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October 7, 2004
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**Tennessee Department of Transportation
Division of Materials and Tests**

**Manufacture and Acceptance of Pre-cast Concrete Drainage
Structures, Noise wall panels, and Earth retaining wall products
(SOP 5-3)**

Purpose- The purpose of this document is to establish the minimum qualifications for the manufacture and acceptance of pre-cast drainage structures, including pipes, headwalls, manholes, catchbasins, box culverts, structural spans, noise wall panels, and earth retaining wall products. This document will provide the requirements for producers, testing frequencies, re-testing procedures, and product identification.

Background- TDOT Standard Specifications and Standard Drawings generally specify drainage structures to be in accordance with AASHTO and/or ASTM Standards. These Standards provide the design requirements and various materials and testing procedures.

Procedures-

1.0 Producer Requirements- All producers of pre-cast concrete drainage structures, noise wall panels, and earth retaining wall products to be supplied on TDOT projects shall be CERTIFIED. For pipe production, either the American Concrete Pipe Association (ACPA) or the National Pre-cast Concrete Association (NPCA) certification will be required, for drainage structures, not pipe, either the National Pre-cast Concrete Association (NPCA) or the Pre-stressed Concrete Institute (PCI) certification is required, and for other pre-cast products, either the American Concrete Pipe Association (ACPA), or the National Pre-cast Concrete Association (NPCA) or the Pre-stressed Concrete Institute (PCI) certification will be required, effective February 1, 2004. Certified Producers must submit a copy of their certification and documentation that they are certified and have successfully completed the annual inspections.

2.0 Standard Drawings - All pre-cast concrete products shall be manufactured in strict accordance to the dimensions and details shown on the TDOT Standard Drawings, approved shop drawings, plans, or ASTM/AASHTO Specifications. Any variations to the TDOT Standard Drawings must be submitted to the TDOT Design Division for approval.

3.0 Materials-

3.1 Aggregates- All aggregates used for wet and dry cast products shall be in accordance with Section 903.01, 903.03, and 903.22 of the TDOT Standard Specifications. The percentage of wear for coarse aggregates shall not exceed 40 when tested in accordance with AASHTO T-96.

- 3.2 Cement- All cements shall meet the requirements of Section 901.01 and be on the TDOT Qualified Product List (QPL). The producer shall retain copies of material certifications with chemical and physical properties.
- 3.3 Fly Ash, Ground granulated blast furnace slag, silica fume- other cementitious and pozzolanic materials must meet the requirements of Sections 918.31 or 918.32, and be on the TDOT QPL
- 3.4 Reinforcing steel and wire strands- steel used for reinforcement of the drainage structures shall be in accordance with the applicable AASHTO or ASTM Standard for the structure, or as required by TDOT Standard Drawings, and/or approved shop drawings. The producer shall retain copies of all mill test reports and material certifications.
- 3.5 Admixtures- All admixtures must comply with sections 604.03 and 918.09 of the TDOT Standard Specifications and be on the TDOT QPL.

4.0 Mixture Design- The producer shall submit to the TDOT for approval a concrete mixture design for each mixture that will be used. The mixture design submittal shall contain the minimum information required in subsection 604.03 of the Specifications. The mixture design will be valid for a one-year period. Any changes in material suppliers will require a new design submittal. The minimum cement content for any pipe shall be 470 lbs/CY. The minimum cement content and maximum water-cement ratio for wet cast products shall be 564 lbs/CY and 0.40 respectively. Concrete for noise wall panels shall meet the requirements of sub-section 604.03 Class "A" concrete. Concrete for retaining wall panels shall meet the requirements of sub-section 604.03 Class "A" concrete with the following requirements: minimum cement content 620 lbs/CY, maximum water-cement ratio 0.40, and minimum compressive strength of 4000 psi. The maximum allowable substitution rates of cementitious materials will be as specified in section 604.03 of the TDOT Specifications. All other mix design criteria (i.e. strength, etc...) shall be in accordance with the applicable AASHTO/ASTM Standard Specifications, Approved Shop Drawings, or TDOT Standard Drawings and Specifications.

