

ALDOT-451 PRODUCTION AND INSPECTION OF SPUN CAST CYLINDER PILES

1 SCOPE

- 1.1 This procedure provides guidelines for the production and inspection of spun cast cylinder piles. This procedure is a supplement to the contract and plans for the manufacturing of spun cast cylinder piles. Where conflicting requirements exist, the requirements given in the contract or plans shall be applicable instead of the requirements given in this procedure.

2 REFERENCED DOCUMENTS

2.1 ALDOT STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION

- 2.1.1 Requirements for the materials and processes required for the production of spun cast cylinder piles are given in the following Sections of the Specifications:

- Section 505 Piling
- Section 834 Piling Materials

2.2 ALDOT PROCEDURES

- 2.2.1 Requirements for the materials and processes required for production of spun cast cylinder piles are given in the following ALDOT Procedures contained in the Testing Manual:

- ALDOT 170 Method of Controlling Concrete Operations for Structural Portland Cement Concrete
- ALDOT 358 Jack Calibration Procedure
- ALDOT 367 Production and Inspection of Precast Non-Prestressed and Prestressed Concrete
- ALDOT 405 Certification and Qualification Program for Concrete Technicians and Concrete Laboratories

2.3 AASHTO AND ASTM STANDARDS

- 2.3.1 Requirements for the materials and processes required for production of spun cast cylinder piles are given in the following AASHTO and ASTM Standards:

- T 22 Compressive Strength of Cylindrical Concrete Specimens
- T 23 Making and Curing Concrete Test Specimens in the field
- M 32 Cold Drawn Steel Wire for Concrete Reinforcement
- M 203 Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete
- A 615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- C 942 Compressive Strength of Grouts

3 PLANT CERTIFICATION AND QUALITY CONTROL PLAN

- 3.1 The producer of spun cast cylinder piles shall meet the certification requirements outlined in Section 834 of the Standard Specifications.
- 3.2 The producer of spun cast cylinder piles shall submit a Production and Quality Control Plan to the Materials and Tests Engineer as required in Section 834 for evaluation of completeness.
- 3.3 Producers of spun cast cylinder piles shall be listed on List I-10, Producers of Precast Non-Prestressed and Prestress Concrete Bridge Members.

- 3.4 The producer's Quality Control (QC) technician shall meet the certification requirements outlined in Section 834 of the Standard Specifications.
- 3.5 The producer's QC technician shall be responsible for all aspects of production from the initial preparations for casting to the shipment of the piles. The QC technician shall be responsible for ensuring that the materials and workmanship meet the requirements given in the Specifications, on the Plans, and as described in this Procedure.
- 3.6 The QC technician and plant laboratory shall meet the requirements in Section 834 and ALDOT-367.

4 MANUFACTURING OF SPUN CAST CYLINDER PILES

4.1 MATERIALS

4.1.1 CONCRETE MIXTURE DESIGN

- The producer shall submit a proposed mixture design to be used for the production of spun cast piles in accordance with the requirements given in Subarticle 834.06(c), ALDOT-367, and the requirements given in this procedure.
- Concrete mixes may be designed by a commercial laboratory or by the plant's laboratory meeting the requirements given in ALDOT-405.

4.1.2 GROUT

- The producer shall submit a proposed non-shrinkage grout mixture to be used in the grouting of steel strands after post tensioning in accordance to the requirements of Subarticle 834.06(d).

4.1.3 REINFORCING AND PRESTRESSING STEEL

- The certifications for the steel reinforcement shall be submitted to the Materials and Tests Engineer for review. The certifications shall include the actual test results for each lot of reinforcing steel. Certifications that include typical test results for steel reinforcing in general are unacceptable.
- The reinforcing and prestressing steel shall meet the requirements outlined in Subarticle 834.06(b) of the Standard Specifications.
- Reinforcing steel shall be made in the U.S.A.. Materials suppliers shall provide proof of compliance with the Buy America Policy. The statement "MADE IN THE USA" shall be included in every certification.

4.2 SPUN CAST CYLINDER PILE SECTIONS

- 4.2.1 The reinforced steel cage shall be securely held in position during the casting and spinning of the concrete.
- 4.2.2 Longitudinal holes for the stressing strands shall be formed during casting in the walls of the pile sections. The spiral steel reinforcement shall be outside the strand holes and shall have a nominal concrete cover of 2 inches to the outside surface of the pile section.

4.3 CURING

- 4.3.1 After the pile sections are centrifugally cast and removed from the spinner, they shall be covered to prevent rapid loss of moisture. Pile sections shall be cured by low-pressure steam after an initial setting time of 45 minutes.
- 4.3.2 Forms shall be removed when the concrete has reached a compressive strength of 4,000 psi. After the pile sections are removed from the steel forms they shall be moved to the storage area where the curing cycle is completed by air or moist curing.

