

USGA Recommendations For A Method Of Putting Green Construction

By The USGA Green Section Staff

The Root Zone Mixture

The sand used in a USGA root zone mix shall be selected so that the particle size distribution of the **final root zone mixture** is as described in Table 1.

Table 1

PARTICLE SIZE DISTRIBUTION OF USGA ROOT ZONE MIX

Name	Particle Diameter	Recommendation (by weight)
Fine Gravel	2.0 - 3.4 mm	
Very coarse sand	1.0 - 2.0 mm	Not more than 10% of the total particles in this range, including a maximum of 3% fine gravel (preferably none)
Coarse sand	0.5 - 1.0 mm	Minimum of 60% of the particles must fall in this range
Medium sand	0.25 - 0.50 mm	
Fine sand	0.15 - 0.25 mm	Not more than 20% of the particles may fall within this range
Very Fine Sand	0.05 - 0.15 mm	Not more than 5%
Silt	0.002 - 0.05 mm	Not more than 5%
Clay	less than 0.002 mm	Not more than 3%
Total Fines	Very fine sand + silt + clay	Less than or equal to 10%

Soil Selection:

If soil is used in the root zone mix, it shall have a minimum sand content of 60%, and a clay content of 5% to 20%. The final particle size distribution of the sand/soil/peat mix shall conform to that outlined in these recommendations, and meet the physical properties described herein.

Organic Matter Selection:

Peats - The most commonly used organic component is a peat. If selected, it shall have a minimum organic matter content of 85% by weight as determined by loss on ignition (ASTM D 2974 Method D).

Other organic sources - Organic sources such as rice hulls, finely ground bark, sawdust, or other organic waste products are acceptable if composted through a thermophilic stage, to a mesophilic stabilization phase, and with the approval of the soil physical testing laboratory. Composts shall be aged for at least one year. Furthermore, the root zone mix with compost as the organic amendment must meet the physical properties as defined in these recommendations. Composts can vary not only with source, but also from batch to batch within a source. Extreme caution must be exercised when selecting a compost material. Unproven composts must be shown to be nonphytotoxic using a bentgrass or bermudagrass bioassay on the compost extract.

Inorganic and Other Amendments: Porous inorganic amendments such as calcined clays (porous ceramics), *calcined diatomites*, and zeolites may be used in place of or in conjunction with peat in root zone mixes, provided that the particle size and performance criteria of the mix are met. Users of these products should be aware that there are considerable differences between products, and long term experience with some of these materials is lacking. It should also be noted that the USGA requires any such amendment to be incorporated throughout the full 12-inch (300 mm) depth of the root zone mixture. Polyacrylamides and reinforcement materials are not recommended.

Physical Properties of the Root Zone Mix: The root zone mix shall have the properties summarized in Table 2, as tested by USGA protocol (proposed ASTM Standards).

Table 2

PHYSICAL PROPERTIES OF THE ROOT ZONE MIX

Physical Property	Recommended Range
Total Porosity	35% - 55%
Air-filled Porosity	15% - 30%
Capillary Porosity	15% - 25%
Saturated Hydraulic Conductivity	Minimum of 6 inches/hr (150 mm/hr)

Related Concerns

IT IS ABSOLUTELY ESSENTIAL TO MIX ALL ROOT ZONE COMPONENTS OFF-SITE. No valid justification can be made for on-site mixing, since a homogeneous mixture is essential to success.

A QUALITY CONTROL PROGRAM DURING CONSTRUCTION IS STRONGLY RECOMMENDED. Arrangements should be made with a competent laboratory to routinely check gravel and root zone mixtures during production and blending. It is imperative that these materials conform to the recommendations approved by the laboratory in all respects.

Care should be taken to avoid overshredding the peat, since it may influence performance of the mix in the field. Peat should be moist during the mixing stage to ensure uniform mixing and to minimize peat and sand separation.