

FIELD SAMPLING AND TESTING MANUAL
QUALITY ASSURANCE PROGRAM
FOR
PRESTRESSED AND PRECAST
CONCRETE PRODUCTS

QUALITY ASSURANCE PROGRAM FOR PRESTRESSED AND PRECAST CONCRETE PRODUCTS

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FORM

SFN 10093 Reinforced Concrete Pipe Test and Inspection Record

QUALITY ASSURANCE PROGRAM FOR PRESTRESSED AND PRECAST CONCRETE PRODUCTS

PRESTRESSED CONCRETE BEAMS

A. Plant Review

The plant review will consist of a review of all plant operations and will include an inspection of the plant facilities. Required documentation review and testing will be conducted annually (before the first NDDOT project begins) as follows:

1. Concrete Batch Plant

Scale Certification - scale certification shall be in accordance with NDDOT Specification 802.04 B.1.

Batch Weight Accuracy - Batch weight accuracy shall be in accordance with NDDOT Specification 802.04 B.1.

Admixture Accuracy - Admixture accuracy shall be in accordance with NDDOT Specification 802.04 C.

2. Prestressing Jack

The Department will obtain a "Certificate of Calibration." The "Certificate" shall indicate that the gauges, jacks and pumps have been calibrated as a system in the same manner as they are used in tensioning operations. The "Certificate" shall indicate that the calibration was performed by an ASTM approved testing laboratory or calibration service and a certified calibration curve shall accompany each tensioning system. Pressure reading can be used directly if the calibration determines a reading is within a $\pm 2\%$ tolerance of actual load. Calibrations shall be performed at any time a tensioning system indicates erratic results, and in any case at intervals not greater than 12 months. The loads to be gauged shall not be less than 1/4 or more than 3/4 of the total graduated gauge capacity, unless the calibration chart clearly establishes consistent accuracy over a wider range.

All jacking and load measuring equipment shall be calibrated as specified above.

Calibration records shall show the following data:

- Date of calibration.
- Agency or laboratory supervising the calibration.
- Method of calibration; i.e., proving ring, load cell, testing machine, etc., and its calibration reference.
- The full range of calibration with gauge readings indicated against actual load.

Calibration records for all tensioning systems in use shall be kept on hand for use in preparing theoretical tensioning values. Personnel involved in preparing tensioning calculations shall have a copy of these records for reference. Sections 2.1.4 and 2.1.7 of the PCI "Manual for Plants and Production of Precast and Prestressed Concrete Products" may be used as a reference for the prestressing jacks.

3. Water Testing

Water testing shall be conducted annually if the water source is questionable, i.e., well water. Testing shall be in accordance with NDDOT Specification 812.

4. Quality Control Evaluation

The Materials and Research Division of the NDDOT will annually evaluate the fabricators QC program. The adequacy of the fabricator's QC program will determine the waiver of NDDOT Specifications Sections 604.02 A, 604.02 C, and 604.02 D, and the level of verification testing by NDDOT. Divisions I and VI of the PCI "Manual for Plants and Production of Precast and Prestressed Concrete Products" may be used as reference for this evaluation.

B. Project/Production Review

1. Mix Design

A written mix design for each project will be provided by the fabricator and shall include the following information:

- Type and amount of cement.
- Amount of water.
- Amount, maximum size, and coarse aggregate source.
- Amount and fine aggregate source.
- Amount and types of admixtures.

- Fines/total aggregate ratio.
- Water/cement ratio.
- Unit weight of concrete mix.
- Maximum slump of concrete mix.

This mix design shall be reviewed prior to the initial inspection. Section 3.1 of the PCI "Manual for Plants and Production of Precast and Prestressed Concrete Products" may be used as reference for mix designs.

