be evaluated on a case by case basis and the relative impact of the revision evaluated prior to making a decision regarding substitution, use and approval for production. Revisions and resumption of production prior to final approval will be performed entirely at the risk of the producer.

### **Batching Tolerance for Mixing Water – Small Batches**

Section 704 indicates that batching tolerances for concrete mixtures must conform to AASHTO M157. Although the specification provides additional consideration of tolerances for small batches for cement and aggregates, batching tolerances for the mixing water for small batches was not similarly addressed.

Because of the variety of types of mixers and how water is introduced into the batch, some precast plants who introduce water by volume in minimum increments of one gallon or by weight in increments of 10 lbs may not be able to meet the 1%<sup>1</sup> tolerance in M157 for small batches (3 cubic yards and less).

In these cases, the Department will allow the water tolerance to be controlled through a variation of the target water/cement ratio of 0.01. For example, for a two yard batch produced for a mixture having a w/c ratio of 0.40 and a cement quantity of 700 pounds, the actual water may vary from design by  $(700 \times 0.01) = \pm 7 \text{ lbs/cy} \times 2 \text{ yds} = \pm 14 \text{ lbs}$ .

In any case, whether aggregate, cement or water tolerances are not met, the Inspector should immediately contact the Department's regional Engineer. In most cases during production, a fabrication incident report would be issued, but the concrete would generally be accepted based on the plastic concrete testing and compressive strength testing.

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<sup>1</sup> Due to AASHTO and Dept. rounding rules a 1% tolerance (where no decimal is shown after the integer digit) provides for a maximum actual tolerance of 1.49% of the total mixing water. (Total mixing water is defined as water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates and water introduced in the form of admixtures.)

**SECTION VIII - PRODUCTION, SHIPPING AND INVENTORY CONTROL OF STANDARD (STOCK) PRECAST CONCRETE PRODUCTS**

Stock items are defined as standard precast concrete products which are not produced for a specific Department project. Historically, the Department has permitted production of additional standard items for producers to have on hand as inventory to readily fill orders for Department projects.

Maximum limits for the production of stock have not been established, however the precast producer must be producing to an active Department project and the product inspected must be maintained in inventory for use on Department or other county or local governmental agencies' projects.

When shipments are made to local governmental agencies, the precaster will complete the 'Local Government/Commercial Stock EQMS Transfer Worksheet' and associated shipping papers and provide a copy to the agency inspector.

The table below provides guidance for the minimum inventory verification to be performed by precaster and Department representative. Stock inventory reports will be generated from EQMS by the Department quarterly and forwarded to the producer and inspection agency for verification within ten calendar days. Verification of inventory at inactive plants may be extended or postponed at the discretion of the Department.

The inspection agency will report any discrepancies to the regional Engineer following the inventory inspection, especially where stock products cannot be accounted for (ie were shipped to commercial projects). Discrepancies will be investigated and resolved between the plant and the Department.

Inventory must be controlled by the producer where the 'oldest' products are shipped first by production date.

	Product Type and Quantity	Inlet Tops (Each type)	Inlet bases, risers, cover adjustment slabs (Each Size and Type)	Inlet grade adjustment rings	Manhole bases, riser sections, conical tops and grade rings (Each)	Endwalls D, DE, DW and ES (Each Type). Sub surface drain outlets (each size)	Junction Boxes and lids (Each type)	Permanent and Temporary Traffic Barrier, (# Sections of each size)
Minimum inventory inspection frequency	Quarterly	50 or more	50 or more	100 or more	50 or more	50 or more	50 or more	100 or more
	Bi-Annually	25-49	25-49	50-99	25-49	25-49	25-49	50-99
	Annually	<25	<25	<50	<25	<25	<25	<50

## PART 2 - FORM OF INSPECTION REPORTS

### SECTION I – FORM TR-4220c, INSPECTION CHARGES

Each inspector is responsible for providing a complete and accurate record of inspection activity and charges. Project specific time charges and applicable expenses must be recorded in EQMS.

### SECTION II – ELECTRONIC REPORTING – SHOP REPORTS

1. **General:** All reporting is to be completed in EQMS unless otherwise directed. The following information is intended primarily to provide general guidance in describing the reporting functions in EQMS and the Department's direction for your role in providing Quality Assurance inspection. This information is not intended to replace the specific instruction provided in the User Guide/Help Topics of EQMS.
2. **Narrative:** There are two narrative types in EQMS – Plant Narrative and Project Narratives. Plant narratives are those activities which are general in nature and do not pertain specifically to an individual inspector or which pertain to all projects. Examples may include equipment calibrations reviewed, description of visitors, etc. The Project narrative is a description of those activities associated only with a specific project.

