

State of Nevada
Department of Transportation
Materials Division

**METHOD OF TEST FOR AIR CONTENT OF FRESHLY MIXED CONCRETE
BY THE VOLUMETRIC METHOD (ROLL-A-METER)**

SCOPE

This test method is for determining the air content of freshly mixed concrete. This method can be used for all classes of concrete.

APPARATUS

1. Air Meter, shall consist of a bowl for containing the fresh concrete, and a top section, both conforming to the requirements listed below: (See Fig. 1)
 - a. Bowl, shall be sufficiently rigid to withstand normal field use and of such construction as to resist attack from the cement paste. The diameter of the bowl shall be 1 to 1.25 times the height. The bowl shall have a capacity of not less than 0.002 m^3 (0.075 ft^3) and be constructed with a flange at or near the top surface.
 - b. Top Section, shall be sufficiently rigid to withstand normal field use and be resistant to chemical attack from the cement paste. The capacity of the top section should be approximately the same as the bowl. It shall be equipped with hooks or lugs and a flexible gasket that will form a watertight connection with the flanged end of the bowl. The top section shall be equipped with a glass or plastic lined neck, the neck must be graduated in increments not greater than 0.5 percent from 0 at the top to 9 percent or more of the volume of the bowl. The upper end shall be stoppered with a cap that forms a watertight seal.
2. Funnel, when inserted through the neck of the top section, will extend to a point just above the top of the bowl. The discharge end of the spout shall distribute the water added to the meter to cause a minimum disturbance to the concrete in the bowl.
3. Tamping Rod, a round straight steel rod, straight high density polyethylene or straight aluminum rod, with minimum dimensions of 16 mm (5/8 in.) in diameter and approximately 300 mm (12 in.) in length, having the tamping end rounded to a hemispherical tip of the diameter.
4. Strike-off Bar, a flat steel bar, flat high density polyethylene or flat aluminum rod, with minimum dimensions of 3 mm x 19 mm x 280 mm long (1/8 in. x 3/4 in. x 11 in. long),
5. Calibrated Measuring Cup, a metal or plastic cup having a capacity equal to 1.0 percent of the volume of the bowl of the air meter.

6. Syringe, small rubber bulb syringe having a capacity of at least that of the measuring cup.
7. Pouring Vessel, a metal, glass or plastic container of approximately 1 L (1 qt) capacity.
8. Mallet, with a rubber or rawhide head weighing 0.60 ± 0.02 kg (1.25 ± 0.50 lb).
9. Small Tools, trowel, small metal scoop.
10. 70% Isopropyl Alcohol.

CALIBRATION OF METER

1. The volume of the bowl of the air meter, in cubic meters or cubic feet, shall be determined by accurately weighing the amount of water at $25 \pm 3^{\circ}\text{C}$ ($77 \pm 5^{\circ}\text{F}$) required to fill it, and dividing this mass by 999.6 kg/m^3 (62.4 lb/ft^3). A cover plate (made of glass or acrylic) shall be used to cover the bowl to remove excess water and to insure that the container is full.
2. The accuracy of the graduations on the neck of the top section of the air meter shall be determined by filling the assembled measuring bowl and top section with water to the level of the mark for any air content. A quantity of water at $25 \pm 3^{\circ}\text{C}$ ($77 \pm 5^{\circ}\text{F}$) equal to 1.0 percent of the volume of the bowl, shall be added to the water already in the neck. The height of the water column shall increase by an amount equivalent to 1.0 percent of the air.
3. The volume of the measuring cup shall be checked by adding one cupful of water to the air meter in the manner described in paragraph 2, above. Such additions shall increase the height of the water column by an amount equivalent to 1.0 percent of air.
4. If the meter does not meet the calibration criteria, the meter needs to be repaired or replaced.

