

# Guidelines for Establishing Quality Control Tolerances

**A** CRITICAL COMPONENT of putting green construction is the production of the rootzone material. Whether this material is straight sand or a composite of sand and amendments, it is very important that the material remain as consistent as possible throughout the blending and installation processes.

Quality control sampling and testing is the best means of assuring the consumer that they are *getting what they paid for*. The quality control process is accomplished by collecting samples throughout the blending and installation steps, submitting these samples to an accredited laboratory for analysis, and comparing the results to a "benchmark" or target sample.

When comparing quality control samples to the target sample, it is unreasonable to expect the test results to be identical. There are many factors throughout the *entire chain of custody* of a rootzone mixture that inevitably result in differences from one test to another in spite of the best efforts of everyone concerned. Factors that result in differences in test results can be grouped into two categories — **Field Variables** and **Laboratory Variables**.

## Examples of Field Variables

- Changes in the makeup of the sand source.
- Changes in the composition of the organic matter or other amendment.
- Variability in the blending processes.
- Variability in how quality control samples are collected.

## Examples of Laboratory Variables

- Variability in carrying out the test procedures.
- Variability that occurs due to limitations in repeatability of the test procedures (also referred to as test ruggedness).

To keep laboratory variability to a minimum, it is critical that the same accredited laboratory be utilized throughout all phases of the project. Through extensive statistical analysis, it has been determined that the amount of test variability within the same lab is quite small (assuming they are testing the exact same material each time). However, sending the same sample to different laboratories greatly increases the amount of test variability that will occur. This is due to differences in test equipment and laboratory technique. Although the USGA and the accredited laboratories are diligently working together to minimize these differences and reduce inter-lab variability, the best option by far is to utilize only one lab for the entire project.

These factors should be given strong consideration when establishing variation tolerances for quality control testing. Setting tolerances that are unrealistically tight can result in the disqualification of a perfectly good rootzone mixture, significantly increased cost of the project (for both the owner and the contractors), unnecessary litigation, and lengthy construction delays. Setting tolerances that are too loose could result in large changes in the makeup of the rootzone mixture — to the point that the performance of the greens could suffer.

## USGA CONFIDENCE INTERVALS FOR QUALITY CONTROL TESTING

Test Parameter	USGA Confidence Interval
Fine Gravel	50%
Very Coarse Sand	50%
Coarse Sand	10%
Medium Sand	10%
Fine Sand	15%
Very Fine Sand	30%
Silt	25%
Clay	25%
Total Porosity	10%
Air-Filled Porosity	10%
Capillary Porosity	10%
Saturated Conductivity	20%
Percent Organic Matter of Mix	0.2*

\*The confidence interval for percent organic matter is not represented as a percentage. Thus a reported value of 0.7% organic matter could range from 0.5% to 0.9%.

With assistance from university and laboratory scientists, the USGA Green Section has identified the maximum amount of variation that should be tolerated for key test parameters measured during quality control testing. The accompanying table details a variability percentage for each parameter. This variability percentage is more accurately referred to as the **confidence interval** and is used to establish plus or minus values for each measured parameter. For example, assume the laboratory test indicates a value for fine sand to be 10%. Using the confidence interval percentage for fine sand of 15%, the acceptable variance is 10% plus or minus 1.5% for an acceptable range for quality control testing of 8.5% to 11.5%.

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