Narratives are expected to be brief and concise, but must provide a basic accounting of the quality assurance oversight activities performed or witnessed, not just a recordation of deficiencies. For example:

- Describe the major items of inspection during the day.
- Identify any problem(s) and the action(s) taken or desired. Follow-up on problems previously reported until resolved. Note final dispositions.
- Note attached correspondence, indicating date received, if appropriate.
- Note when shop drawings are not approved. Follow-up daily until they are approved.
- Note when unapproved mix designs are used.
- Note when Dept. approved repairs are performed
- Note when inspection for stored materials payment is performed.
- Note when materials are sampled.

### SECTION III – MISCELLANEOUS REPORT

The Department's role in providing Quality Assurance plant inspection is not intended to replace or relieve the fabricator from providing Quality Control inspection. While it may not be practical or possible to oversee the entire production operation, the inspector should review and document fabrication activities to the greatest extent possible.

1. **Concrete Plant startup:** Complete this form initially at new plants and not less than monthly at active locations.
2. **Concrete Forms:** Each approved concrete mix design must be entered in EQMS. It is not practical to expect that EVERY aggregate gradation, batcher mixer slip and batch tolerance information will be documented, however these electronic forms should be completed wherever practical, without sacrificing an inordinate amount of inspection time on the plant floor. It is required, however, that all concrete test data, i.e. slump, air and compressive strength results be documented.

3. **Air Meter calibration and Scale Checks:** These operations occur infrequently; therefore they should be documented each time they are performed.
4. **Sample Identification:** Use hardcopy Department Form TR-447 when samples are sent to LTS for testing purposes. Immediately after completing, forward a completed copy of the form to the SME via facsimile or an electronically scanned pdf file. Periodically check status of sampled materials using EQMS. Notify fabricators of the disposition of sampled materials.
5. **Fabricated Items:** Complete the pre-pour checklist column for each item which that is being fabricated. Standard items can be consolidated on a single form. For general precast concrete products, perform and document post pour dimensions, etc. on not less than 10% of the units produced each day. For box culverts and prestressed concrete beams, perform a post-pour inspection on not less than 25% of the culverts sections/beams produced for the structure. Increase the inspection frequency when dimensional tolerances or other defects are encountered, or as required by the Structural Materials Engineer. When dimensional deviations (deviations at or exceeding dimensional tolerance limits) are found, perform dry fitting of two (2) adjacent pieces (at a minimum) for 100% of the structure. or as required by the Structural Materials Engineer. The Structural Materials Section recommends performing dry fitting of all box culvert sections to alleviate concerns with box culvert placement in the field.
6. **Quality Reports and Fabrication Incident Reports:** This procedure is intended to address the intent of and justification for issuance of Quality Reports and Fabrication Reports. For situations not specifically addressed, the inspector is directed to consult with the Structural Materials Engineer.
  - a. Fabrication Reports and Quality Reports are issued to provide written notification to the fabricator of a product or procedural deviation. The supporting justification for issuing a Fabrication Report differs from a Quality Report as illustrated below. **For situations where it is unclear whether a Fabrication Report or Quality Report is to be issued, the consultant inspector or Department technician will seek direction from the Department.**
    - i. Fabrication Report: generally are issued for 'less serious' circumstances than a Quality Report. A Fabrication Report should be issued to the Plant Quality Control Manager when the following conditions are met:
      - Continued poor Workmanship, requiring repair
      - Quality Control plan deviations
      - Minor specification deviations which do not affect product acceptability or performance
      - Fabrication Reports should NEVER be issued when the product specification deviation would prevent acceptance. For these circumstances, a Quality Report must be issued.

Fabrication Reports must be completed in their entirety and resolved in a timely manner. Upon completion of the Fabrication Report, the plant will submit to the consultant inspector and SME for review and acceptance. Continued quality control violations or specification deviations, however minor, will not be permitted to persist. Bring repetitive quality issues or outstanding deviations to the attention of the Structural Materials Engineer for further action.