2. Production Observation

Materials and Research Division will observe 25 to 50% of the beams fabricated for each project. The observation will be conducted on the first set of beams fabricated on each project and then randomly thereafter. Division V of the PCI "Manual for Plants and Production of Precast and Prestressed Concrete Products" may be used as reference for the production observations. The observation will address the following:

a. Initial Tensioning

The placement and the amount of tensioning in the prestressing cables shall be in accordance with the approved shop drawings. This shall be done by checking the readings on the calibrated jacks and observing the elongation of the cables. Section 2.2 of the PCI "Manual for Plants and Production of Precast and Prestressed Concrete Products" may be used as reference for the pretensioning.

b. Steel Inventory

The reinforcing steel shall be in agreement with the approved shop drawings for grade, proper size, and quantity before the forms are placed.

c. Steel Placement

The reinforcing steel placement shall be in agreement with the approved shop drawings before the forms are placed. The following are acceptable tolerances:

1. Prestress Cable - The prestress cable shall be within $\pm 1/4$ " of the position shown on the approved shop drawings. Cables shall be protected against physical damage and rust or other results of corrosion at all times. Cables shall be free of deleterious material such as grease, oil, wax, or paint. Cables shall not have nicks or kinks.

Steel that has sustained physical damage at any time shall be rejected. The development of pitting or other results of corrosion, other than rust stain, shall be cause for rejection. Hold down devices for deflected cables shall be placed within ± 6 " of the approved shop drawing positions.

2. Reinforcing Steel - Reinforcing steel shall be adequately supported by chairs and rigidly held in place within the forms. Chairs in contact with the forms must be either plastic or stainless steel tipped. Stirrups shall be within ± 1 " of the position shown in the approved shop drawings. Stirrups projecting above the top of the beam shall be within a tolerance of $+1/4$ ", $- 3/4$ ". The clear cover shall be within a tolerance of $+1/4$ " to 0". Welding or tack welding of reinforcing steel is prohibited.
3. Inserts - The inserts shall be within $\pm 1/2$ " of the positions shown on the approved shop drawings. Any metal devices in contact with the forms shall be galvanized or coated as specified on the plans.
4. Lift Hooks - Lift hooks shall be placed within ± 6 " of the position shown on the approved shop drawings.

d. Beds and Forms

Beds and forms shall be clean, smooth and without warps; set on a rigid foundation; able to withstand fluid pressures of concrete; mortar tight at all joints; accurately built to the proper dimensions; and coated with a release agent.

e. Concrete

The concrete's slump and temperature shall be recorded. In addition, air temperature and weather conditions shall be recorded. Batching equipment shall be capable of achieving a rate of pour that will avoid cold joints and will allow float finishing of the top of the beam before initial set. If the vibrator will not sink under its own weight, a cold joint has developed. When cold joints have developed, the partially cast member shall be rejected. Section 3.3 of the PCI "Manual for Plants and Production of Precast and Prestressed Concrete Products" may be used as reference for a concrete pour.

f. Curing Process

The fabricator shall cure the beams by steam or radiant heat if the

ambient air temperature does not provide an adequate cure. The concrete shall reach its initial set before application of steam or heat curing. Time of set may be determined by ASTM C 403. During the initial set period the curing chamber temperature must be maintained at or above 50°F. The fabricator shall have a least two maximum and minimum temperature recording thermometers per curing chamber. The maximum curing temperature shall not exceed 160°F. Section 3.4 of the PCI "Manual for Plants and Production of Precast and Prestressed Concrete Products" may be used as reference for the curing process.

g. Detensioning

The detensioning shall not be done until control cylinders, cured with the beams, indicate the concrete has reached the design prestress transfer stress, or 4,000 psi, whichever is greater. The forms, ties, inserts, hold-downs or other devices that would restrict longitudinal movement of the beams along the bed shall be removed. Heating of individual strands shall be done simultaneously at a minimum of two locations along the casting bed. The sequence of the heating of each strand along the bed, and the sequence between strands, and the release of hold down devices, shall be accomplished so that no damage occurs to the girder. Detensioning by simply cutting the strand with a shear will not be allowed. Section 2.3 of the PCI "Manual for Plants and Production of Precast and Prestressed Concrete Products" may be used as reference for detensioning operations.

