Count on Accuracy: Selecting the Right Scale for the Job

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When it comes to counting scales, a common misconception is that high internal resolution directly impacts accuracy. Some manufacturers state that their counting scale achieves up to 1 million internal resolutions or more. The fact is that internal resolution is unrelated to achievable counting accuracy.

Some of those misconceptions result in statements that are misleading and sometimes even wrong. Here are the facts: The performance of a scale used in a counting process is determined by its counting resolution. To achieve high counting resolution, the quality of the weighing electronics needs to be superior. In addition, the electronic noise, which directly defines the repeatability error of the weighing electronic, must be low. The performance of a counting scale can be defined by the repeatability error of the weighing electronic. It is not related to the internal resolution or the A/D converter resolution.

Statements such as, "a standard counting scale provides an internal resolution of 1 million count," imply that a 6-kilogram strain-gauge scale could accurately weigh a reference weight of 6 milligrams (6000 g / 1'000'000 counts = 0.006 g). This is impossible, as the electronic noise of the weighing electronic is too high to allow such accuracies.

The repeatability error

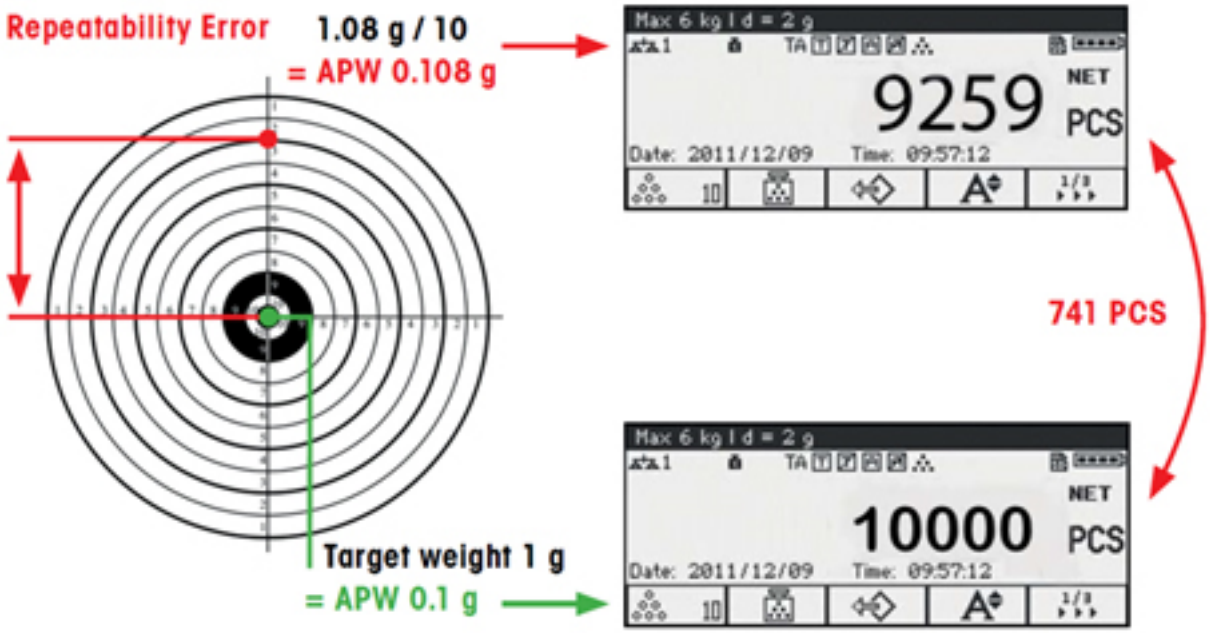
One of the key factors for accurate counting is correct measurement of the reference weight. If mistakes are made doing this, that translates to counting errors later. As the reference weight is often weighed in the low range or less than 1

percent of the scale's capacity, the error mainly derives from the electronic repeatability error of the scale. As a rule of thumb, we can say that in a counting process, less than 90 percent of the total counting error stems from the electronic repeatability error when weighing the reference weight.