- ii. Quality Report: generally are issued to address 'more serious' circumstances than a Fabrication Report. A Quality Report should be issued to the Plant Quality Control Manager when the following conditions are met:
  - Fabrication which is not in accordance with the approved drawings.
  - Shipment of unapproved /unstamped material.
  - Significant specification deviations which render the material unacceptable.
  - Other areas, as defined in Form TR-443, Quality Report
  - **Persistent quality related issued which have not been corrected.**

Quality Reports must be completed in their entirety and resolved in a timely manner. Upon completion of the Quality Report the plant will submit to the consultant inspector and SME for review and acceptance.

7. **Shipping Papers:** Forms CS-439, and TR-4218 are hardcopy forms and should be completed, signed and provided to the fabricator to include with their CS-4171 Certificate of Compliance whenever prestressed concrete beams are shipped. For all other products, only form CS-4171 is required to be completed by the fabricator to certify material delivered to a project.
8. **Miscellaneous:** other forms or reports may be required if requested by the Engineer.

**TABLE “A” PRESTRESSED/PRECAST CONCRETE PRODUCT INSPECTION RESPONSIBILITIES**

**PRESTRESSED/PRECAST PLANT**

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(Producer)	Produce Prestressed/Precast items with in framework of approved quality control plan in accordance with Department specification.
QUALITY CONTROL	<p>RESPONSIBILITIES</p> <ul style="list-style-type: none"> <li>– Submit quality control plan revisions for review to the Structural Materials Section.</li> <li>– Provide an ACI level I certified quality control technician for concrete testing.</li> <li>– Provide PCI Level II certified staff during tensioning, detensioning and casting operations.</li> <li>– Provide PCI Level III to provide overall management for the QC processes.</li> <li>– Perform acceptance tests.</li> <li>– Maintain required Quality Control records</li> </ul>

**INSPECTION AGENCY**

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	Act as an extension of the Department. Shop operations are monitored by agency inspector performing quality assurance inspection.
QUALITY ASSURANCE	<p>RESPONSIBILITIES</p> <ul style="list-style-type: none"> <li>– Assure that producer is following the approved quality control plan</li> <li>– Verify that materials incorporated in product are from approved sources and review certifications provided</li> <li>– Perform quality assurance tests at plant</li> <li>– Accept/reject finished item.</li> <li>– Stamp acceptable product at time of shipping.</li> <li>– Document tests and inspection activities using the EQMS application.</li> </ul>

## **STRUCTURAL MATERIALS FIELD PERSONNEL**

Department personnel oversee plants and observe the performance of agency inspectors.

### **INDEPENDENT ASSURANCE**

#### **RESPONSIBILITIES**

- Make random shop visits.
- Observe/report on performance of consultant inspection
- Witness/perform independent assurance tests at plant
- Sample materials, as required in accordance with the Materials Action Program.
- Accept/reject finished item.
- Assist in resolving fabrication related problems at project and plant.

## **DISTRICT/PROJECT ENGINEER**

Incorporates acceptable product into the project

#### **RESPONSIBILITIES**

- Verify that items shipped were approved by agency inspector.
- Visually inspect for damaged pieces.
- Observe unloading operations by contractor.
- Assure proper storage at project site prior to use.
- Notify Structural Materials Section of unacceptable workmanship or defects (TR-800)

## **STRUCTURAL MATERIALS STAFF ENGINEERS**

Direct state-wide program to produce Prestressed / Precast concrete products.

#### **RESPONSIBILITIES**

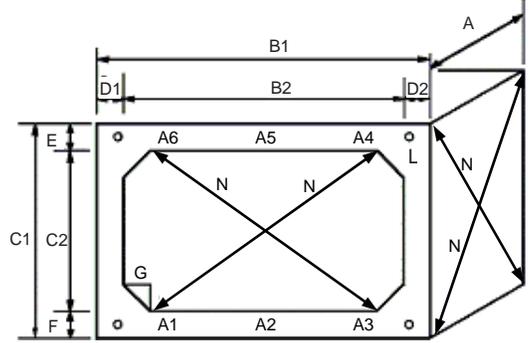
- Provide service to the Districts.
- Prequalify Prestressed/Precast plants for Bulletin 15 approval.
- Approve quality control plans and mix designs.
- Approve repair procedures.
- Supervise plant/field inspection personnel
- Conduct and document prequalification meetings for new fabrication or for large or complex projects, as required.
- Provide timely answers to prestressed/Precast producers concerning specification requirements.
- Review specifications, update as needed.
- Work with Districts to resolve quality problems.

