

DETERMINATION OF THE APPARENT DENSITY AND BULK FACTOR OF POWDERS, GRANULES, DICE, AND PELLETS

METHOD NUMBER

WC-2-B

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1 PURPOSE AND UTILITY

Methods for determining the apparent density and bulk factor of powders, granules, dice and pellets are described. These methods conform with the applicable instructions of "Tentative Methods of Test for Apparent Density, Bulk Factor, and Pourability of Plastic Materials", ASTM Designation: D1895-65T, but provide for the addition of carbon black to finely divided powders when necessary to reduce test variability caused by electrostatic charges on the powder particles.

Method A is used for free-flowing powders and its use is recommended whenever practical.

Method B provides necessary modifications for powders, pellets, and dice which either do not flow or flow with difficulty through the funnel described in Method A. This method also permits a choice of measuring cup.

Very finely divided powders or very coarse materials which will not flow through either of the funnels described may be poured lightly from a paper held approximately 1.5 inches (3.8 cm.) above the opening of the measuring cup.

No provision is made in this method for Method C of ASTM Designation: D1895-65T.

2 DEFINITIONS

Apparent density is defined as the weight per unit volume of a material, including voids inherent in that material as test d.

Note: The term "bulk density" is commonly used for materials such as molding powder.

Apparent density is usually expressed in grams per cubic centimeter but may be converted as follows:

$$\begin{aligned} \text{grams/cm}^3 \times 16.4 &= \text{grams/in.}^3 \\ \text{grams/cm}^3 \times 62.4 &= \text{lbs./ft.}^3 \end{aligned}$$

Not : Apparent density figures are not comparable except for materials having similar specific gravities after molding or forming.

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Bulk factor is defined as the ratio of the volume of any given quantity of the loose plastic material to the volume of that same material after molding or forming. Bulk factor also is the ratio of the density after molding or forming to the apparent density of the material as received.

Note: Bulk factors may be compared regardless of differences between the molded specific gravities of the materials being examined.

3 APPARATUS

- (a) Balance capable of measuring the weight of the material in the cup to the nearest 0.1 gram.
- (b) Measuring cups and funnels as shown in figures 1 and 2 appended. (Either or both as required).
- (c) Stand capable of supporting the funnel over the measuring cup as shown in figures 1 and 2.
- (d) A straightedge or a spatula with a straight edged blade.

4 TEST SPECIMENS

- (a) Representative samples shall be selected and three such samples shall be tested unless otherwise directed. No conditioning of these samples is required.
- (b) Finely divided powders are prone to collect electrostatic charges and the apparent density of the material may vary depending upon the presence or absence of such charges. Such variability may be diminished by the addition of carbon black which serves to dissipate electrostatic charges. (Note 1) If test variability due to electrostatic charges is experienced, add .05 to 0.1 per cent by weight of finely divided carbon black (Superba B or equivalent) to the sample and disperse it thoroughly. (Note 2) The weight of the added carbon black is disregarded in any subsequent calculations.

Note 1: Since the occurrence of low values is diminished, average apparent density is likely to be increased by the addition of carbon black. The amount of increase for any given material should be determined.

Note 2: A simple and effective means for dispersing the carbon black is to add it to a sample of the resin contained in a paper bag of ample size which then is closed and shaken thoroughly for one minute.

5 TEST CONDITIONS

Tests may be conducted under ordinary conditions of temperature and humidity. Closely regulated laboratory conditions are not requisite.

6 PROCEDURE

Method A:

The funnel and measuring cup shown in Fig. 1 are used. The small end of the funnel is closed with a finger or with a flat strip and then $115 \pm 5 \text{ cm}^3$ of powder is poured into the funnel. The bottom of the funnel then is opened quickly to allow the material to flow freely into the measuring cup. If caking occurs in the funnel, the material may be loosened with a small glass rod.

After all of the material has passed through the funnel, immediately scrape the excess off the top of the measuring cup with a straight edge without shaking the cup. Weigh the material in the cup to the nearest 0.1 gm. and calculate its apparent density in gm./cm^3 .

Method B:

Except as noted hereafter, the funnel and measuring cup shown in Fig. 2 are used.

Note: The funnel shown in Fig. 2 also is used for finely divided powders such as vinyl resins which will not flow through the funnel shown in Fig. 1. However, such powders may bridge in the measuring cup shown in Fig. 2, so the 100 cm^3 cup shown in Fig. 1 may be substituted. If the smaller cup is used, the sample shall be reduced to $115 \pm 5 \text{ cm}^3$.