Example*:* The impact of the counting scale's electronic repeatability error

Take a calibrated weight of 1 gram and weigh it as a reference weight on the scale. We assume that this 1 gram is 10 reference parts and establish the reference 10 -> APW = 0.1 g. If you place a 1 kilogram calibrated weight on the counting scale, the result should be 10,000 pieces (=1000g/0.1g).

As the weight is very small, the scale has a repeatability error. In the example below, the scale determined 1.08 gram instead of 1 gram (it’s a calibrated weight). This relatively small error results in a huge counting error of 741 pieces (10’000 - 9259 = 741).



Resolution is not accuracy

When selecting a counting scale, it is critical for it to accurately determine the reference weight. To achieve high accuracy, the quality of weighing electronics in terms of electronic noise needs to be superior. And it's not sufficient to just count on a high internal resolution. METTLER TOLEDO has determined for its counting scales the minimum reference weight the scale is capable of achieving within a certain process tolerance.

Additional Information:

Definition: Reference weight and minimum reference weight

To determine the average piece weight of the parts to count, a sample of parts (usually 10 or a multiplier of it) has to be weighed. This so-called reference weight or sample weight will be divided by the number of sample pieces. This value is the average piece weight, which will be stored in the scale's internal memory.

The minimum reference weight is the smallest reference weight the scale is capable of determining within a certain tolerance. For example, a basic counting scale with a 6 kilogram capacity can weigh a minimum reference weight of 10 grams. With a high-precision counting scale, (6 kg capacity with load-cell-based electromagnetic force compensation technology) a minimum reference weight of 0.5 g can be achieved.

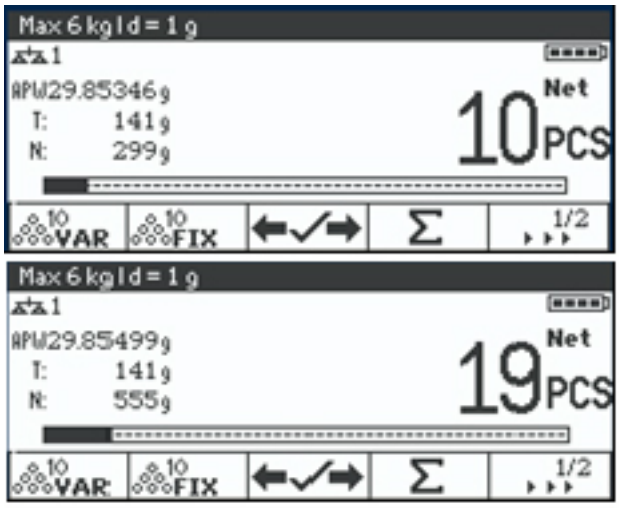
Piece-weight variation

Furthermore, variations in piece weight is one of the most frequent sources of counting errors. Piece weights can differ from part to part due to the varying machine settings, tool wear and raw material inconsistencies or changing environmental conditions. To reduce the impact of part variation, it's recommended to increase the sample size during reference weighing. For example, if parts have a high deviation of more than 1 percent, the counting error can be cut in half by increasing the number of reference parts for example from 10 to 30 pieces.

Additional Information:

Tips and Tricks: Good sampling practice

To achieve an accurate counting result, proper sampling is essential.



Consider the following:

- Select sample pieces from among different sections of the bulk quantity
- Do not select fewer than 10 pieces because the reference number would be too small to achieve a representative average piece weight
- The higher the number of reference pieces, the higher the accuracy
- From a statistics point of view, 20 to 30 parts are ideal
- With more than 30 parts, the tradeoff between counting errors from hand-counting and counting accuracy is increasing. Therefore, the reference optimization feature, a standard in METTLER TOLEDO counting scales, can be activated. This feature helps to increase the sample size and reduces manual counting errors.
- If the parts to be counted have a high deviation from part to part, the more reference samples will be needed to achieve an accurate counting result.
- After each lot or batch change, a new average piece should be determined, as machine settings, raw materials or production machines may have been changed.

Finally, external factors, such as operator error, drafts caused from other manufacturing devices or opening doors can negatively impact the counting result. To ensure accurate weighing, it's important to select a scale that makes procedures, such as reference counting, easy and error-free.

For more information, download the Free Piece Counting White Paper *[1].*

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