



SUBJECT APPARENT POROSITY DETERMINATION OF
 CERAMIC PARTS

SUPERSEDED DATE

The percent apparent porosity of fired ceramic parts must be controlled within certain limits for some applications. The apparent porosity expresses as a percentage the relationship of the volume of the open pores of the specimen to its exterior volume. This specification provides a method for obtaining this data.

A. Simplified Method

1. The specimens shall consist of standard fired ceramic parts. The average of at least five specimens is desirable.
2. These parts shall be dried for 2 hours at 110°C (230°F.) and then cooled to room temperature in such a manner that they do not absorb moisture from the air. If a desiccator is not available, a covered container may be used. The pieces shall then be weighed on a suitable balance to obtain the dry weight (D) in grams.
3. The test specimens shall be placed in briskly boiling distilled water and boiled for 30 minutes. During the boiling period, they shall be kept entirely covered with water and shall be supported on a wire mesh so that they are not in contact with the heated bottom of the container.
4. After the boiling period the test specimens shall be cooled to room temperature while still completely covered with water.
5. One specimen at a time shall be removed from the water, blotted lightly with a moistened cloth to remove all drops of water from the surface, and shall then be weighed immediately to obtain the saturated weight (W) in grams. The blotting operation shall be performed with care by lightly folding the specimen in the wet cloth. Avoid "wiping" the surface, as excessive blotting will introduce errors by withdrawing water from the pores of the specimen. Also for this reason, do not try to remove water from the holes with compressed air or by shaking. It is better to have a constant error (for which a correction may be applied if necessary) caused by the additional water in the holes, than it is to introduce uncontrollable variations by using an air jet or shaking.
6. With the information obtained in the preceding steps, the percent absorption (A) can be calculated:

$$\% \text{ Absorption} = A = \frac{W-D}{D} \times 100$$

7. Multiply the percent absorption by the bulk density (B) of the material from which the specimen is made to obtain the percent apparent porosity (P):

$$A \times B = P$$

Note: If the proper processing and firing schedules are maintained, the bulk density for any particular pressure is a constant for all practical purposes. At the present time, the following have been determined.



A. Simplified Method (Cont'd)

7. Cont'd)

Note:

| | Bulk Density "B" (gms/cc) | |
|------|---------------------------|---------------|
| | at 5000 psi | at 10,000 psi |
| C214 | 2.58 | 2.67 |
| C224 | 2.19 | 2.27 |
| C234 | 2.42 | 2.48 |
| C235 | 2.64 | 2.71 |

The bulk density is most easily obtained by pressing a regularly shaped "blank" at the required psi. After the piece has been fired, its dry weight can be obtained as in step 2, and its volume can be calculated from its measurements. The bulk density is the dry weight divided by the volume.

$$\text{Bulk Density} = B = \frac{D}{V}$$

B. "Referee" Method

If for some reason, more accurate results are desired than can be obtained with the preceding method, the following procedure is recommended.

1. The specimens shall consist of solid pieces cut from standard fired parts in such a manner that they contain no holes. The average of at least 2 pieces (as large as possible) from each of 5 parts, is desirable.
2. They shall be dried to constant weight at 110°C, and after the pieces have been cooled to room temperature in a desiccator, the dry weight (D) may be obtained in grams with a chemical balance.
3. The test specimens shall be placed in briskly boiling distilled water and boiled for 30 minutes. During the boiling period, they shall be kept entirely covered with water and shall be supported on a wire mesh so that they are not in contact with the heated bottom of the container.
4. After the boiling period the test specimens shall be cooled to room temperature while still completely covered with water.
5. The suspended weight (S) in grams of each boiled specimen is usually obtained by suspending the piece in distilled water by means of a loop or halter of thin wire hung from one arm of the balance. The balance shall be previously counterbalanced with the wire in place and immersed in the water to the same depth as is used when the specimen is in place.



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B. "Referee" Method (Cont'd)

6. One specimen at a time shall be removed from the water, blotted lightly with a moistened cloth to remove all drops of water from the surface, and shall then be weighed immediately to obtain the saturated weight (W) in grams. The blotting operation shall be performed with care by lightly folding the specimen in the wet cloth. Avoid "wiping" the surface, as excessive blotting will introduce errors by withdrawing water from the pores of the specimen.
7. With the information obtained in the preceding steps, the percent apparent porosity can be calculated:

$$P = \frac{W-D}{W-S} \times 100$$

Note: Step 5 may be eliminated if the cut specimens are regularly shaped and can be easily measured so that the volume may be calculated. If the volume of the piece is known:

$$P = \frac{W-D}{V} \times 100$$

The simplified method is based on the following facts:

1. % Absorption (A) = $\frac{W-D}{D} \times 100$

2. Volume (V) = $\frac{W-S}{\text{S.G. of water}} = \frac{W-S}{1} = W-S$

3. Bulk Density (B) = $\frac{D}{V} = \frac{D}{W-S}$

4. Multiplying (A) x (B) =

$$\left(\frac{W-D}{D}\right) (100) \left(\frac{D}{W-S}\right) = \frac{W-D}{W-S} \times 100 = P \text{ (Percent apparent porosity)}$$

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PC-H1407-35/EG