METHOD OF TEST FOR
OPEN GRADED DRAINAGE LAYER (OGDL)
CORE POROSITY TEST

1.   SCOPE

1.1   This method covers the determination of porosity of a core or saw cut sample of Open Graded Drainage Layer.

2.   RELEVANT DOCUMENTS

2.1   ASTM D7063   Standard Test Method for Effective Porosity and Effective Air Voids of Compacted Bituminous Paving Mixture Samples

2.2   Interim Report, Iowa Pore Index Test, Myers, J.D., Dubberke, W., Iowa Department of Transportation Highway Division, January 1980

3.   DEFINITION

3.1   Porosity, *n*, is defined as the ratio of the volume of voids, to the total volume of the sample.

4.   APPARATUS

4.1   PRESS-UR-METER: A modified Press-ur-meter is used to perform the porosity laboratory test (see Figure 1). The pump, valve, and gauge are removed from the lid and replaced by a 320 ml Plexiglas tube, graduated in 2 ml increments. The addition of a standard 60-psi pressure gauge completes the lid modifications. A hole is drilled through the side of the air meter bowl at the bottom, fitted with a valve, and is used for loading and unloading the air meter bowl with cold tap water. Two valves are located at the top of the Plexiglas tube. One valve is connected to a line supplying air at a constant 241 kPa (35 psi). The other valve is a vent and is opened while charging the unit with water.

4.2   CoreLok™ (optional): CoreLok (InstroTek, Inc.) is used in the determination of laboratory density measurements of porous materials in the hot mix asphalt design process. This device is capable of automatically vacuum sealing a sample as a means of determining the total sample volume (including internal voids) by immersion in water.

5.   PREPARATION OF TEST SAMPLE

5.1   The sample shall be an intact core, typically 150 mm diameter, or an intact rectangular saw cut sample, minimum dimension 140 mm, maximum dimension 145 mm, each side.

5.2   Cores with irregular ends may be saw cut perpendicular to the cylindrical axis to obtain a regular geometric solid for volume determination by direct measurement. The amount of cut-off should be minimized.

5.3   Air-dry the sample on a clean laboratory bench for a minimum of 24 h.

5.4   Calculate the total volume of the sample (V_C) by direct measurement of regular dimensions or by water displacement

Note: The total volume of the sample includes the volume of voids. Volume determination by water displacement requires the outer surface of the sample to be sealed to prevent the influx of water. The CoreLok apparatus vacuum-seals the sample in a polymer bag and includes appropriate procedures and volumetric correction factors for the bag configuration, i.e. small bag, large bag, double bag. When using the CoreLok apparatus to vacuum seal the sample, sharp protrusions of exposed aggregate in the sample may be filed smooth to prevent puncture of the bag.

6.   TEST PROCEDURE

6.1   Obtain the initial volume of the assembled modified Press-ur-meter (V_T), by charging the unit with water up to the "0" ml mark. Record the volume of water required. (This measurement may be established for the system and used in subsequent calculations.) Drain and dry the apparatus prior to testing.

6.2   Place the air-dried sample in the modified Press-ur-meter meter bowl.

6.3   Fill the bowl with a measured quantity of cold tap water (V_1) to within 2 cm from the top of the bowl.

Note: Filling of the bowl with water should be done slowly so that the sample properly saturates and entrapped air is allowed to escape. A small rubber mallet may be used to lightly tap the sides of the bowl to dislodge air from the sample and from the apparatus once the lid is in place.

6.4   Attach the lid, open the vent valve, and fill the remainder of the bowl and Plexiglas tube with a measured quantity of cold tap water (V_2) to the "0" ml mark. The pressure gauge on the lid must remain at the zero psi mark during this filling stage.

6.5   Close the water supply and vent valves and open the 241 kPa (35 psi) air supply valve as soon as possible. The air supply valve remains open maintaining air pressure on the air meter bowl for 15 min.

6.6   After 15 min of loading, close the air supply valve and open the vent valve to release the air pressure from the air meter bowl.

6.7   Take a water level reading at 15 min after unloading (V_3).

7.   CALCULATIONS

7.1   Calculate the total volume of the sample, V_C, by one of the following methods:

i)   by direct measurement of a core: $V_C = \pi \dfrac{d^2}{4} xh$, where

   d = diameter of the core (cm); h = height of the core (cm)

ii)   by direct measurement of a saw cut prism: $V_C = LxWxH$, where

   L, W, and H are the length, width, and height of the prism (cm)

iii)   by immersion in water, $V_C = M_{air} - M_{water}$, where

M_{air} is the mass of the sample in air (g)

M_{water} is the mass of the sealed sample in water (g), corrected for the CoreLok vacuum seal bag.