# DIMENSIONAL REVIEW FOR BOX CULVERT



FABRICATOR NAME:			FORM ID:			
PLANT JOB ID:			ECMS #:			STATE PROJECT #:
SR:		SEC:		COUNTY:		S-
REVIEW TYPE: <input type="checkbox"/> QUALITY CONTROL (QC) <input type="checkbox"/> QUALITY ASSURANCE (QA) <input type="checkbox"/> INDEPENDENT ASSURANCE (IA)						

Section Lay Lengths						
Dim	Desc.	Tol.	Design	Pre-Pour	Post-Pour	Dev.
A1	Length – Left, Middle, Right (Top and Bottom)	See A Below				
A2						
A3						
A4						
A5						
A6						



Dim	Description	Tolerance	Design	Pre-Pour	Actual	Deviation
A	Lay Length	1/8"/FT of Length (1/2" Max.)				
B1	Width - Outside					
B2	Width - Inside	+/- 1% (1" Max.)				
C1	Height - Outside					
C2	Height - Inside	+/- 1% (1" Max.)				
D1	Wall Thickness	+ 1/4" / - 3/16"				
D2	Wall Thickness	+ 1/4" / - 3/16"				
E	Top Slab Thickness	+ 1/4" / - 3/16"				
F	Base Slab Thickness	+ 1/4" / - 3/16"				
G	Haunch	1/4"				
H	Weep Holes	+/- 2"				
K	Inserts					
L	Post Tension Duct	1/4" (at ends only)				
M	Length of Opposite Surfaces	1/8"/FT of Internal Span (5/8" Max.)				
N	Internal / External Diagonal	+/- 1% (1" Max.)				
O	Mating Surface (pallet and hand finished joint)	< 10 FT: +/- 1/4" 10 FT to 20 FT: +/- 3/8" > 20 FT: +/- 1/2" Max.				

- Protective coating properly applied.....  YES     NO     N/A
- Reinforcement (size, grade, location) .....  YES     NO     N/A
- Approved Shop Drawing .....  YES     NO     N/A
- Properly Repaired .....  YES     NO     N/A
- Bottom of culvert acceptable / free of defects.....  YES     NO     N/A
- Post-tension duct adequately secured (bowing/sway requires Engineer approval).....  YES     NO     N/A
- Dry fit performed .....  YES     NO     N/A
- Features (inserts, key joints, fish baffles, etc.) +/- 1/4" on CL between adjacent segments.....  YES     NO     N/A

Date of Casting: \_\_\_\_\_ Date of Post-Pour Check: \_\_\_\_\_

Name: \_\_\_\_\_

Comments: \_\_\_\_\_

- Cure the repaired area either in accordance with the Bulletin 15 manufacturer's recommendations, or, in accordance with the approved Quality Control plan for a minimum of 24 hours.
- Evaluate the repaired area by applying moderate blow with a 16 ounce hammer at several locations of the repaired area.
- Apply a finish coat to the repaired area to match the approved architectural finish.

**Note:** A repair mix is typically developed through a trial and error process in order to match color and texture of the concrete surface. Slight variations can be expected due to the difference in age and curing conditions for the repair.

### **Section 6 – For Cosmetic Repairs of Exposed Surfaces with Architectural Finishes.**

- Areas to be repaired must be clean, sound and free of contaminants.
- If the depth exceeds 1 inch make a 3/4 inch deep vertical surface along the perimeter of the damaged area, where applicable (where patch will feather to nothing.)
- Provide an aggregate fractured surface with a minimum surface profile of – 1/8 inch
- Saturate the repair surface with clean water to provide a SSD condition when applicable.
- Fill the area with either a thoroughly mixed Bulletin 15 repair material in accordance with manufacturer's recommendations, the approved concrete mix design, or if less than 1 inch in depth, a mortar mix.
- Cure the repaired area either in accordance with the Bulletin 15 manufacturer's recommendations, or, in accordance with the approved quality control plan for a minimum of 24 hours.
- If the depth exceeds 1 inch evaluate the repaired area by applying a moderate blow with a 16 ounce hammer at several locations of the repaired area.
- Apply a finish coat to the repaired area to match the approved architectural finish.