Producers requesting to use self-compacting concrete (SCC) mixtures must submit a design in accordance with the chemical admixture manufacturer's recommendations and further demonstrate through trial batches that the mixture can be produced homogeneously without segregation. The TDOT must witness and approve the trial batch demonstrations for acceptance.

5.0 Quality Control Program-

- 5.1 Quality Control Plan (QCP) - Each production facility shall have a Quality Control Plan as required by the applicable National certification Program.
- 5.2 Testing Equipment and Laboratory-
 - 5.2.1 Each production facility shall have, or have immediate access to a "Type A" laboratory as defined in Section 106.06 of the Specifications to conduct quality control testing. Laboratory qualifications shall meet requirements stated in SOP 1-4 (Laboratory Qualification Requirements).
 - 5.2.2 Each production facility that is CERTIFYING products for acceptance must have a compression machine that is of sufficient capacity to test to the required strength of cylinders or cores and/or a "testing rack" for conducting

three-edge bearing for testing pipe products to the required ultimate load strengths. A private testing laboratory, approved by the Department, may be used for compressive testing. The testing laboratory shall be accredited through the AASHTO Accreditation Program (AAP).

5.2.3 The testing equipment shall be certified a minimum of every 12 months. The producer shall maintain documentation and records of all certifications.

5.2.4 Gradations shall be performed on each aggregate used at least once per month.

5.3 Quality Control Personnel-

5.3.1 Each production facility shall have an individual responsible for the quality production of precast products. This individual shall have authority to make necessary adjustments, reject concrete, cease production, or reject products when the quality of the product is in question.

5.3.2 Technicians and other individuals who conduct sampling and testing for quality control must be at least TDOT level 2 certified, or other approved equal. Any individuals submitting concrete mixture designs must be TDOT level 3 certified, or other approved equal.

5.4 Concrete Batching/Central Mixing Plant- the concrete batch/central mixing plant shall have all scales, weighing devices, and/or metering devices calibrated and correlated a minimum of every 6 months. Documentation shall be available to show the calibration results.

Concrete may be supplied by a ready mix producer provided the plant and hauling equipment are in compliance with section 501.04 and 604.03 of the TDOT Specifications. The plant must be further approved by TDOT and meet requirements stated in SOP 4-3 (Ready Mix Concrete Plant Certification Procedures).

6.0 Acceptance Testing-

6.1 All testing for acceptance shall be completed, as a minimum, in accordance with TABLE 1. A LOT is defined as one week, Sunday to Saturday, and SUB-LOT is daily for dry cast applications. A LOT is daily for all wet cast applications. All testing shall be in accordance with ASTM C-497 (AASHTO T-280).

6.2 A product will be accepted if: 1- All the acceptance test results for the LOT comply with the requirements of the applicable Specification, 2- the product is manufactured within the "Permissible Variations" allowable for the applicable specification, and 3- the product is manufactured in accordance with the "Rejection" limits established for the applicable specification.

6.3 Retesting- When an acceptance test fails to meet the requirements specified, then the product is unacceptable. Retesting will be allowed as follows:
6.3.1- D-Load test (or compressive strength for SUB-LOT) - The producer shall randomly sample and test 2 (two) additional pipe pieces from that SUB-LOT. Both test results must exceed the required D-load strength (or compressive

strength) for the SUB-LOT to be acceptable. If both tests do not meet specified strengths then each individual pipe must be test for acceptance.

6.3.2- Ultimate Load and Absorption- The producer must retest a piece of pipe from the same day's production that failed to comply initially and one from another day's production during that week. Both test results must exceed the required ultimate Load and Absorption for the LOT to be acceptable. If both tests do not meet the requirements, then 2 pieces of pipe from each day of that week must be tested and both pieces must pass for the daily LOT to be acceptable.

6.3.3 Compressive Strength (Wet Cast)-

6.3.3.1 If acceptance by cylinders: 1 (one) additional set of backup cylinders may be tested for acceptance. If the cylinders do not meet specified strengths, then 2 (two) cores shall be taken from different pieces for testing. Both test results must exceed the required compressive strength requirement for the LOT to be acceptable.

