Standard Method of Particle Size Analysis and Grading Sand Shape for Golf Course Putting Green Root Zone Mixes

1. Scope

1.1 This method covers the determination of particle size distribution of putting green root zone mixes. Particles larger than 0.05 mm (retained on a No. 270 sieve) are determined by sieving. The silt and clay percentages are determined by a sedimentation process, using the pipet method. This procedure was developed for putting green root zone mixes; those assumed to have sand contents of 80% by weight or greater. Particle size analysis of soils may be performed by this or other methods described in the Referenced Documents listed below. This standard also describes a qualitative evaluation of sand particle shape.

1.2 *This standard does not address the safety problems that may be associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the regulatory limitations prior to its use.*

Referenced Documents

2.1 Methods of Soil Analysis Part 1: Physical and Mineralogical Methods. American Society of Agronomy Monograph No. 9.

2.2 ASTM Standard Method D 422-63. Standard Test Method for Particle Size Analysis of Soils.

3. Apparatus

3.1 *Balance*, sensitive to 0.001 g.

3.2 *Stirring apparatus*, may be either of the following types.

3.2.1 For Method A: An *electric mixer* made for mechanical mixing of soils, or

3.2.2 For Method B: a *horizontal reciprocating shaker,* with holder for 250 mL flasks or bottles.

3.3 *Sedimentation cylinder,* a glass cylinder marked for a volume of 1000 mL. The height of the 1000 mL mark must be 36 ± 2 cm from the bottom on the inside.

3.4 *Thermometer,* accurate to 0.5°C.

3.5 *Pipet rack,* a device for lowering a pipet to a precise depth in the sedimentation cylinder.

3.6 *Pipets*, Lowy or other wide tipped type, 25 mL capacity.

3.7 *Weighing bottles or beakers*, glass with a capacity of 100 mL.

3.8 *Sieves*, square mesh with woven wire (brass or stainless steel). A full set of sieves shall include the following:

No. 10 — 2 mm
No. 18 — 1 mm
No. 35 — 500 micron
No. 60 — 250 micron
No. 100 — 149 micron
No. 140 — 105 micron
No. 270 — 53 micron

3.9 *Sieve shaker,* type that provides vertical tapping action as well as horizontal shaking.

3.10 *Desiccator*

3.11 *Dispersing agent*, a 5% sodium hexametaphosphate (HMP) solution, made by dissolving 50 g of reagent or technical grade HMP in 1000 mL of distilled or demineralized water.

3.12 *Oven*, capable of maintaining a temperature of 105°C.

3.13 *Water,* shall be distilled or demineralized, and brought to the temperature that is expected to prevail during the sedimentation process. If air temperatures are expected to fluctuate, cylinders should be placed in a water bath, and the distilled or demineralized water brought to the temperature of the water bath. The temperature should be at or close to 25°C.

3.14 *Dissecting microscope*, 25x to 50x power.

4. Procedure for Particle Size Analysis

4.1 Dispersion of sample

4.1.1 Weigh out 100 grams of air-dried root zone mix and place in mixing cup (Method A) or flask (Method B). Place a duplicate sample into a drying oven set at 105°C for correction to oven dried basis.

4.1.2 Add 100 mL of dispersing agent. Stir or swirl until the root zone mix is thoroughly wet. Allow to stand for at least 4 hours. If using Method B, place the flasks or bottles on the shaker and shake for at least 16 hours or overnight.

4.1.3 Method A: Add about 100 ml of water to the mixing cup and place onto the mixer. Mix for 5 minutes.

4.2 Determination of the sand fractions

4.2.1 Place a tared 270 mesh sieve onto a large funnel held by a stand over a sedimentation cylinder. Pour the suspension onto the sieve. Rinse remaining sand out of the cup or flask with water onto the sieve. Wash the collected sand with misted water to wash any remaining silt or clay particles through the sieve into the cylinder.