SAMPLING

1. Obtain a representative sample of fresh concrete per Test Method Nev. T425.
2. If the concrete contains coarse aggregate particles larger than 25 mm (1 in.), wet sieve a representative sample over a 25 mm (1 in.) sieve to obtain more than what is required to fill the bowl of the roll-a-meter. Place only enough concrete on the sieve at any one time so that after sieving, the thickness of the layer of retained aggregate is not more than one particle thick. Do not scrape mortar off of the coarse aggregate retained on the sieve, dispose of all aggregate retained on the sieve. Scrape mortar off of the sieve and add it to the material passing the 25 mm (1 in.) sieve. Once enough concrete has been obtained for the test, remix the concrete into a uniform sample and proceed with testing immediately.

PROCEDURE

1. This test shall be started within 5 minutes of obtaining the representative sample.

2. Dampen the inside of the bowl. Using the scoop, fill the measuring bowl with concrete in two equal lifts. Rod each lift 25 times with the tamping rod. Do not forcibly strike the bottom of the measuring bowl when rodding the first lift. When rodding the next lift, penetrate the previous lift approximately 25 mm (1 in.). After rodding each lift, tap the sides of the bowl 10 to 15 times with a mallet to close the voids left by the tamping rod.
3. After the top lift has been placed, tamped, and the voids rodded closed. Strike-off the excess concrete with the strike-off bar until a smooth surface is obtained. Clean the rim and flange of the measuring bowl with a damp sponge.
4. Clamp the top section tightly into position on the measuring bowl, insert the funnel into the neck and add 1 to 2 pints of Isopropyl Alcohol. Finish filling the top section with water until it appears in the neck. Remove the funnel and using the rubber syringe adjust the water level until the bottom of the meniscus is level with the zero mark. Attach and tighten the cap.
5. Invert and agitate the air meter until the concrete dislodges from the measuring bowl. Quickly invert the air meter, shake the base horizontally, and return the air meter to the upright position. To prevent the aggregate from lodging in the neck of the air meter, do not keep it inverted for more than 5 seconds at a time. Repeat the inversion and shaking process until the concrete has broken free and the aggregate can be heard moving in the air meter as it is inverted. Once, the concrete has been dislodged from the measuring bowl, place the air meter on the ground. Place one hand on the neck and the other hand on the flange and tip the air meter at a 45° angle while the base is still in contact with the ground. Vigorously roll the air meter a ¼ to ½ turn back and forth several times, while quickly starting and stopping the rolling process. Repeat this process until all the air appears to have been removed from the concrete. If at any time during this process, liquid leaks from the air meter, the test is invalid and a new test shall be started. Set the air meter upright, loosen the cap and tilt the air meter slightly at a 20° angle allowing the air to rise to the top and the liquid level to stabilize.
6. After all the air has been removed from the concrete allowing it to rise to the top of the neck, set the air meter flat on the surface and remove the cap.
7. Make a direct reading of the water level in the neck, reading to the bottom of the meniscus, and estimating to the nearest 0.25 percent. If a direct reading cannot be determined due to an unclear line of demarcation between the foam mass and the liquid, add in one calibrated measuring cup of Isopropyl Alcohol, add additional increments of Isopropyl Alcohol one at a time with the bulb syringe to dispel the foam mass on the surface of the water, once added stir the foam mass with a non-absorbent device, small enough to fit in the neck and until a line can be read. (One calibrated measuring cup of Isopropyl Alcohol is equivalent to 1.0 percent of air). When Isopropyl Alcohol is added, take the direct reading of the liquid and add the total cups of Isopropyl Alcohol to the direct reading to obtain the air content.

No Additional Alcohol added: 4.5% = 4.5% Air Content

Additional Alcohol added: Final reading with Isopropyl Alcohol 4.5% + 2 calibrated measuring cups of Isopropyl Alcohol added = 6.5% Air Content

8. Once the air content reading has been taken disassemble the meter. Dump the contents of the bowl out and verify that there are no undisturbed portions of tightly packed concrete in the bowl. If there are portions of undisturbed concrete in the bowl, the test is invalid and another test shall be ran.

REPORT

Report the air content to the nearest 0.25%. Results should be documented on NDOT form 020-017.



Brass Roll-A-Meter



Light Weight Roll-A-Meter