h. Beam Dimensions

To ensure that the beams have been accurately cast to the dimensions shown on the plans, all major dimensions of five completed beams selected randomly from each NDDOT project shall be measured, including length, height, flange widths, sweep and camber. In addition, the fabricator's quality control paperwork shall be reviewed by the Materials and Research Division with regard to beam dimensions for the remaining beams. Tolerances for as build dimensions shall be as per PCI Specifications 6.4. Camber shall be measured not sooner than 24 hours after the beam has been cast.

i. Acceptance

Beams cast that vary from the approved shop drawings with respect to dimensions; reinforcement steel size, quantity, or location; prestressing cable size, quantity, or location; and void form size or location shall be

subject to rejection or evaluation by the Department Bridge Engineer.

If honeycombing is present or any reinforcing or prestressing cable is exposed at the time of form removal, a beam shall be subject to rejection by the Department Bridge Engineer.

Beam repairs shall be submitted in writing and approved by the Department Bridge Engineer. Any variation from approved shop drawings shall be subject to rejection by the Department Bridge Engineer if said Engineer determines that the variation will result in an inferior product.

After Materials and Research Division has determined that the beam has been constructed in accordance with the approved shop drawings, the beam will receive the Department stamp. The Materials and Research Division shall record all beams dimensions, any repair work, and the date stamped. Final acceptance of beams will be conducted by the project engineer.

3. Materials Testing

a. Random Aggregate Testing

One random test shall be performed for each project in accordance with NDDOT Specification 816.01 A.2 for fine aggregate and 816.02 A.2 for coarse aggregate. Sodium sulfate soundness tests may be omitted if this test has been run on the source pit.

b. Random Cement Testing

Three random samples shall be tested each construction season or one test with a change in source. Testing shall be in accordance with NDDOT Specification 804.01.

c. Steel Strand Testing

One test shall be performed on each new lot. Testing shall be in accordance with NDDOT Specification 836.03.

d. Rebar and Cage Testing

Three tests shall be performed each year. Testing shall be in accordance with NDDOT Specifications 836.02 and 836.03.

e. Admixtures

All admixtures shall be tested at the rate of one test per lot. Testing shall be in accordance with NDDOT Specification 808.

f. Freeze-Thaw Testing

One set of bars shall be cast every year and when the admixture amount or lot changes.

g. Concrete Strength Testing

One set of three cylinders on three random occasions shall be cast each year for verification. The average concrete strength of the fabricator's cylinders must be within 5% of the Department average cylinder strength.

4. Certifications

Materials and Research Division will review the manufacturer's QC documentation and applicable certifications and affidavits for materials used to produce each of a project's beams. These will also be reviewed by the project engineer.

PRECAST CONCRETE PIPE

A. Plant Review

The plant review will be conducted by the District Materials Coordinators. The plant review will consist of a review of all plant operations and will include an inspection of the plant facilities. Required documentation, review, and testing will be conducted annually as follows:

1. Concrete Batch Plant

Scale Certification - Scale certification shall be in accordance with NDDOT Specification 802.04 B.1.

Batch Weight Accuracy - Batch weight accuracy shall be in accordance with NDDOT Specification 802.04 B.1.

Admixture Accuracy - Admixture accuracy shall be in accordance with NDDOT Specification 802.04 C.

2. Three-Point Bearing Jack

District Materials Coordinators shall review the independent laboratories results of the three-point bearing tests conducted at least three times a year. The District Materials Coordinators will document the review and report results to the Materials and Research Division. In addition, the District Materials Coordinators will review the three-point bearing jack calibration documentation annually.

Calibration records shall show the following data:

- Date of calibration.
- Agency or laboratory supervising the calibration.
- Method of calibration; i.e., proving ring, load cell, testing machine, etc., and its calibration reference.
- The full range of calibration with gauge readings indicated against actual load.

3. Water Testing

Water testing shall be conducted annually if the water source is questionable, i.e., well water. Testing shall be in accordance with NDDOT Specification 812.

