

Method of Test for
**MAKING AND FIELD CURING COMPRESSIVE STRENGTH SPECIMENS FOR
CONCRETE PIPE**

DOTD Designation: TR 227

Method A – Rodded Method

I. Scope

- A. This procedure is used in making, protecting, field curing, and transporting Portland cement concrete compression test specimens for concrete pipe. This procedure allows the addition of water to the concrete mixture to facilitate molding.

II. Reference Documents

- A. DOTD S 301 - Sampling Fresh Concrete
B. DOTD TR 207 – Slump of Portland Cement Concrete
C. DOTD TR 230 – Curing, Capping, and Determining the Compressive Strength of Cylindrical Concrete Specimens
D. AASHTO M 205 – Molds for Forming Concrete Test Cylinders Vertically

III. Apparatus

- A. Cylinder Molds – Right circular cylinders having a nominal inside diameter of 6 inches and a length of 12 inches for casting concrete compression test specimens vertically.
1. Single Use Molds – Approved plastic molds, to be used only once, with a rigid lipped opening, light gray or light in color in order that permanent black ink markings on containers can be easily read. All molds shall conform to AASHTO M 205.
2. Reusable Molds – Approved metal molds, intended for use more than once, with a metal base plate. The assembled mold shall be such that the base plate is at right angles to the longitudinal axis of the cylinder and shall conform to AASHTO M 205.
- B. Tamping Rod – A round, smooth straight steel rod, approximately 5/8 inches in diameter and 24 inches in length, having each end rounded to a hemispherical top of the same diameter as the rod.
- C. Small Tools – Pail, trowel, scoop, timer or watch, water, brush or cloth.
- D. Straightedge – Approximately 1-3/8 inches wide by 3/16 inches thick by 12 inches long with a 1/4-inch bevel on one side.
- E. Work Base – Stable platform or foundation rigid enough to accommodate a minimum of four (4) molds, (i.e. concrete, plywood, etc.).
- F. Curing Supplies – Approved polyethylene bags and rubber bands or an approved plastic cap.
- G. Transport Box – A wooden box for transporting the cylinders in a vertical position (Figures A-1 and A-2).
- H. Mallet – With a rubber head having a mass of 1.25 ± 0.50 lb.
- I. Form Release Agent – Mineral oil or an approved form release agent for use with metal molds.
- J. Pen – Waterproof black ink marker.
- K. Sealant – Any waterproofing sealant for use with metal molds.
- L. Numbered Field Book – For recording data.

IV. Sample

- A. Obtain sample in accordance with DOTD S 301.
- B. If the sample of plastic concrete is too stiff for compaction by rodding, add water and remix to produce a slump no greater than 3 inches determined in accordance with DOTD TR 207.
- C. If the adding of water produces a slump of greater than 3 inches obtain another sample and repeat this procedure until the mixture of plastic concrete produces a satisfactory slump.

V. Procedure for Molding Specimens**A. Molds**

1. Reusable Metal Molds – Assemble mold to base plate and lightly coat the inner surface with the form release agent. The assembled mold shall be watertight. Use a sealant where necessary to prevent leakage through the joints.
2. Single Use Molds – Before concrete is placed into the mold, identify each specimen by writing on the side of the cylinder mold with the black ink marker the sample number, and date of pour.

B. Molding Specimens

1. Place the mold(s) on a level, rigid, horizontal surface, free from vibration and other disturbances at the location where they are to be stored during the first 20 hours. If the ground is not level, place the molds on a level, stable work base. The location of molding shall be as near as possible to the pipe represented by the specimens.
2. Using a scoop or trowel, place the concrete into the cylinder mold in an even layer that will yield approximately 1/3 the volume of the mold. When placing the concrete into the mold move the scoop or trowel around the perimeter of mold opening to ensure even distribution of the concrete and to minimize segregation.
3. Level the layer of concrete in the mold using a circular motion of the tamping rod.
4. Rod the layer 25 times with the tamping rod, distributing the strokes uniformly over the cross section of the mold. Rod the layer throughout its depth without damage to the bottom of the mold.
5. Tap the sides of the mold to eliminate voids left by rodding. Tapping is to be done around the circumference of the mold at the mid-point of each layer.
 - a. For reusable molds, tap the sides 10 to 15 times using the mallet.
 - b. For single use molds, use the mallet to lightly tap the sides of the mold around the circumference 10 to 15 times.