6.3.3.2 If acceptance by cores: 2 (two) additional cores shall be taken from different pieces for testing. Both test results must exceed the required compressive strength requirement for the LOT to be acceptable.

TABLE 1- Minimum testing frequencies for acceptance

PRODUCT		D-LOAD (0.01" crack)	Ultimate Load ₄	Absorption ₄	Compressive Strength _{1,2,3}
DRY CAST	Round Pipe- Diameter ≤30"	1/ day	1/ month	1/ month	
	Round Pipe- Diameter ≥36"	1/ day or compressive strength ₆	1/ week or compressive strength	1/ month	1/ day or D-Load
	Arch Pipe- <265/8" x 433/8"	1/ week	1/ month	1/ month	
	Arch Pipe- ≥ 265/8" x 433/8"	1/ week or compressive strength	1/ week or compressive strength	1/ month	1/ week or Ultimate Load
	Elliptical Pipe- < 29" x 45"	1/ week	1/ month	1/ month	
	Elliptical Pipe- ≥ 29" x 45"	1/ week or compressive strength	1/ week or compressive strength	1/ month	1/ week or ultimate load
WET CAST	Manholes				1/ day min. ₅
	Catchbasins				1/ day min. ₅
	Structural Spans				1/ day min. ₅
	Box Culverts				1/ day min. ₅
	Endwalls				1/ day min. ₅
	Noise and retaining wall panels ₇				1/ day min. ₅

1- Compression strength may either be by core (minimum 3.75" diameter) or cylinders (4" x 8" or 6 x 12" cylinders)

2- Compression strength must be 100% of the specified strength to be acceptable

3- A pair of cylinders, if used in lieu of coring, shall be made at a minimum of 3 random points during production. The cylinders shall be cured in the same manner as the products they represent. One pair of cylinders shall be retained for TDOT verification testing for at least 14 days.

4- A piece of pipe tested to ultimate shall be tested for Absorption. Only one absorption test per month is required per design. Absorption may be tested in accordance with ASTM C497, Section 7, Method B

5- Six cylinders/day per mixture minimum. If the same mixture design is used in all products then the 6 specimens will represent all products manufactured that day

6- When small quantities (20 sections or less) per week of a product are produced, 1 test per week will be acceptable.

7- Noise and retaining wall panels require 1 air and slump test per day.

7.0 **Stamping/Etching-** Each pre-cast product produced shall be marked, by either stamping or etching, with the following information:

7.1 Pipe- Date of manufacture, diameter, AASHTO/ASTM designation and class, and the manufacturing plants unique stamp/location identifier.

7.2 Other than pipe: Date of manufacture, AASHTO/ASTM designation and class, TDOT Standard type, project/contract number, plans location, and the manufacturing plants unique stamp/location identifier.

7.3 Each product accepted by certification must also have “Certified” clearly stamped on the product.

8.0 Documentation and Reporting- The manufacturer shall keep daily reports documenting each product made that day and the number made. That report shall identify the date, type, contract, structure number, and test results of all acceptance tests made for that product. The manufacturer shall maintain this information for a minimum of 5 years.

9.0 TDOT Verification testing and inspection-

9.1 The Tennessee Department of Transportation retains the right to test and/or request the producer to retest any SUB-LOT or LOT for verification purposes. Verification may include any of the Acceptance tests identified. The frequency of verification testing may vary at the discretion of the Regional Materials Supervisor. When an acceptance test is conducted once a day then a minimum of one verification test must be conducted once a week. If an acceptance test is conducted once per week then a verification test must be conducted once per month. If an acceptance test is conducted once per month then a verification test is required once every 6 months

9.2 If verification test results do not comply with product specifications, or reasonably resemble the test results of the acceptance results, then all products represented by the manufactures acceptance test results will be immediately considered “questionable for acceptance” and additional testing will be required.

9.3 Addition testing will entail that 2 (two) additional samples of product manufactured the same day as the verification sample will be tested. Both test results must exceed the requirements of the applicable test. If both results do not comply with specification requirements the products from that day are unacceptable, and shall not be used on Department projects.

9.4 If products are deemed unacceptable as determined in section 7.3, then additional verification testing shall be conducted on other products produced.