4.2.2 Wash the sand into a tared beaker, and place into an oven at 105°C until dry. Weigh the sand.

4.2.3 Transfer the dried sand to a nest of sieves. Shake the sieves on a shaker for five minutes. Weigh each sand fraction to the nearest 0.1 g.

4.3 Determination of clay (< 2 micron)

4.3.1 Add distilled or demineralized water to the sedimentation cylinder to bring up to the 1000 mL volume. Cover the cylinder with waxfilm, a stopper, or watch glass. Place the cylinder into a water bath, or allow it to stand until the temperature of the suspension is the same as the water bath or the air temperature, respectively.

4.3.2 After the temperature is constant, the silt and clay should be resuspended by one of the two following methods: a) stir thoroughly with a hand stirrer, using an up and down motion for a least 30 seconds; b) stopper the cylinder and shake end over end for one minute.

4.3.3 After the appropriate settling time (8 hr for 20°C), carefully lower the closed pipet to a depth of 10 cm below the top of the suspension. The table below lists the settling times for suspensions at temperatures other than 20°C for determining 2 micron particle size.

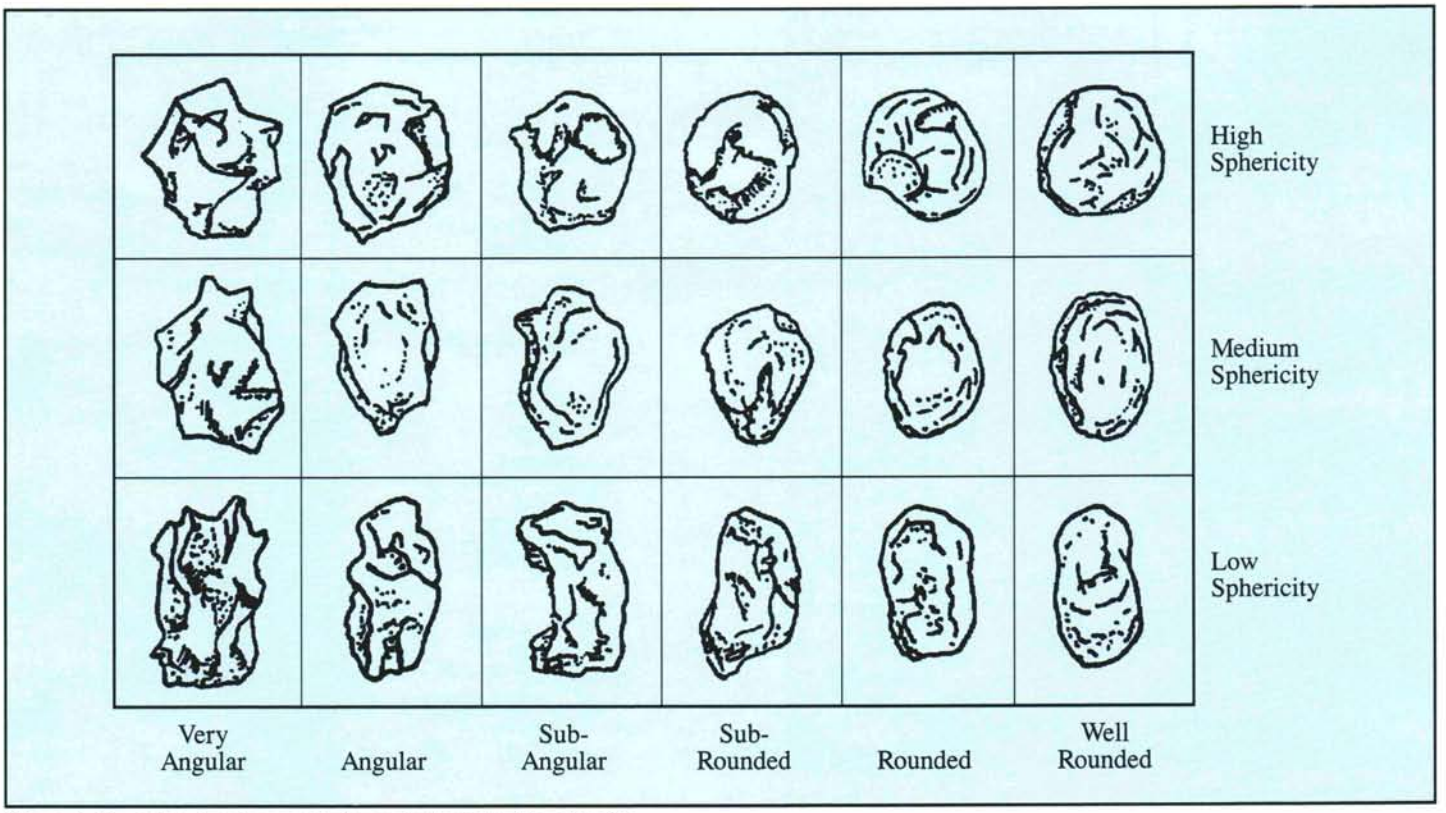

Figure 1. Chart showing the angularity and sphericity of sand grains.

Temperature (°C)	Settling Time (hr)
18	8.41
20	8.00
22	7.63
24	7.28
26	6.95
28	6.65
30	6.37

4.3.4 Turn on the vacuum and withdraw a 25 mL sample in about 12 seconds. Rate of withdrawal is important.

4.3.5 Discharge the sample into a tared beaker or drying dish.

4.3.6 To wash out any residual material in the pipet draw 25 mL of water into the pipet, and discharge into the same drying dish.

4.3.7 Evaporate the water and dry the clay at 105°C.

4.3.8 Cool in a desiccator and weigh.

5. Determination of Correction for Dispersing Solution

5.1 Dispense 100 ml of dispersing solution into 1 L container.