4. Quality Control Evaluation

District Materials Coordinators will annually evaluate the fabricators QC program. The evaluation and a typed copy of the QC program shall be sent to the Materials and Research Division. The District Materials Coordinators will review all certifications for individual projects.

B. Materials Testing

1. Random Aggregate Testing

Three random tests shall be performed each year or when the source changes. The testing shall be conducted in accordance with NDDOT Specification 816.01 A.2 for fine aggregate and 816.02 A.2 for coarse aggregate. Sodium sulfate soundness tests may be omitted if this test has been run on the source pit. Aggregate testing may be omitted if similar tests have been conducted by the Department for a different concrete product, i.e., prestressed beams or precast box culverts. The District Materials Coordinator will review all certifications for this material.

2. Random Cement Testing

Three random samples shall be tested each construction season or one test with a change in source. Testing shall be in accordance with NDDOT Specification 804.01. Cement testing may be omitted if similar tests have been conducted by the Department for a different concrete product, i.e., prestressed beams or precast box culverts. The District Materials Coordinator will review all certifications for this material.

3. Rebar and Cage Testing

Three tests shall be performed each year. Testing shall be in accordance with NDDOT Specifications 836.02 and 836.03. Rebar and cage testing may be omitted if similar tests have been conducted by the Department for a different concrete product, i.e., prestressed beams or precast box culverts. The District Materials Coordinator will review all certifications for this material.

4. Admixtures

All admixtures shall be tested at the rate of one test per lot. Testing shall be in accordance with NDDOT Specification 808. Admixture testing may be omitted if similar tests have been conducted by the Department for a different concrete product, i.e., prestressed beams or precast box culverts. The District Materials Coordinator will review all certifications for this material.

5. Absorption Testing

Two samples shall be taken per year per plant and sent to the Materials and Research Division for absorption testing. One sample can be taken each construction season for absorption verification testing if the manufacturer is doing frequent absorptions. The samples may be taken from the wall of the pipe after they have been strength tested for Dultimate. The samples shall not be from the same pipe size. Absorption tests may not be omitted.

6. Strength Testing

One pipe section for each pipe size, up to 60", used on NDDOT construction projects each year shall be obtained for three-edge-bearing testing for D0.01 and Dultimate. Pipe sections greater than 60" shall be tested for compressive strengths using molded cylinders. Strength testing is not required for concrete end sections. This verification testing cannot be omitted. The District Materials Coordinator will review all of the manufacturer's compression test results for concrete.

7. Acceptance

When all of the above test results meet specifications and the District Materials Coordinator determines that the plant is in compliance, then 100% of the precast concrete pipe produced at the subject plant may be accepted on certification. The final acceptance will be conducted by the project engineer. If one or more of the above material tests fail, the District Materials Coordinator will increase the sampling and testing frequency. Precast concrete pipe will not be accepted on certification for the lot represented by the failed tests. Testing will then be in accordance with Section 830.01. The precast concrete pipe may be accepted on certification when the quality control and quality assurance tests indicate that the product is within specification.

PRECAST BOX CULVERTS

A. Plant Review

The plant review will be conducted by the District Materials Coordinators. The plant review will consist of a review of all plant operations and will include an inspection of the plant facilities. Required documentation review and testing will be conducted annually as follows:

1. Concrete Batch Plant

Scale Certification - Scale certification shall be in accordance with NDDOT Specification 802.04 B.1.

Batch Weight Accuracy - Batch weight accuracy shall be in accordance with NDDOT Specification 802.04 B.1.

Admixture Accuracy - Admixture accuracy shall be in accordance with NDDOT Specification 802.04 C.

2. Water Testing

Water testing shall be conducted annually if the water source is questionable, i.e., well water. Testing shall be in accordance with NDDOT Specification 812.

3. Quality Control Evaluation

District Materials Coordinators will annually evaluate the fabricators QC program. The evaluation and a typed copy of the QC program shall be sent to the Materials and Research Division. The District Materials Coordinators will review all certifications for individual projects.

