

Method of Test for
AIR CONTENT OF FRESHLY MIXED CONCRETE
METHOD A – VOLUMETRIC METHOD (ROLL-A-METER)

DOTD Designation: TR 202 (Method A)

I. Scope

- A. This method of test covers the procedure for determining the air content of freshly mixed concrete with a slump of 1 inch or greater by determining the volumetric displacement of air with water after thorough agitation. This method should not be used with aggregates greater than 1.5 inches. This is the appropriate method to use when the concrete contains lightweight or highly porous aggregates. This is the only method allowed for concrete with aggregate absorption of 4.0% or greater.

Note 1: When the concrete contains aggregates larger than 1.5 inches, wet sieve over the 1 inch sieve, discard the larger aggregates, and then proceed with the slump test.

B. Reference Documents

1. DOTD S301 – Sampling Fresh Concrete
2. DOTD TR 640 – Calibration of Measures Used to Determine Unit Weights
3. ASTM C173 – Air Content of Freshly Mixed Concrete by Volumetric Method

Note 2: ASTM C173 may be used in lieu of this method.

II. Apparatus

- A. Air Meter – Consisting of a bowl and a top section conforming to the following requirements. (Figure 1)
1. The bowl and top sections shall be of sufficient thickness and rigidity to withstand rough field use. The material shall not be attacked by high pH cement paste, deform when stored at high temperatures in closed spaces, or become brittle or crack at low temperatures. A watertight seal must be obtained when the top section is attached to the bowl.
 2. Bowl – Shall have a diameter equal to 1 to 1.25 times the height and be constructed with a flange at or near the top surface. Bowls shall not have a capacity of less than 0.075 ft³.
 3. Top Section – Shall have a capacity at least 20% larger than the bowl and shall be equipped with a flexible gasket and a device to attach the top section of the bowl. The top section shall be equipped with a transparent scale, graduated in increments (not greater than 0.5%) from 0% at the top to 9% or more, of the volume of the bowl. The upper end of the neck shall have a watertight cap that will maintain a watertight seal when the meter is inverted and rolled.



Figure 1

- B. Funnel – With a spout of a size permitting it to be inserted through the neck of the top section and long enough to extend to a point just above the bottom of the top section. The discharge end of the spout shall be so constructed that when water is added to the container there will be a minimum disturbance of the concrete.
- C. Tamping Rod – A round, smooth straight $5/8 \pm 1/16$ inch diameter rod at least 12 inches long with both ends rounded to a hemispherical tip of the same diameter. The rod shall be made of steel, high-density polyethylene, or other plastic of equal or greater abrasion resistance.
- D. Strike-Off Bar – A flat, straight steel bar at least $1/8 \times 3/4 \times 12$ inch or a flat, straight high-density polyethylene bar, or other plastic of equal or greater abrasion resistance, at least $1/4 \times 3/4 \times 12$ inches.
- E. Calibrated Cup – A metal or plastic cup either having a capacity of or being graduated in increments equal to $1.00 \pm 0.04\%$ of the volume of the bowl of the air meter.
- F. Syringe – A small rubber bulb syringe having a capacity of at least that of the calibrated cup.
- G. Pouring Vessel (For Water) – A container having a capacity of approximately 1 quart.
- H. Scoop – A small metal scoop.
- I. Isopropyl Alcohol – 70% by volume isopropyl alcohol (approximately 65% by weight).

Note 3: 70% isopropyl alcohol is commonly available as rubbing alcohol. More concentrated grades can be diluted with water to obtain the required concentration.

- J. Glass Plate – At least $1/2$ inch thick with a length and width at least 2 inches greater than the diameter of the bowl.
- K. Mallet – (With a rubber or rawhide head) with a mass approximately 1.25 ± 0.5 lb.
- L. Paper Towel

M. Applicable Documentation

1. Batch Certification for Portland Cement Concrete (DOTD 03-22-4028)
2. Structural Concrete Tests (DOTD 03-22-0740, Figure 2)
3. Portland Cement Concrete Report (DOTD 03-22-4035)
4. Approved computer generated forms or spreadsheets.

III. Health Precautions

- A. Protect against potential injury by avoiding skin contact with fresh concrete by wearing appropriate protective clothing and eye wear.
- B. If the freshly mixed concrete should contact skin or eyes, immediately flush with water for a minimum of 5 minutes. If symptoms continue, consult a physician immediately.
- C. Observe all precautions as specified by the manufacturer before handling fresh concrete.

IV. Calibration of Apparatus

- A. Calibrate the meter and calibrated cup initially and annually or whenever there is reason to suspect damage or deformation of the meter or calibrated cup.
- B. Determine the volume of the bowl with an accuracy of at least 0.1%. Follow the calibration procedure in accordance with DOTD TR 640.
- C. Determine the volume of the calibrated cup using water in accordance with DOTD TR 640. A quick check can be made by adding one or more calibrated cups of water to the assembled apparatus and observing the increase in the height of the water column after filling to a given level.
- D. Determine the accuracy of the graduations on the neck of the top section of the air meter by filling the assembled measuring bowl and top section with water to the level mark for highest air content graduation.
- E. Add water in increments of 1.0% of the volume of the bowl to check accuracy throughout the graduated range of air content. The error at any point throughout the graduated range shall not exceed 0.1% of air.

V. Sample

Obtain the sample of mixed concrete in accordance with DOTD S301 of the Materials Sampling Manual and meet the minimum sample quantity of 0.25 ft³.