The small end of the funnel is closed with the hand or with a flat strip and then $500 \pm 20 \text{ cm}^3$ of sample is poured into the funnel (as previously noted, $115 \pm 5 \text{ cm}^3$ of sample if the smaller measuring cup is used). The bottom of the funnel then is opened quickly to allow the material to flow freely into the measuring cup. If bridging occurs in the funnel, the material may be loosened with a glass rod.

After all of the material has passed through the funnel, immediately scrape the excess off the top of the measuring cup with a straight-edge without shaking the cup. Weigh the material in the cup to the nearest 0.1 gm. and calculate its apparent density in gm./cm^3 .

Materials which will not flow through either of the funnels described may be poured lightly from a paper held approximately 1.5 inches (3.8 cm.) above the measuring cup. In all other respects, the apparent

density of such material shall be determined as previously described with size of sample governed by the measuring cup used.

7 CALCULATIONS

(a) **Apparent Density:**

Calculate the apparent density for each sample portion as follows:

$$\text{Apparent Density} = \frac{W}{V}$$

where: W - weight in grams of the material in the measuring cup.
V - volume of the measuring cup (either 100 cm.³ or 400 cm.³ depending upon the measuring cup used).

Determine the average of the three samples tested and report that average.

(b) **Bulk Factor:**

If the bulk factor is to be reported, calculate as follows:

$$\text{Bulk Factor} = \frac{D_2}{D_1}$$

where: D₂ - the average density (or specific gravity) of the molded or formed specimen as determined in accordance with any accepted method.
D₁ - the average apparent density of the same material prior to forming as determined by this method (WC-2-B/7).

8 REPORT

- (a) Sample identification
- (b) Addition of carbon black if used.
- (c) Identification of the funnel used or, if poured from a paper, report that.
- (d) Identification of the measuring cup used.
- (e) Average apparent density.
- (f) Average bulk factor if required.
- (g) Identification of the method, i. e., WC-2-B/7, Method A or B.
- (h) Date of testing
- (i) Identification of the operator.

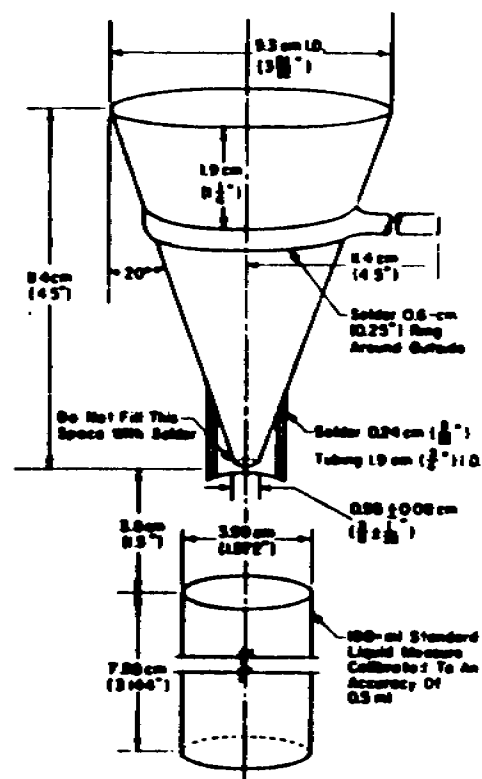


FIG. 1.—Apparatus for Apparent Density Test, Method A.

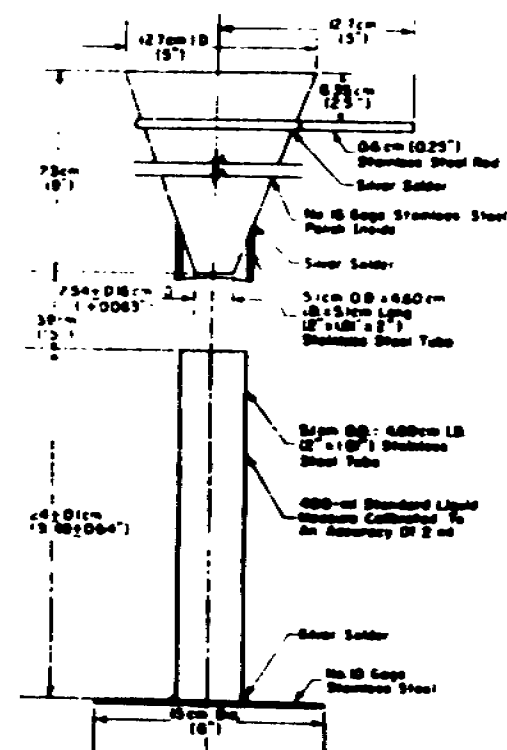


FIG. 2.—Apparatus for Apparent Density Test, Method B.