METHODS OF SAMPLING AND TESTING
MT 107-04
METHOD OF DETERMINING AIR CONTENT OF FRESHLY MIXED CONCRETE BY THE VOLUMETRIC METHOD
(Modified AASHTO T 196)

1 Scope:

1.1 This method covers determination of the air content of freshly mixed concrete containing any type of aggregate, whether it is dense, cellular, or light-weight.

2 Reference Documents:

2.1 ***AASHTO:***
T 196 Air Content of Freshly Mixed Concrete by the Volumetric Method

MT Materials Manual:
MT-102 Air Content of Freshly Mixed Concrete by the Pressure Method
MT-105 Sampling Fresh Concrete
MT-115 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
MT-203 Unit Weight of Aggregate

3 Apparatus:

3.1 *Airmeter* - An airmeter consisting of a bowl and a top section (Figure 1) conforming to the following requirements:

3.1.1 *Bowl* - The bowl shall be constructed of machined metal of such thickness as to be sufficiently rigid to withstand normal field use and of such composition as not to be readily attacked by cement paste. The 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 ft.³ (0.002m³).

3.1.2 *Top Section* - The top section shall be constructed of machined metal of thickness sufficiently rigid to withstand normal field use and of composition not readily attacked by cement paste. The top section shall have a capacity at least 20 percent larger than the bowl and shall be equipped with a flexible gasket and with hooks or lugs to attach to the flange on the bowl to make a watertight connection. The top section shall be equipped with a glass-lined transparent plastic neck, 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. Graduations shall be accurate to ± 0.1 percent by volume of the bowl. The upper end of the neck shall be threaded and equipped with a screw cap having a gasket to make a water-tight fit.

3.2 *Funnel* - A metal 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.

3.3 *Tamping Rod* - A round, straight steel rod, 0.625 in. or 16 mm in diameter at least 12 in. or 300 mm long with both ends rounded to a hemispherical tip of the same diameter.

3.4 *Strike-off Bar* - A flat, straight steel bar at least 1/4 by 3/4 by 12 in. or 3 by 20 by 300 mm long.

3.5 *Measuring Cup* - A metal cup having a capacity equal to 1.03 ± 0.04 percent of the volume of the bowl of the air meter.

3 Apparatus: (continued)

Note 1 - The volume of the measuring cup is slightly larger than 1.0 percent of the volume of the bowl to compensate for the volume contraction that takes place when 70 percent isopropyl alcohol is mixed with water. Other alcohols or defoaming agents may be used if calculations show that their use will result in an error indicated air content less than 0.1 percent.

3.6 *Syringe* - A small rubber bulb syringe having a capacity at least that of the measuring cup.

3.7 *Pouring Vessel* - A metal or glass container of approximately 1 qt. or 1 litre capacity.

3.8 *Trowel* - A blunt-nosed brick mason's trowel.

3.9 *Scoop* - A small metal scoop.

3.10 *Isopropyl Alcohol* - Use 70 percent by volume isopropyl alcohol (approximately 65 percent by weight) (Notes 1 and 2).

Note 2 - Seventy percent isopropyl alcohol is commonly available as rubbing alcohol. More concentrated grades can be diluted with water to the required concentration.

3.11 *Mallet* - A mallet (with a rubber or rawhide head) weighing approximately 1.25 ± 0.50 lb. (0.57 ± 0.23 kg) for use with measures of 0.5 ft³ (0.014 m³) or smaller, and a mallet weighing approximately 2.25 ± 0.50 lb. (1.02 ± 0.23 kg) for use with measures larger than 0.5 ft³ (0.014 m³).

4 Calibration of Apparatus:

4.1 The volume of the bowl of the air-meter in cubic feet or cubic metres shall be determined by accurately weighing the amount of water required to fill it at room temperature, and dividing this weight by the unit weight of water at the same temperature. Follow the calibration procedure outlined in Section 6 of Method MT-203.

4.2 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 a preselected air content graduation and then determining the quantity of 70º F (21.1ºC) water required to fill the meter to the zero mark. The quantity of water added shall equal the preselected air content graduation within ± 0.1 volume percent of the measuring bowl. Repeat the procedure to check a minimum of 3 graduations within the expected range of use.