Note 1: Do not use the tamping rod or any other objects other than the mallet to tap the sides.

6. Repeat steps 2 through 5 for two more layers with the following exception.
 - a. Penetrate each underlying layer approximately 1/2 inch with the tamping rod.
 - b. When placing the final layer, slightly overfill the mold no greater than 1/2 inch. Each layer shall be rodded 25 times.
7. After consolidation, strike off the surface of the concrete and finish with the straightedge. Perform all finishing with the minimum manipulation necessary to produce a flat even surface that is level with the rim or edge of the mold and that has no depression or projections larger than 1/8 inch.

Note 2: Molding of test specimens shall be completed within 15 minutes from the time the sample was taken.

8. To prevent loss of moisture, cover the specimens immediately after completion of molding by placing a polyethylene bag or cap over the exposed surface of each specimen. Do not allow the polyethylene bag to come in contact with the plastic concrete. Use a rubber band to secure the bag on the mold.

9. Identification of specimens:

a. Single use molds were identified before the concrete was placed in them.

b. For reusable molds, after initial set and before removal from the mold, mark the top of the cylinder using black ink marker or suitable tool with the sample number, and date of pour.

10. Allow the specimen to cure in accordance with Section VI.

VI. Procedure for Field Curing

A. Twenty hours (20) after molding, or as soon thereafter as practical, remove the molds from the specimens, transfer the information on the molds to the specimens with a waterproof black ink marker and allow the concrete specimens to cure in the same environment as the pipe prior to testing.

VII. Transporting Test Specimens

A. Do not damage specimens during handling or transporting. Place specimens in a transport box, described in TR 226 if they are transported in a vehicle or subjected to vibration during transportation. If a transport box is not available, use other suitable means to ensure that the cylinders are protected from damage.

VIII. Report

A. Document each pour in a numbered field book. Enter in the field book all information required to identify each specimen and the pipe it represents. There is no test report generated with this procedure.

IX. Normal Test Reporting Time

A. Maximum time for making cylinders is 15 minutes. Minimum time for field curing cylinders is 20 hours.

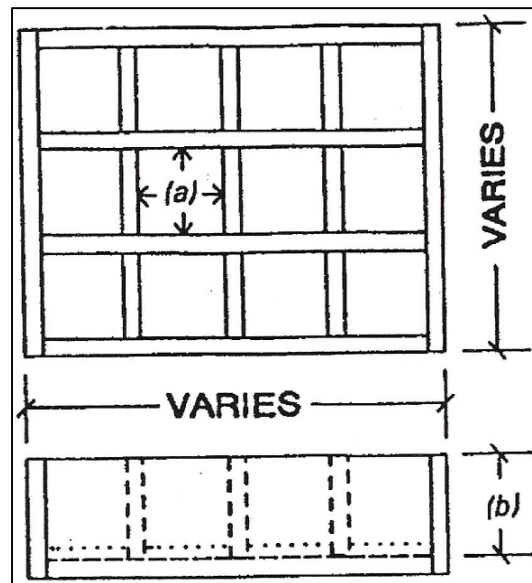


Figure A-1

**Dimensions of a Typical Concrete Cylinder Transport Box
The Bottom of Each Component May Be Cushioned with ½ Inch Closed Cell Polyethylene
or Similar Material:**

- (a) Recommended Hole Opening: Maximum Diameter of 6 ¼ inch**
- (b) Recommended Depth of Hole: 7-9 inches**



Figure A-2

Typical Concrete Cylinder Transport Box

Method B – Vibrated Table Method

I. Scope

- A. This procedure is used in making, protecting, field curing, and transporting Portland cement concrete compression test specimens for concrete pipe. This procedure allows vibration and surcharging of the concrete mixture (at its existing moisture content) into the mold.