7.2   Calculate porosity *n*, of sample as follows:

$$n = \frac{V_C + V_A - V_T}{V_C}$$

Where:

V_C =   Total volume of the sample, including voids, in cm^3 (5.4)

V_T =   Volume of water required to initially fill the air meter bowl containing no sample and the Plexiglas tube to the "0" millilitre mark   (6.1)

V_A = $V_1 + V_2 + V_3$

Where:

V_1 =   Volume of water added to bowl containing the sample, in ml   (6.3)

V_2 =   Volume of water added to fill Plexiglas tube to the"0" millilitre mark, in ml   (6.4)

V_3 =   Volume of the unload reading, in ml   (6.6)

8.   REPORTING

8.1   Report the porosity of the sample to 3 decimal places.

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1. rubber air hose
2. brass hose connector
3. brass nut (2)
4. 3/4" - 3/8" pipe nipples (7)
5. 3/8" pipe size needle valve (2)
6. 3/8" shutoff cock
7. 3/8" 90° brass block pipe elbow
8. 3/8" tee
9. 3/8" x 1" hex reducing nipple (2)
10. 1" diameter O-ring (2)
11. 26" x 1" (I.D) plexiglass pipe, 1/4" walls
12. broom hangar clips (2)
13. scale - graduated from 0 – 60 cm
14. pressure gauge capable of up to 60 psi
15. 3/8" x 1/2" pipe reducer
16. 3/8" pipe plug
17. 1 air meter lid conforming to AASHTO T152 with air pump and shutoff cocks removed
18. air meter bowl with bored and tapped 3/8" hole at bottom
19. 3/8" MPT plug for quick connect water hose coupling
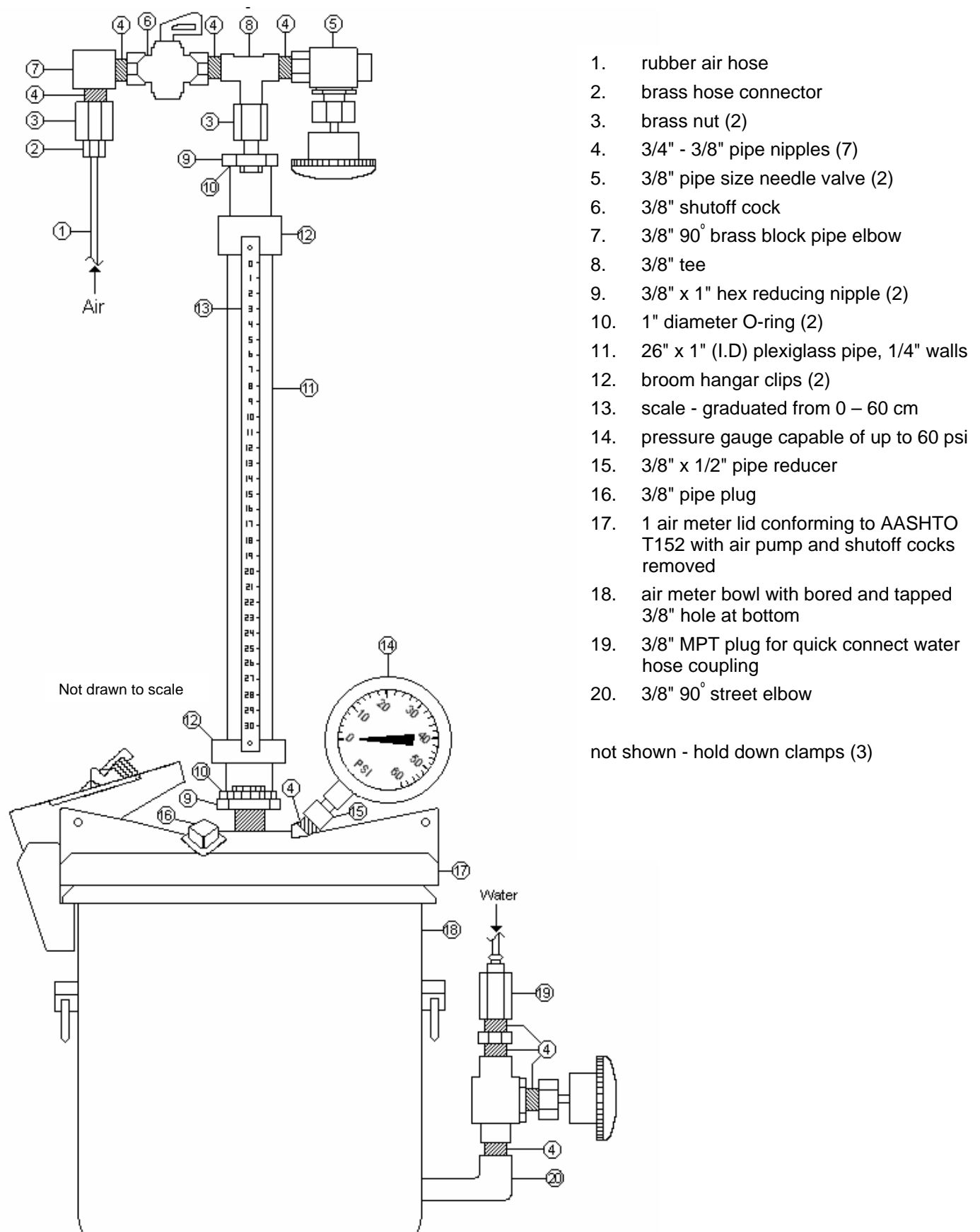20. 3/8" 90° street elbow

not shown - hold down clamps (3)

Figure 1. Modified PRESS-UR-METER Apparatus