4.3 Determine the volume of the measuring cup using water at 70º F (21.1º C) by the method outlined in Section 6.1. A quick check can be made by adding one or more cups of water to the assembled apparatus and observing the increase in the height of the water column after filling to a given level as described in Section 6.2.

5 Sample:

5.1 Obtain the sample of freshly mixed concrete in accordance with applicable provisions of Method MT-105. If the concrete contains coarse aggregate particles that would be retained on a ½ in. (37.5 mm) sieve, wet sieve a representative sample over a 1 in. (25 mm) sieve to yield somewhat more than enough material to fill the measuring bowl. The wet sieving procedure is described in Method MT-105. Carry out the wet sieving operation with the minimum practicable disturbances of the mortar. Make no attempt to wipe adhering mortar from coarse aggregate particles retained on the sieve.

6 Procedure:

6.1 *Rodding and Tapping* - Using the scoop, aided by the trowel if necessary, fill the bowl with freshly mixed concrete in three layers of equal depth. Rod each layer 25 times with the tamping rod. After each layer is rodded, tap the sides of the measure 10 to 15 times smartly 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.

6.2 *Striking Off* - After placement of the third layer of concrete in accordance with Section 6.1, strike off the excess concrete with the strike-off bar until the surface is flush with the top of the bowl. Wipe the flange of the bowl clean.

6.3 *Adding Water* - Clamp the top section into position on the bowl, insert the funnel, and add water until it appears in the neck. Remove the funnel and adjust the water level, using the rubber syringe until the bottom of the meniscus is level with the zero mark. Attach and tighten the screw cap.

6.4 *Agitating and Rolling* - Invert and agitate the unit until the concrete settles free from the base; and then, with the neck elevated, roll and rock the unit until the air appears to have been removed from the concrete. Set the apparatus upright, jar it lightly and allow it to stand until the air rises to the top. Repeat the operation until no further drop in the water column is observed.

6.5 *Dispelling Bubbles* - When all the air has been removed from the concrete and allowed to rise to the top of the apparatus, remove the screw cap. Add, in one cup increments, using the syringe, sufficient isopropyl alcohol to dispel the foamy mass on the surface of the water.

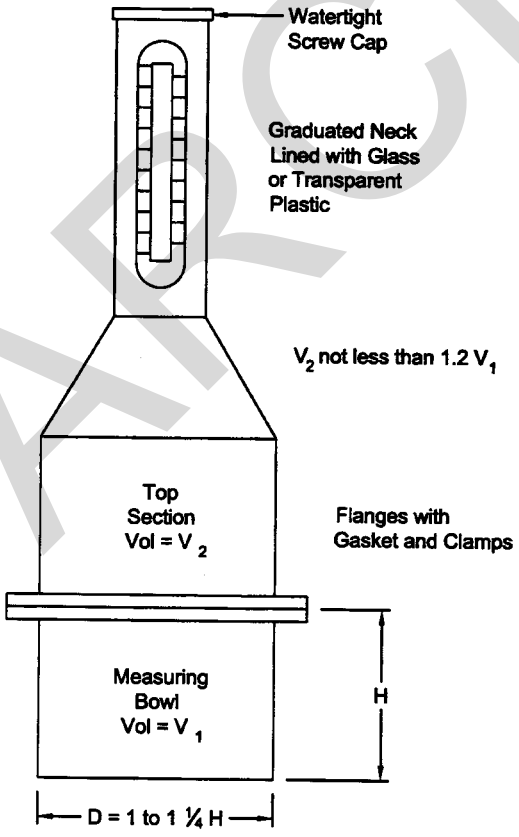

Figure 1—Apparatus for Measuring Air Content of Fresh Concrete by Volumetric Method

6 Procedure: (continued)

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6.6 *Reading* - Make a direct reading of the liquid in the neck, reading to the bottom of the meniscus, and estimating to the nearest 0.1 percent.

7 Calculation:

7.1 Calculate the air content percent of the concrete in the measuring bowl in percent by adding to the reading from Section 6.6 the amount of alcohol used in accordance with Section 6.5.

7.2 When the sample tested represents that portion of the mixture obtained by wet sieving over a 1 in. (25 mm) sieve, calculate the air content of the mortar or of the full mixture using the formulas given in Method MT-102. Use appropriate quantities coarser or finer than the 1 in. (25 mm) sieve instead of the 1½ in. (37.5 mm) sieve specified in Method MT-102.