II. Reference Documents

- A. DOTD S 301 - Sampling Fresh Concrete
- B. DOTD TR 230 – Curing, Capping, and Determining the Compressive Strength of Cylindrical Concrete Specimens
- C. AASHTO M 205 – Molds for Forming Concrete Test Cylinders Vertically

III. Apparatus

- A. Cylinder Molds – Right circular cylinders having a nominal inside diameter of 6 inches and a length of 12 inches for casting concrete compression test specimens vertically. The molds shall be approved metal molds, intended for use more than once, with a metal base plate. The assembled mold shall be such that the base plate is at right angles to the longitudinal axis of the cylinder and shall conform to AASHTO M 205.
- B. Vibratory Table – Smooth, horizontal, steel plate with level surface, rigid enough to accommodate a minimum of four (4) molds. The table shall be provided with a clamping mechanism for firmly securing all molds to the table. The table must have a capacity to vibrate all test specimens at once. External vibration shall be applied to the table with a frequency of at least 60 Hz (3600 vibrations per minute).
- C. Surcharge – A minimum of four (4) 10 lb. cylindrical steel plates with machined surfaces, approximately 1-½ inch in thickness and ¼ inch smaller in diameter than the inside of the mold, each with a suitable lifting device. Each lifting device used shall be symmetrically attached. The contact surfaces of each surcharge plate shall be lightly coated with mineral oil or an approved form release agent before use.
- D. Tachometer – A vibrating-reed tachometer for checking the frequency of vibrations.
- E. Small Tools – Appropriate wrenches, level, pail, water, trowel, scoop, brush or cloth, timer or watch.
- F. Straightedge – Approximately 1-3/8 inches wide by 3/16 inch thick by 12 inches long with a ¼-inch bevel on one side.
- G. Transport Box – A wooden box for transporting the cylinders in a vertical position (Figures A-1 and A-2).
- H. Form Release Agent – Mineral oil or an approved form release agent for use with metal molds.
- I. Pen – Waterproof black ink marker.
- J. Sealant – Any waterproofing sealant for use with metal molds.
- K. Numbered Field Book – For recording data.

IV. Sample

- A. Obtain sample in accordance with DOTD S 301.

V. Procedure for Molding Specimens

- A. Assemble molds to base plates and lightly coat the inner surface with form release agent. The assembled mold shall be watertight. Use suitable sealants where necessary to prevent leakage through the joints.
- B. Place all assembled molds on top of the vibrating table and take care to ensure that each mold is rigidly attached to the vibrating surface.
- C. Using a scoop or trowel, place the concrete into each cylinder mold in an even layer that will yield approximately $\frac{1}{4}$ the volume of the mold. When placing the concrete, move the scoop or trowel around the perimeter of each mold opening to ensure an even distribution of the concrete and to minimize segregation.
- D. Place the surcharges on the top surface of the concrete within each mold and apply external vibration with a frequency of at least 3,600 vibrations per minute until mortar begins to ooze around the bottom of the surcharges.
- E. Remove the surcharge from each mold and clean prior to reusing.
- F. Repeat steps C through E for three more layers. After the top layer has been compacted, the surface of the concrete shall be finished by adding only enough concrete with a scoop or trowel to overfill the mold about $\frac{1}{8}$ in. and working it into the surface. Strike off the excess concrete with the straightedge. Perform all finishing with the minimum manipulation necessary to produce a flat even surface that is level with the rim or edge of the mold and that has no depression or projections larger than $\frac{1}{8}$ in.

Note 3: Molding of test specimens shall be completed within 15 minutes from the time the sample was taken.

- G. After the concrete in the molds has hardened sufficiently. Mark the top of each specimen using the black ink marker or suitable tool with the sample number and date of pour. Record all information in the field book.
- H. Allow the specimen to cure in accordance with Section VI.

VI. Procedure for Field Curing

- A. Twenty hours (20) after molding, or as soon as practical, remove the specimens from the molds, transfer the information on the molds to the specimens with a waterproof black ink marker and allow the concrete specimens to cure in the same environment as the pipe prior to testing.

VII. Transporting Test Specimens

- A. Do not damage specimens during handling or transporting. Place specimens in a transport box, described in TR 226 if they are transported in a vehicle or subjected to vibration during transportation. If a transport box is not available, use other suitable means to ensure that the cylinder is protected from damage.

VIII. Report

- A. Document each pour and enter all information required to identify each specimen and the pipe it represents in the field book. There is no test report generated with this procedure.

IX. Normal Test Reporting Time

A. Maximum time for making cylinders is 15 minutes. Minimum field curing time is 20 hours.