B. Materials Testing

1. Random Aggregate Testing

Three random tests shall be performed each year or when the source changes. The testing shall be conducted in accordance with NDDOT Specification 816.01 A for fine aggregate and 816.02 A for coarse aggregate. Sodium sulfate soundness tests may be omitted if this test has been run on the source pit. Aggregate testing may be omitted if similar tests have been conducted by the Department for a different concrete product, i.e., prestressed beams or precast concrete pipe. The District Materials Coordinator will review all certifications for this material.

2. Random Cement Testing

Three random samples shall be tested each construction season or one test at a change in source. Testing shall be in accordance with NDDOT Specification 804.01. Cement testing may be omitted if similar tests have been conducted by the Department for a different concrete product, i.e., prestressed beams or precast concrete pipe. The District Materials Coordinator will review all certifications for this material.

3. Rebar and Cage Testing

Three tests shall be performed each year. Testing shall be in accordance with NDDOT Specifications 836.02 and 836.03. Rebar and cage testing may be omitted if similar tests have been conducted by the Department for a different concrete product, i.e., prestressed beams or precast concrete pipe. The District Materials Coordinator will review all certifications for this material.

4. Admixtures

All admixtures shall be tested at the rate of one test per lot. Testing shall be in accordance with NDDOT Specifications 808. Admixture testing may be omitted if similar tests have been conducted by the Department for a different concrete product, i.e., prestressed beams or precast concrete pipe. The

District Materials Coordinator will review all certifications for this material.

5. Compression Testing

The District Materials Coordinator will review all of the manufacturer's compression test results for concrete.

C. Production Observation

The District Materials Coordinators will inspect the first section of a box culvert for each project. If fabrication does not occur in the District Materials Coordinator's own district, then the District Materials Coordinator shall make arrangements with the Materials and Research Division or another District.

The District Materials Coordinator is to conduct the required observation. This observation will address the following:

1. Steel Inventory

The reinforcing steel shall be in agreement with the approved shop drawings for grade, proper size, and quantity, before the forms are placed.

2. Steel Placement

The reinforcing steel placement shall be in agreement with the approved shop drawings, before the forms are placed. The reinforcing steel shall be adequately supported by chairs and rigidly held in place within the forms. Chairs in contact with the forms must be either plastic or stainless steel tipped.

3. Forms

Forms shall be clean, smooth and without warps; able to withstand fluid pressures of concrete; mortar tight at all joints; accurately built to the proper dimensions; and coated with a release agent.

4. Acceptance

Box culverts cast that vary from the approved shop drawings with respect to dimensions, reinforcement steel size, quantity, or location shall be subject to rejection or evaluation by the Department Bridge Engineer. If honeycombing is present, or if any reinforcing steel is exposed at the time of form removal, the box culvert shall be subject to rejection by the Department Bridge

Engineer. Any repairs to the box culvert shall be submitted in writing and approved by the Department Bridge Engineer. Any variation from approved shop drawings shall be subject to rejection by the Department Bridge Engineer, if said Engineer determines that the variation will result in an inferior product. Final acceptance of box culvert will be conducted by the project engineer.

REINFORCED CONCRETE PIPE TEST AND INSPECTION RECORD

North Dakota Department of Transportation, Materials & Research

SFN 10093 (Rev. 04-2000)

MANUFACTURER	PLANT LOCATION	TESTED BY	DATE OF TEST
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Date of Test Piece	Class of Pipe	Internal Diameter			Length			Wall Thickness			3 Edge Bearing Test			Date of Pieces Stamped	Number of Pieces Stamped
		Nominal Inches	Actual Inches	Meets Requirements	Nominal Feet	Actual Feet - Inches	Meets Requirements	Nominal Inches	Actual Inches	Meets Requirements	Required Load Lbs.	Applied Load Lbs.	Result *		

Remarks:

Distribution: 1- Dept. Files

*Code: DNC - Did Not Crack - Approved
 HC - Hair Crack - Less than 0.01" - Approved
 DNP - Did Not Pass - Crack over 0.01"