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Accuracy, precision, and resolution in weight measurements

The terms ***accuracy***, ***precision***, and ***resolution*** are important descriptors of the properties of weighing scales. Although these terms have different and distinct meanings, they are often confused with one another. This brief glossary provides explanations for these terms.

When an object is placed on a scale, the scale reacts by displaying a measurement of the object's weight. This "indicated weight" is generally recorded as the weight of the object. Our confidence in knowing how close the displayed weight is to the actual weight depends on our understanding of the scale's accuracy, precision and resolution.

The **accuracy** of a scale is a measure of the degree of closeness of the average value of an object's displayed weight to the object's actual weight. If, on average, a scale indicates that a 200 lb reference weight weighs 200.20 lb, then the scale is accurate to within 0.20 lb in 200 lb, or 0.1%.

The **precision** of a scale is a measure of the repeatability of an object's displayed weight for multiple weighings of the same object. For example, if the displayed weights of an object that weighs 200 lb are 200.20, 200.30, 200.15, 200.10, and 200.25 lb, then the *average* displayed weight is still 200.20 lb, but the measured values deviate by as much as 0.10 lb with respect to this average. Thus the precision is expressed as ±0.10 lb, meaning that the fluctuations are limited to 0.10 lb in either direction.

In a similar example, if the displayed weights are 200.20, 200.40, 200.10, 200.00 and 200.30, the average is still 200.20 lb, and the accuracy is still 0.20 lb or 0.1%. However, the deviation is larger (0.20 lb) and the precision would be ±0.20 lb, not ±0.10 lb.

The **resolution** of a scale is the smallest *increment* in applied weight that can be detected or displayed on the scale. In all scales, this quantity is most affected by the number of digits that are displayed when an object is weighed.

In the first example cited above for precision, the readout appears to show changes in 0.01 lb increments, but in fact the digits change by only 0.05 lb. Even though the readout appears to provide the weight to the nearest 0.01 lb, the *resolution* of the readout is actually only 0.05 lb. This is one of the most common misconceptions regarding the exactness of a particular scale's readings.

In addition, resolution can also be affected by other factors such as friction, wear, and scale design. If, for example, internal friction within the scale causes the scale to require 0.1 lb of added (or subtracted) weight to cause the readout to change from its current reading, then the resolution is actually only 0.1 lb regardless of the number of digits displayed on the scale.

Accuracy, **precision** and **resolution** are different characteristics of weight measurements and should not be confused with one another. It is important that they not be used in isolation as a way to determine the quality or exactness of a scale's output. Taken together, however, these properties are important tools in understanding a scale's readings.

Sincerely yours,

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