Introduction
The biggest challenge for weighing instruments is weighing small samples with reliable accuracy. Knowing the minimum weight of the instrument solves this issue. In addition, regular performance verification ensures the continuous validity of weighing results. Both minimum weight determination and performance verification are fundamentals of successful quality assurance of weighing processes.

Assured Accuracy – Determination of the Minimum Weight and Regular Calibration
Accurate results are results that fulfill quality requirements and stay within acceptable limits. In weighing, this means that the measurement uncertainty when weighing a sample should always be smaller than the required weighing accuracy. This rule is particularly important when weighing small samples, since relative measurement uncertainty increases with smaller sample sizes (figure 1). Every weighing instrument has such an accuracy threshold – the so called minimum weight. The determination of the minimum weight is the most crucial factor in the quality assurance of weighing processes. As long as the user weighs above the minimum weight, the accuracy requirements are met.

Figure 1: Typical behavior of measurement uncertainty across the weighing range of a balance.

Measurement uncertainty and thus the minimum weight are affected by various factors, such as the location of the balance or its environment. Therefore, it is important that the minimum weight is assessed in regular intervals. Changes in environment and other unforeseen effects in-between two calibrations can be eliminated by applying a safety factor for the calculation of the minimum weight. (See also “Safety Factor”).

Regular Performance Verification of Weighing Equipment
In addition to calibration and minimum weight determination, simple user tests need to be performed at regular intervals to continuously monitor and document the weighing performance of the equipment. This ensures the validity of weighing results and minimizes unexpected deviations.
Quality Assurance Solutions from METTLER TOLEDO

Calibration Certificate including Minimum Weight

The calibration certificate documents the measurement uncertainty and the minimum weight for different weighing accuracies and safety factors. Choose the minimum weight that applies to your accuracy requirements and multiply it with a safety factor to avoid deviations between two calibrations. For standard processes, a safety factor of 2 is recommended.

Table of minimum sample weight display values (minimum weights) for different weighing accuracies and various safety factors

<table>
<thead>
<tr>
<th>Weighing Accuracy</th>
<th>1x (no safety factor)</th>
<th>2x (safety factor of 2)</th>
<th>3x (safety factor of 3)</th>
<th>5x (safety factor of 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1%</td>
<td>0.16497 g</td>
<td>0.33191 g</td>
<td>0.50085 g</td>
<td>0.84489 g</td>
</tr>
<tr>
<td>0.2%</td>
<td>0.08224 g</td>
<td>0.16497 g</td>
<td>0.24819 g</td>
<td>0.41613 g</td>
</tr>
<tr>
<td>0.5%</td>
<td>0.03284 g</td>
<td>0.06575 g</td>
<td>0.09875 g</td>
<td>0.16497 g</td>
</tr>
<tr>
<td>1%</td>
<td>0.01641 g</td>
<td>0.03284 g</td>
<td>0.04929 g</td>
<td>0.08224 g</td>
</tr>
<tr>
<td>2%</td>
<td>0.00820 g</td>
<td>0.01641 g</td>
<td>0.02462 g</td>
<td>0.04106 g</td>
</tr>
<tr>
<td>5%</td>
<td>0.00328 g</td>
<td>0.00666 g</td>
<td>0.00984 g</td>
<td>0.01641 g</td>
</tr>
</tbody>
</table>

Figure 2: Minimum weight determination for a weighing accuracy of 1% and a safety factor of 2 (METTLER TOLEDO Standard Calibration Certificate, SCC).

Performance Verification – GWP® Verification

To ensure the validity of weighing results, a sound calibration and control scheme for weighing equipment should be established, containing as few tests as possible but as many as necessary. A safe and effective performance verification of weighing equipment defines:

- The accuracy limit of the instrument – the minimum weight
- The test methods and frequencies – based on risk and process requirements
- The test acceptance limits – based on accuracy and safety factor
- The test weights – based on balance characteristics

Figure 3: Specimen of a GWP® Verification recommendation for weighing performance verification.

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GWP®
Good Weighing Practice™

The global weighing guideline GWP® reduces risks associated with your weighing processes and helps to

- choose the appropriate balance
- reduce costs by optimizing testing procedures
- comply with the most common regulatory requirements

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