9.5 TDOT shall maintain records and documentation of all Verification testing that occurs.

9.6 TDOT shall have the right to review and inspect all producer quality control data, records, and files to assure compliance with these requirements.

9.7 TDOT shall randomly select a minimum of one precast structure in each region every quarter for destructive testing to be performed by Regional Materials and Tests. TDOT will coordinate the regional test to ensure all plants have at least one item tested statewide each year.

9.8 TDOT Headquarters Materials and Tests shall make random quality control inspections at each plant yearly.

10.0 Disqualification of Manufacturers-

10.1 All producers of pre-cast concrete drainage products and panels shall be CERTIFIED by the American Concrete Pipe Association (ACPA) and/or the National Pre-cast Concrete Association (NPCA) and/or Pre-stressed Concrete Institute (PCI). If a producer fails to maintain their certification they will not be allowed to produce products for use on TDOT projects

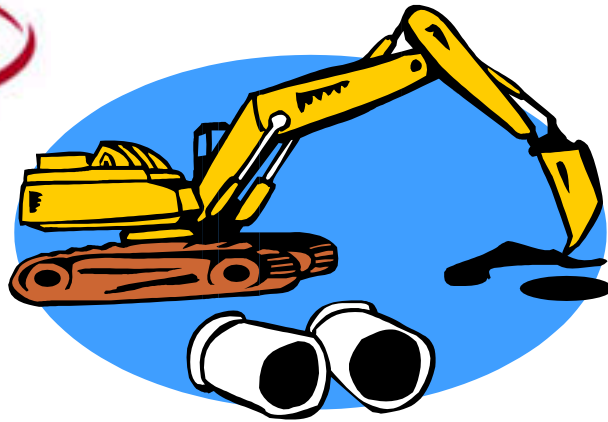
10.2 TDOT may disqualify a producer if they fail to manufacture, test, accept, or certify in accordance with the procedure set forth herein.

10.3 TDOT may disqualify a producer if they falsify acceptance test results or certify/stamp products that have not meet acceptance criteria.

10.4 TDOT may disqualify a producer if TDOT verification testing indicates that the quality of product being manufactured is questionable.

11.0 Shipment- The producer must submit a completed certification form for each shipment to a TDOT project. An example form is attached, with the minimum information required. This form shall contain a statement certifying the products were manufactured, tested, and accepted in accordance with TDOT Procedures.

No products shall be shipped from the fabrication plant/stockyard until they have met all acceptance criteria.



Example

Date July 14, 2003 Contract number CNB 555 Report Number 1234567890
 Project Number 123458-987-04 Contractor Joe's Pipe Installation Co. County Davidson

We, Precast - R-Us, Inc., certify that the following products have been made in reasonable close conformance to the lines and grades shown as specified in accordance with: TDOT Standard Drawings, TDOT Standard Specifications, Approved plans, Approved shop drawings, and/or AASHTO/ASTM Standards. We also certify that the test results documented are correct, and the product has been completed in full accordance with the TDOT procedures for the manufacture of Pre-cast Concrete Products.

Reinforced concrete pipe:

Pipe Size/ Class/Wall	Date Mfg'd	D- Load to produce 0.01" crack	D- Load to produce ultimate load	Concrete Strength (psi)	Absorption percent	Quantity	Identific ation Number
18"-III- B ASTM C-76	6/25/03	1650	2450		5.2%	80 LF	12345
18"-III- B ASTM C-76	6/28/03	1600	2450		5.2%	96 LF	98765

Pre-cast concrete manholes, catch basins, end walls, box culverts, retaining walls, noise walls, etc. . . :

Item/type/dimensions/Structure Number	Date Mfg'd	Concrete Strength (PSI)	TDOT Drawing Number	Quantity	Identific ation Number
Type 12 Manhole- 32" x 32" x 48" Structure # 25 with risers and top	7/1/03	5600	DCB-12-LP	1 (8 feet)	12345
Noise wall panels 60" x 72" x 5"	6/27/03	5445	From Plan Sheet pg. 55	25 panels = 83.3 SY	98765

Signature: of Quality Control Manager
 Date: July 14, 2003