

Method of Test for
**OBTAINING AND TESTING DRILLED CORES AND SAWED BEAMS OF
CONCRETE FOR PAVEMENT**

DOTD Designation: TR 225

- I. Scope**
- A. This method outlines the procedures for obtaining, preparing and testing cores drilled from hardened concrete pavement for thickness and compressive strength determinations.
- II. Reference Documents**
1. DOTD TR 113 – Sieve Analysis of Fine and Coarse Aggregates
 2. DOTD TR 230 – Curing, Capping, and Determining the Compressive Strength of Cylindrical Concrete Specimens
 3. DOTD S 605 – Random Numbers Table
 4. AASHTO T 148 – Measuring Length of Drilled Concrete Cores
 5. AASHTO T 231 – Capping Cylindrical Concrete Specimens
- III. Apparatus**
- A. An approved drilling apparatus with a diamond drill bit shall be used for obtaining core specimens.
- B. Suitable measuring tape.
- IV. Sampling**
- A. The concrete shall be at least 14 days old before cores are obtained, and surface tolerance requirements shall first be met. Cores that show abnormal defects or that have been damaged in the process of removal shall not be used. Cores containing partially embedded reinforcement shall be avoided if possible.
- B. Each lot of concrete pavement and shoulders (approximately 4,000 yd²) will be divided into five segments of approximately equal size. One core will be obtained from each segment. The longitudinal location within each segment will be selected at random using DOTD Designation: S 605, Random Number Tables. The transverse drilling location shall be in alternating lanes in multi-lane pavements, with the location in each lane also selected at random. No core shall be taken within two (2) feet of any edge or joint.
- C. Other areas such as intersections, entrances, crossovers, ramps, etc., will be grouped together to form lots of approximately 4,000 yd² each. Small irregular areas may be included with other unit areas to form a lot.
- D. When re-coring is necessary, the second core shall be taken within a 1-ft radius of the original drilling location.
- V. Thickness**
- A. Test Specimens – A core specimen shall have a minimum diameter of approximately four (4) inches.
- B. Measurements – The lengths of core specimens for determining the thickness of pavement shall be measured in accordance with the provisions of AASHTO T 148, with the following

modification: Five length measurements shall be taken; one at the center, and one each at the 12 o'clock, 3 o'clock, 6 o'clock and 9 o'clock positions. If any reading varies more than 0.10 inch from any other, the four additional readings required by AASHTO T 148 shall be taken, and the nine readings used in computing the average for that core. If no readings vary more than 0.10 inch, the five readings will be used to establish the thickness of that core.

- C. Calculations – Compute the arithmetic average of the values in a lot using the following formula:

$$\bar{T} = \frac{T_1 + T_2 + T_3 + T_4 + T_5}{5}$$

Where:

T_1, T_2, T_3, T_4 and T_5 are the individual lengths of five (5) cores

\bar{T} = the arithmetic average.

(In calculating the average pavement thickness, individual measurements in excess of specified thickness by more than 0.25 inch will be considered as specified thickness plus 0.25 inch.)

VI. Compressive Strength

- A. Test Specimens – The diameters of core specimens must be at least twice the nominal size of the coarse aggregate as defined in DOTD TR 113. The length of the specimen, when capped, shall be as nearly as practical to twice its diameter (length to diameter ratio, L/D, of 1.50 to 2.50 based on plan thickness). A core having length less than its diameter after capping shall not be tested. Cores containing embedded steel may be trimmed to eliminate the reinforcement provided a ratio of capped length to diameter (L/D) of 1.00 or greater can be obtained.
- B. End Preparation – The ends of core specimens shall be essentially smooth, perpendicular to the longitudinal axis, and of the same diameter as the body of the specimen. If necessary, the ends of the specimens should be sawed or tooled until the following requirements are met:
1. Projections, if any, shall not extend more than 0.2 inches above the end surfaces.
 2. The end surfaces shall not depart from perpendicularity to the longitudinal axis by more than 5 degrees.
 3. The diameters of the ends shall not depart more than 0.1 inches from the mean diameter of the specimen.
- C. Moisture Conditioning – The test specimens shall be moist cured at 73.4 ± 3.6 °F for a minimum of 40 hours immediately prior to performing the compression test. (Moist curing means that the test specimens shall have free water maintained on the entire surface area at all times. This condition is met by storage in a suitable moist room or cabinet or by immersion in saturated limewater). The specimens shall be tested promptly after removal from moist curing and kept moist during the period between removal and testing by covering with wet burlap or other suitable fabric.

D. Capping

1. If the core's end conditions satisfy the requirements of Section VI.B, the core can be capped using unbonded neoprene caps in accordance to TR230.
2. If the core's end conditions do not satisfy the requirements of Section VI.B, the core's ends shall be capped in accordance to the applicable provisions of AASHTO T 231.

E. Measurement – Prior to testing, the length of the capped specimen shall be measured to the nearest 0.10 inch and the average diameter determined to the nearest 0.01 inch from two measurements taken at right angles to each other at about mid-height of the specimen.

F. Testing – The specimens shall not be tested until the concrete has attained an age of at least 28 days after placement. Testing shall be in accordance with the applicable provisions of DOTD TR 230.

G. Calculations

1. The compressive strength of each specimen shall be calculated using the computed cross-sectional area based on the average diameter of the specimen. If the ratio of capped length to diameter is less than 2.0, allowance for the L/D is made by multiplying the compressive strength by the applicable correction factor given in the following table, or by an intermediate value obtained by interpolation.

Ratio of Length of Capped Specimen to Diameter (L/D)	Strength Correction Factor
2.00 or greater	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.87

2. Compute the arithmetic average of the values in a lot using the following formula:

$$\bar{X} = \frac{X_1 + X_2 + X_3 + X_4 + X_5}{5}$$

Where:

X_1, X_2, X_3, X_4 and X_5 are the individual strengths of five (5) cores

\bar{X} = the arithmetic average.

VII. Resampling for Compressive Strength

For the following two conditions, the test results for any individual core shall be discarded. The compressive strength and thickness of a second core taken at that location shall be used both individually and in the computation of average lot thickness.

- A. When the strength of any individual core is less than 3,000 psi, the segment represented by that core shall be resampled.
- B. When the average strength for a lot consisting of five cores would result in a pay adjustment and the L/D ratio of any individual core exceeds 2.50, the segment represented by that core shall be resampled using a core sample with a greater diameter. The core sample shall have an L/D ratio of 1.00 to 2.50.

VIII. Report

- A. The results required by DOTD Designation: TR 230 shall be reported, with the addition of the following information:
1. The length of each core specimen as determined in paragraph IV (B).
 2. Length of test specimen after capping.
 3. Direction of application of the load on the specimen if other than perpendicular to the horizontal plane of the concrete as placed.
 4. The L/D ratio and any strength correction factor used.
- B. Report the lot average thickness to the nearest 0.01 inch and the lot average compressive strength to the nearest psi.

Note 1: Computations for percent payment based on thickness and compressive strength shall be performed as explained in the Department's manual entitled, "Application of Quality Control Specifications for Portland Cement Concrete Pavement and Structures".