4.4 SPUN CAST CYLINDER PILE ASSEMBLY

- 4.4.1 Before post-tensioning stressing is applied, the individual pile sections shall be lined up. The maximum deviation in the outside joint alignment of two adjacent pile sections shall not be more than $\frac{1}{4}$ inch.
- 4.4.2 The abutting joining surfaces of individual pile sections shall be covered by a joint sealing material of sufficient thickness to fill voids between the end surfaces, except at the formed holes for the stressing strands, when brought together under compression. The sealing material shall be resistant to exposure and weathering as is the concrete. After the sealing material is applied, the pile sections shall be brought into contact and held together by applying an initial stress of 100 psi to the gross concrete area until the sealing material sets.
- 4.4.3 The stressing strands shall be tensioned to an initial stress as indicated on the plans. This tension shall be measured by the hydraulic stressing jack and verified by the elongation of the strand. The variation in the actual elongation and the calculated elongation shall not be greater than 5%. Tension in the strands shall be maintained by mechanical end-locks or anchors until final stress transfer.
- 4.4.4 Stress strands from opposite holes. Start with the top and bottom holes and continue with the strands in the holes exactly in between the top and bottom; after that, stress the strands in any sequence from opposite holes. The complete pile unit shall be lined up so that the axis of the pile does not deviate from a straight line by more than $\frac{1}{8}$ - inch per 10 feet of length.

4.5 GROUTING

- 4.5.1 After stressing all tendons, each tendon hole shall be cleaned and completely filled with grout. While the grout is curing, the pile unit shall not be moved or handled in any manner that would result in permanent damage to the grout or pile.
- 4.5.2 The stressing strands shall be considered to be without slippage with the removal of the end-locks when upon cutting the strands between the end of the pile and the end-locks with a burning torch, the strands do not part under stress with a “cup and cone” fracture, but are burned through with the torch. Pile units showing evidence of stressing strand slippage shall be rejected.

4.6 TESTING

4.6.1 CONCRETE CYLINDERS

A minimum of one set of test cylinders shall be cast for every 50 cubic yards, or fraction thereof, of concrete placed in a day's casting. A set of cylinders shall be six 6" by 12" concrete cylinders. Cylinders shall be cured in the same manner as the pile sections they represent. Test two cylinders to determine form removal, two cylinders to determine post tensioning requirement, and two cylinders to determine the 28-day strength of the concrete. The compressive strength shall be determined by the average of two cylinder tested at the same age. Cylinders for the determination of compressive strength shall be made in accordance with the requirements given in AASHTO T 23 and shall be tested in accordance with the requirements given in AASHTO T 22.

4.6.2 GROUT

A minimum of one grout test shall be done for each day's grouting operation. Grout cube specimens shall be prepared and tested in accordance to Subarticle 834.06(d). Once the specified strength on the plans is achieved, no further testing is required.

5 EQUIPMENT

5.1 GAUGING SYSTEMS

- 5.1.1 Hydraulic pressure gauges, load cells, or dynamometers shall be used for measuring the force applied to the strand during the post tensioning operation. All tensioning equipment shall be equipped with accurately calibrated gauges for determining the tension loads applied to the strand.
- 5.1.2 Devices for measuring the tensioning force shall be graduated to read within $\pm 2\%$ of the required prestressing force. The range of display of a gauge shall be $1\frac{1}{2}$ to 2 times its normal working pressure.
- 5.1.3 The display face of a dial gauge shall not be less than 8 inches in diameter. Each dial shall be designed so that the loads may be read directly in units of pounds or the load may be determined from the dial reading by using a calibration chart on which is given the relationship between gauge reading and force.

5.2 CALIBRATION OF GAUGING SYSTEMS

- 5.2.1 Jacks, gauges, load cells, and any other type of approved gauging system used shall be calibrated in accordance with the requirements given in ALDOT-358. Calibration shall be performed at intervals no greater than six months.
- 5.2.2 The tensioning equipment shall be calibrated by an approved testing laboratory meeting the requirements of the National Institute of Standards and Technology (NIST). A graph of the calibration (load versus gauge reading) shall be furnished as a part of the producer's Quality Control Plan. The laboratory performing the calibration shall furnish a certified calibration curve for each system of tensioning equipment.

5.3 FORMS

- 5.3.1 Forms shall be made of steel and they shall be braced and stiffened to prevent deformations under the pressure of the concrete during the spinning. The end surfaces of the forms shall be a true plane perpendicular to the axis of the sections.

6 HANDLING, STORING AND SHIPPING

- 6.1 Spun cast cylinder pile units shall be handled only by means of adequate devices at the designated locations shown on the plans. Supports and bracing for the members shall be stable and level. Members shall be repositioned or relocated as required to maintain them in a stable and level condition. All spun cast cylinder pile units shall be stored in a position that will make them accessible to the ALDOT inspector at all times. After the ALDOT inspector determines that the spun cast cylinder pile units meet the Department Specifications, the pile units will be stamped to indicate acceptance.
- 6.2 Documentation on each of the spun cast cylinder pile units shall be in accordance to the requirements in ALDOT-367.