VI. Procedure

- A. Wet the inside of the bowl and dry it to a damp, but not shiny appearance.
- B. Using the scoop, fill the bowl with mixed concrete in two equal layers of equal depth.
- C. Rod after each layer 25 times with the tamping rod. Do not forcibly strike the bottom of the bowl when rodding the first layer.
- D. When rodding the second layer, penetrate the prior layer approximately 1 inch.
- E. After each layer is rodded, tap the sides of the bowl 10 to 15 times with the mallet to close any voids left by the tamping rod and to release any large bubbles of air that may have been trapped.

Note 4: After tamping the final layer, a slight excess of concrete, 1/8 inch or less, above the rim is acceptable. Add or remove a representative sample of concrete if necessary to obtain

required amount of concrete.

- F. Strike off excess concrete with the strike-off bar until the surface is flush with the top of the bowl and free of voids. Wipe the flange of the bowl clean.
- G. Wet the inside of the top section of the meter, including the gasket, and attach the top section of the bowl.
- H. Insert the funnel and add water until it appears in the neck.
- I. Remove the funnel and adjust water level, using the rubber syringe, until the bottom of the meniscus is level with zero mark.
- J. Attach and tighten the cap.
- K. Invert the meter, shake the base horizontally, and return the meter to the upright position.

Note 5: To prevent the aggregate from lodging in the neck of the unit, do not keep it inverted for more than 5 seconds at a time.

- L. Repeat the inversion and shaking process for a minimum of 45 seconds and until the concrete has broken free and the aggregate can be heard moving in the meter as it is inverted.
- M. Place one hand on the neck of the meter and the other on the flange. Using the hand on the neck, tilt the top of the meter approximately 45° from the vertical position with the bottom edge of the base of the meter resting on the floor or on the work surface. Maintain this position through the procedures described in this section.
- N. Using the hand on the flange to rotate the meter, vigorously roll the meter ¼ to ½ turn forward and back several times, quickly starting and stopping the roll.
- O. Turn the base of the meter about 1/3 turn and repeat the rolling procedure as stated previously.
- P. Continue the turning and rolling procedures for approximately 1 minute.

Note 6: The aggregate must be heard sliding in the meter during the process.

Note 7: If, at any time during the inversion and rolling procedures liquid is found to be leaking from the meter, the test is invalid and a new test shall be started as in section V.

- Q. Set the unit upright and allow the meter to stand while the air rises to the top and until the liquid level stabilizes. The liquid level is considered stable when no further drop in the water column is observed.
- R. When all the air has been removed from the concrete and allowed to rise to the top of the apparatus, remove the screw cap.
- S. Using the syringe, add sufficient isopropyl alcohol in calibrated cup increments to dispel the foamy mass on the surface of the water. Record the number of calibrated cups used on the back of DOTD Form 03-22-0740 (Figure 2).
- T. Make a direct reading of the liquid in the neck, reading to the bottom of the meniscus and estimate to the nearest (0.25%) of air.

VII. Calculations

Calculate the total air content (TA) of the concrete in the measuring bowl to the nearest 0.25 percent by using the following formula:

$$TA = R_1 + R_2$$

Where:

R_1 = reading directly in the neck, after the alcohol was added.

R_2 = number of cups filled with alcohol used.

Example:

$$R_1 = 4.25\%$$

$$R_2 = 2.0$$

$$TA = 4.25 + 2.0 = 6.25\%$$

VIII. Report

Round and report air content to the nearest 0.1%.

IX. Normal Test Reporting Time

The normal test reporting time is 15 minutes.

MATT MENU SELECTION - 17

Louisiana Department of Transportation and Development
STRUCTURAL CONCRETE TESTS
(DOTD TR 226 & TR 230)

DOTD 03-22-0740
Metric / English
Rev. 7/98

Metric / English (M or E) Located on MATT Menu

Project No. H1-2-22-2222

Material Code 601

Lot No. 0101

Date Sampled 05-15-18

Submitted By 0607

Quantity 2100 CY

Purpose Code

Plant Code C7100

Spec Code

- 1. Qual. Cont. 4. Check 7. Design
- 2. Verification 5. Resample 8. Indep. Assur.
- 3. Acceptance 6. Source Appr. 9. Pre. Source Test

Mix Design No. 0101 Date Rec'd.(lab) 05-17-18

Admixture: Y = Yes Air WR-NS WR-SR
 N = No

Remarks 1 _____

Item No. 805 (103)

Cylinders Made By Signature Acceptance Tests By Signature

Batch Number 001
Date Tested 05-31-18

Acceptance Tests
Slump (TR 207), mm (in) _____ Air Content (TR 202), % 6.3

Sample No.	Laboratory No.	Cond. Break	Age Days	Diam. mm (in)	Area mm ² (in ²)	Max. Load kN(lb)	Strength MPa (PSI)

Time Made: _____ Critical Strength: Low _____ High _____ Batch Avg. _____

Batch Number _____
Date Tested _____

Acceptance Tests
Slump (TR 207), mm (in) _____ Air Content (TR 202), % _____

Sample No.	Laboratory No.	Cond. Break	Age Days	Diam. mm (in)	Area mm ² (in ²)	Max. Load kN(lb)	Strength MPa (PSI)

Time Made: _____ Critical Strength: Low _____ High _____ Batch Avg. _____

Break Codes:
1 = Satisfactory 2 = Unsatisfactory



Cond. Codes:
1 = Good
2 = Improperly Made
3 = Damaged
4 = Frozen

Average Strength for Lot _____
Tested By: Signature
Checked By: Signature

% Pay _____

Remarks 2 _____

Approved By Signature

Figure 2