**Note:** A repair mix is typically developed through a trial and error process in order to match color and texture of the concrete surface. Slight variations can be expected due to the difference in age and curing conditions for the repair.

#### **General Notes:**

Repairs are to be witnessed by a Department representative. **(For submitted repairs, the procedure must be presented to the Department's inspector for verification. After the condition of the beam is verified, the inspector will sign the procedure for distribution to the Department)**

Patching operations as well as the curing cycle shall be a temperature of at least 40 F.

- Repairs to bearing areas must be submitted to the Department for review and approval.
- The damaged area may not exceed a length of 24" in any direction
- Repairs to exposed surfaces will be limited to 5% of the total exposed surface area of each face.
- Bulletin 15 approved materials must be listed in the following sections: of the total exposed surface area of each face.

#### Concrete repair materials:

1. Section 679.2(e) 'Rapid Set Concrete Patching Materials
2. Miscellaneous 'Polymer Modified and Special Cements, Mortars and Concrete'

Bonding Agents:

1. Section 1001.2(k) 'Epoxy Resin Bonding Systems', Type II Grade 2 only
2. Section 1001.2(k) 'Non-Epoxy Bonding Systems'.

**ACCEPTANCE AND REPAIR OF PRESTRESSED CONCRETE BEAMS WITH CRACKS AND OTHER REPAIRS**

The ultimate goal of design, detailing, and fabrication specifications and practices is to produce prestressed concrete bridge beams without cracks. However, some types of cracks are very difficult to predict and the best producers and designers can do is to react to the occurrence of cracks in order to prevent reoccurrence. While fabricator practices can lead to cracks, not all cracks are a result of fabrication errors.

The following descriptions, cause/cure considerations and recommendations of Section B may be helpful to designers and others who may have to review submittals for changes to details for the most likely cures to chronic cracking problems or to better understand how to prevent them in the future. Crack width and length limitations and repair methods for acceptance of beams are given in Sections C and D. Beams with cracks, which do not exceed the limits, described in Table 1 and which have been satisfactorily repaired will be accepted. Any repairs beyond the limits defined in Section C may be submitted to the Structural Materials Engineer for evaluation on a case-by-case basis. **(For submitted repairs, the procedure must be presented to the Department's inspector for verification. After the condition of the beam is verified, the inspector will sign the procedure for distribution to the Department)**

**A. GENERAL OBSERVATIONS**

1. Precast Prestressed concrete beams are designed to be crack free in the compression zone of the member.
2. Additional reinforcing for crack control will not eliminate cracks but may reduce the size of them.
3. End-tension design stresses are not the primary cause of cracks as cracks may appear in members with zero tension.
4. There is little known of the effect that cracks will have on the life of a reinforced member under cyclic loadings. Therefore cracks should be kept to a minimum.
5. Cracking may be induced or increased due to rapid cooling of different sections of the prestressed member.
6. Many small reinforcing bars are more effective in reducing cracking than fewer larger bars furnishing the same area of steel.

**B. CLASSIFICATION OF CRACKS**

**Type 1 Crack (V-Crack)**

# QUALITY CONTROL PLAN GUIDELINES FOR PRECAST AND PRESTRESSED CONCRETE PLANTS



Page # of  
QC Plan

Minimum Testing Frequency

I. Aggregate Testing		
A. Fine Aggregate		
1. Gradation & FM	- Restocking bins - PTM 616	_____
2. Minus #200 mat'l	- Every five gradations - PTM 100	_____
3. Percent of moisture	- Beginning of work and thereafter as required ASTM C70 or AASHTO T 255.	_____
B. Coarse Aggregate		
1. Gradation	- Restocking bins - PTM 616	_____
2. Minus #200 mat'l	- Every five gradations - PTM 100	_____
3. Percent of moisture	- Beginning of work and thereafter as required ASTM C70 or AASHTO T 255.	_____
4. Crush Count (Gravel)	- Monthly	_____
5. % of solids	- Beginning of season or as necessary due to extreme aggregate changes.	_____
II. Batch Scale Checks		
A. Aggregate scale	- Monthly - PTM410**	_____
B. Cement scale	- Monthly - PTM410**	_____
C. Water scale	- Monthly - PTM410**	_____
III. Calibration of Equipment		
A. Water meter	- Annually	_____
B. Plant admixture dispensers	- Annually	_____
C. Unit Weight Bucket	- Optional, can use Air Meter Base as Unit Weight Bucket	_____
D. Air meter	- Bi-weekly	_____
E. Cylinder compression	- Annually by private calibration service.	_____
F. 50 lb. weights	- Once every three years by Dept. of Agriculture or private Calibration service.	_____
G. QC Small Lab Scale	- Annually	_____
* H. Load cells, hydraulic gages, Dynanometers, etc. Section 1107.03(c)3	- Annually	_____
* 1. Temperature recording checks	- Annually	_____
J. Batch Scale	- Annually	_____

NOTE: Equipment calibration will be documented and kept in Plant Book.

