

Precision, Accuracy, and Error

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1 Introduction

Precision, accuracy, and error are concepts used in the context of measurements and calculations. They are essential in assessing the quality and reliability of results. In this document, we will explore these concepts in detail.

2 Precision

Precision refers to the closeness of repeated measurements to each other, regardless of their accuracy. It indicates the consistency or reproducibility of the measurements. We can think of precision as the ability to obtain consistent results. If the measurements are consistent, they are considered to be more precise.

3 Accuracy

Accuracy, on the other hand, refers to the closeness of a measurement or calculation to the true or actual value. It measures the correctness or validity of the results. Accurate measurements are close to the true value, while inaccurate measurements deviate from it.

4 Errors

Errors are variations or differences between a measurement or calculation and its known or true value. They can arise due to various factors, such as limitations in measurement instruments, human error, or environmental conditions.

4.1 Absolute Error

Absolute error is the magnitude of the difference between a measured value and its known value. It is calculated as the absolute value of the difference:

$$\text{Absolute Error} = |\text{Measured Value} - \text{Known Value}|$$

4.2 Relative Error

Relative error compares the absolute error to the known value or the measured value. It provides a measure of the significance of the error in relation to the size of the value being measured. It is calculated as the absolute error divided by the known value or measured value:

$$\text{Relative Error} = \frac{|\text{Measured Value} - \text{Known Value}|}{\text{Known Value}}$$

4.3 Percent Error

Percent error is the relative error expressed as a percentage. It is calculated by multiplying the relative error by 100:

$$\text{Percent Error} = \text{Relative Error} \times 100$$

4.4 Tolerance

Tolerance refers to the acceptable range within which measurements are considered valid. It represents the maximum allowable error. Tolerance is often specified as a tolerance interval, which is the range of values within which measurements are tolerated. For example, if a measurement has a tolerance of ± 0.1 , it means that any value within 0.1 units of the measured value is considered acceptable.

5 Conclusion

Precision, accuracy, and error are fundamental concepts in measurements and calculations. Precision refers to the consistency of measurements, while accuracy measures their closeness to the true value. Errors represent variations between measurements and known values. Absolute error, relative error, and percent error are used to quantify and evaluate the magnitude and significance of these variations. Tolerance defines the acceptable range of values for measurements.