5.2 Add distilled or demineralized water to 1 L volume, stir or swirl until thoroughly mixed.

5.3 Draw 25 ml and dispense into a tared beaker or drying dish.

5.4 Draw 25 ml of water and dispense into same dish.

5.5 Evaporate in an oven at 105°C.

5.6 Weigh the sediment in the beaker (W_D).

6. Calculations

6.1 Percent clay may be calculated as follows:

$$\%\ Clay = \frac{40\,(W_C - W_D)}{W_S} \times 100$$

where:

W_C = weight of clay in drying dish (g).

W_D = weight of sediment from dispersing solution.

W_S = weight of root zone sample, corrected for initial water content.

6.2 Percent sand for each sand size fraction can be calculated as follows:

$$\%\ Sand = \frac{W_{SA}}{W_S} \times 100$$

where:

W_{SA} = weight of sand retained on sieve.

W_S = corrected weight of the root zone sample.

6.3 Percent silt may be calculated as follows:

$$\%\ Silt = \frac{W_S - W_C - W_{SA}}{W_S} \times 100$$

where:

W_S = corrected weight of the root zone sample (g).

W_C = weight of clay.

W_{SA} = sum of sand weights (g).

7.1 Method 2: Qualitative Assessment of Particle Shape

7.1 Place a small quantity of dried sand in a dish or on a microscope slide. Observe particle shape of several grains of sand. Repeat this two or three times.

7.2 Refer to Figure 1 to describe particle angularity and sphericity (taken from Baker, S.W. 1990, Sands for Sports Turf Construction and Maintenance, Sports Turf Research Institute, Bingley, UK).

8. Report

8.1 The report should include the following:

8.1.1 The particle size analysis, listing the percent sand, silt, and clay.

8.1.2 The percent sand retained on each sieve, expressed as the percentage of the entire sample; that is, the total sand fractions should equal the sand percentage listed in the particle size analysis.

8.1.3 Description of the sand particle shape.