## IV. Reinforcing Fabrication (Epoxy Coated) and Welding (if applicable)

### Reinforcement fabrication

A. Protective Pin Bushings (ECR)	- Daily for wear. Replace as required	_____
B. Bend radii, rebar length Geometry (from shop dwgs.)	- First piece, if automated; 10% if manual	_____
C. End coatings, if sheared	- Positector, 100% daily	_____

Minimum Testing Frequency

Welding

D. Procedure/Equipment

- 1. Weld Procedure Specification
- 2. Verify equipment settings
- 3. Carbon equivalency

- Posted at weld station, verify daily
- Verify daily
- Each rebar heat /document

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

E. Workmanship

- 1. Undercut (1/32" max)
- 2. Cracking, Overlap (none Permitted)
- 3. Weld size

- Check/document 10% welds daily
- Check/document 10% welds daily
- Check/document 10% welds daily

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

V. Prepour Checks

- Form dimensions, steel placement

\_\_\_\_\_

VI. Temperature Checks

A. Aggregate

- During cool & cold weather  
408, Section 704.1(F)

\_\_\_\_\_

B. Water -

- During cool & cold weather  
408, Section 704.1(F)

\_\_\_\_\_

C. Concrete Mixture

- First batch each day and two thereafter  
at increments of 10 c.y. to  
establish consistency\*\*\*

\_\_\_\_\_

VII. Concrete Mixture

A. Air Test

- First batch each day and two  
thereafter at increments of  
10 c.y. to establish consistency\*\*\*

\_\_\_\_\_

B. Slump Test

- First batch each day and two  
thereafter at increments of  
10 c.y. to establish consistency\*\*\*

\_\_\_\_\_

C. Molding/Marking Cylinders and  
Cylinder Molds (Describe marking  
system per PTM 631)

- Each shift's production (4 cyls min)

\_\_\_\_\_

VIII. Curing

- Develop plan using ACI 308  
or Pub 408 where applicable.  
Initial cure with product in form; secondary  
cure after stripping

\_\_\_\_\_

IX. Post Pour Checks

- Measure and record dimensions (p/c-  
10% or not less than one unit per lot  
daily; p/s-each unit)
- Visual Inspection

\_\_\_\_\_

\_\_\_\_\_

X. Patching

- Mortar Patched areas are cured a  
minimum of 24 hours. Bulletin 15  
repair materials are cured in  
accordance with the manufacturer's  
recommendations

\_\_\_\_\_

	<u>Minimum Testing Frequency</u>	<u>Page # of QC Plan</u>
XI. Documentation		
A. Batcher/Mixer slips		_____
B. Gradations		_____
C. Moisture		_____
D. Certification shipping form (Form CS-4171)		_____
E. Straight-Line Analysis Charts - Note: establish action points at critical values		
1. Fine Aggregate		_____
2. Coarse Aggregate		_____
3. Slump		_____
4. Air		_____
F. Pre-pour Verification Checklist (Steel Size, Location, Dimensions, etc)		_____
G. Post-pour Measurements		_____
H. Rebar end coating thickness measurements		_____
XII. Certification		
A. Admixture	- Certification	_____
B. Cement	- Certification	_____
C. Steel	- Certification	_____
D. Repair Materials	- Certification	_____
XIII. Identify the Quality Control Manager		
XIV. Handling and Storage	- Pub 408, Section 1085.3(3)	_____
XV. Delivery	- Pub 408, Section 1085.3(3)	_____
* P/S Plants Only		
** Scale checks to be conducted only at 100% of the nominal batch capacity of the mixer.		
*** Once material control is established, frequency will be limited to every 25 cubic yards. If a subsequent test fails to meet specification requirements or exceeds the upper or lower action points, increase testing frequency to 10 cubic yards and test the next two batches. Continue testing at this frequency until material consistency has been re-established.		