2. MEASUREMENT OF MOISTURE CONTENT

2.1. APPLICABLE ASTM STANDARD

- ASTM D2216: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

2.2. PURPOSE OF MEASUREMENT

Moisture content measurement is primarily used for performing weight-volume calculations in soils. Moisture content is also a measure of the shrink-swell and strength characteristics of cohesive soils as demonstrated in liquid limit and plastic limit testing.

2.3. DEFINITIONS AND THEORY

The mass of a given volume of moist soil is the sum of the mass of soil solids, M_s, and the mass of water in the soil, M_w. Moisture content, w, is defined as:

$$w = \frac{M_w}{M_s} x\ 100\% . \qquad (2.1)$$

Moisture content is typically expressed as a percentage using two significant figures (e.g. 12%, 9.2%, etc.). Moisture content can range from a few percent for "dry" sands to over 100% for highly plastic clays. Even soils that appear to be "dry" possess some moisture.

2.4. EQUIPMENT AND MATERIALS

The following equipment and materials are required for moisture content measurements:

- Disturbed sample of moist soil;
- scale capable of measuring to the nearest 0.01 g;
- soil drying oven set at $110^{o} \pm 5^{o}$ C;
- 3 oven-safe containers; and
- permanent marker for labeling containers.

2.5. PROCEDURE[1]

The moisture content calculation is based on three measurements:

1) Mass of container, M_c;
2) mass of moist soil plus container before drying, M_1; and
3) mass of dry soil plus container after drying, M_2.

Moist soil is placed in an oven-safe container and dried for 12-16 hours in a soil drying oven. It is helpful to use an oven mitt or tongs to insert and remove the containers from the oven. The soil-filled container is weighed before and after drying to obtain M_1 and M_2, respectively, and w is calculated as:

$$w = \frac{M_w}{M_s} x\ 100\% = \frac{M_1 - M_2}{M_2 - M_c} x\ 100\%. \qquad (2.2)$$

2.6. EXPECTED RESULTS

In coarse-grained soils such as sands and gravels, w may range from a few percent in drier soils to over 20% in saturated soils. In fine-grained soils such as silts and clays, the possible range in w is much higher due to the ability of clay minerals to adsorb water molecules. Moisture content in fine-grained soils may be as low as a few percent, to over 100% in higher-plasticity clays.

2.7. LIKELY SOURCES OF ERROR

For moisture content measurement, likely sources of error may include inadequate drying, or excessive drying beyond the recommended 12-16 hour drying period. According to ASTM D2216, soil should be dried at 110°C for 12-16 hours. However, for soils containing a significant amount of organic material or hydrous minerals such as gypsum, some of the water is bound by the soil solids, so excessive drying will effectively drive some of the soil solids away and produce erroneous results. In these cases, the oven temperature should be reduced to 60°C.

2.8. ADDITIONAL CONSIDERATIONS

With respect to moisture content measurements and specimen size, the recommended amount of soil required to obtain an accurate measurement increases with increasing maximum particle size, with a minimum of 20 g, as shown in Fig. 2.1.

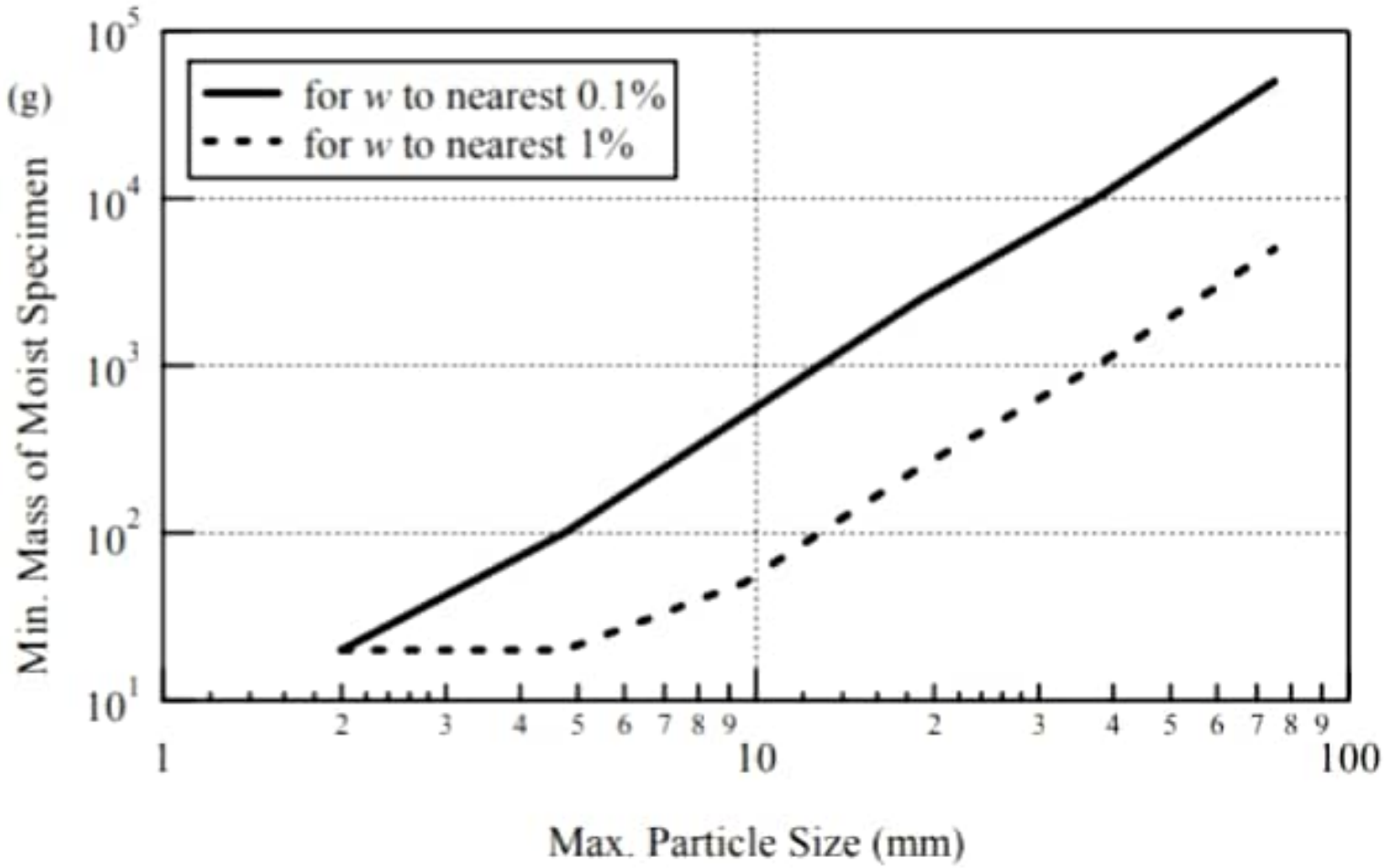

Fig. 2.1—Recommended minimum sample mass for moisture content testing based on maximum particle size.