



جامعة الفرات الاوسط التقنية
الكلية التقنية الهندسية / النجف الاشرف

Measurement Systems

Lecture-19

Measurement Terminologies

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1. Accuracy

- ▶ The accuracy of a measurement relates to the closeness of agreement between the measured value provided by the measurement system and the true value of the measurand (the dimension being measured). The true value of a measurement parameter (Volts, Amps, Kg, etc) is determined by National Standards laboratories working under international agreement and is disseminated by an unbroken chain of calibration.



2. Resolution

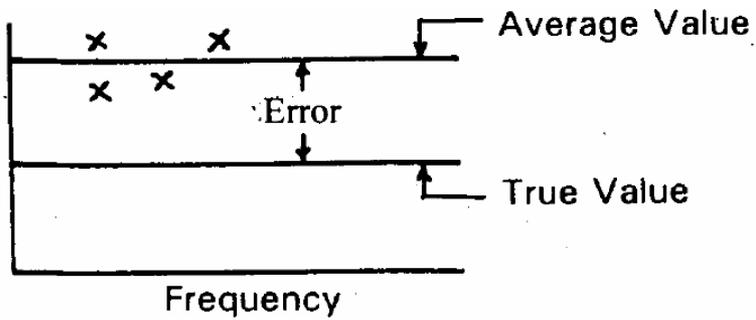
- ▶ The smallest distinguishable increment provided by a measurement system whether digital or analogue systems are used. The resolution of a measurement system is by itself no indication of accuracy.



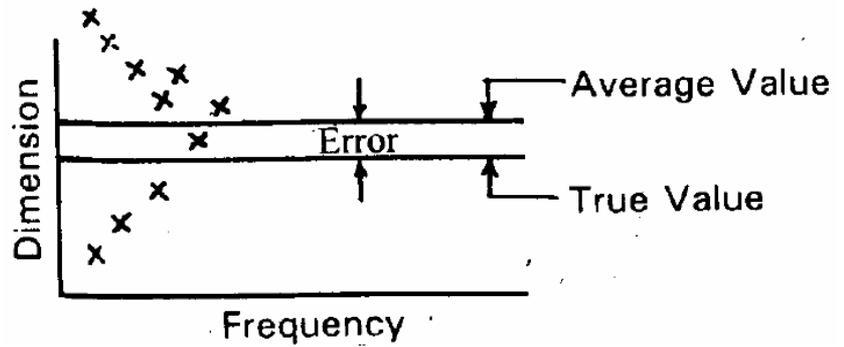
3. Precision

- ▶ The precision of a measurement system relates to the closeness of agreement between measurements made of the same dimension. It is possible to have a measurement system, which is precise but not accurate.

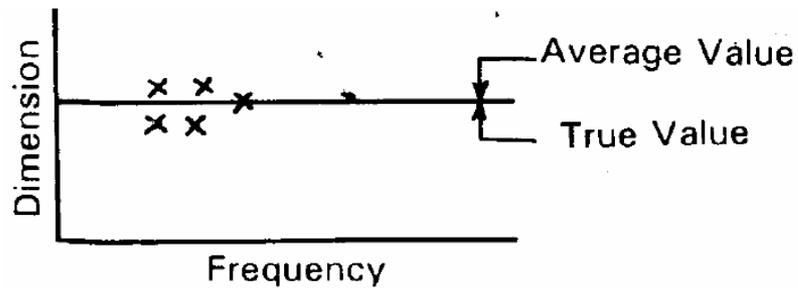




(a) Precise but not accurate



(b) Accurate but not precise



(c) Accurate and precise



4. Uncertainty

- ▶ This factor comprises two elements, the first being a systematic error; the second being due to random variation. Uncertainty is an indication of the degree to which the variation in values obtained when measuring can be reasonably attributed to the measured itself. Uncertainty is normally expressed ratiometrically (% , dB, ppm, etc) or in the relevant engineering units (kN, mm, etc) with a minimum 95% confidence level. All errors affecting measurement uncertainty should be controlled by a documented measurement procedure.



5. Traceability

- ▶ The concept of establishing a valid calibration of a measuring instrument or measurement standard, by step-by-step comparison with better standards up to an accepted or specified standard. In general, the concept of traceability implies eventual reference to an appropriate national or international standard.



6. Sensitivity

- ▶ It should be noted that sensitivity is a term associated with the measuring equipment whereas accuracy & precision are association with measuring process. Sensitivity means the ability of a measuring device to detect small differences in a quantity being measured. For instance if a very small change in voltage applied to 2 voltmeters results in a perceptible change in the indication of one instrument and not in the other. Then the former (A0 is send to be more sensitive. Numerically it can be determined in this way for example if on a dial indicator the scale spacing is 1.0 mm and the scale division value is 0.01 mm then sensitivity =100. it is also called amplification factor or gearing ratio. It is possible that the more sensitive instrument may be subjected to drifts due to thermal and other effects so that its indications may be less repeatable than these of the instrument of lower sensitivity.
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7. Readability

- ▶ Readability refers to the ease with which the readings of a measuring instrument can be read. It is the susceptibility of a measuring device to have its indication converted into more meaningful number. Fine and widely spaced graduation lines ordinarily improve the readability. If the graduation lines are very finely spaced the scale will be more readable by using the microscope however with naked eye the readability will be poor. In order to make micrometer more readable they are provided with vernier scale. It can also be improved by using magnifying devices.



8. Repeatability

- ▶ It is the ability of the measuring instrument to repeat the same results when measurement are carried out
 - ▶ By same observer
 - ▶ With the same instrument
 - ▶ Under the same conditions
 - ▶ Without any change in location
 - ▶ Without change in the method of measurement
 - ▶ And the measurement is carried out in short interval of time.



9. Reproducibility

- ▶ Reproducibility is the consistency of pattern of variation in measurement i.e closeness of the agreement between the results of measurement of the same quantity when individual measurement are carried out
 - ▶ By different observer
 - ▶ By different methods
 - ▶ Using different instruments
 - ▶ Under different condition, location and times.
- ▶ It may also be expressed quantitatively in terms of dispersion of the results.



10. Calibration

- ▶ The calibration of any measuring instrument is necessary for the sake of accruing of measurement process. It is the process of framing the scale of the instrument by applying some standard (known) signals calibration is a pre-measurement process generally carried out by manufactures. It is carried out by making adjustment such that the read out device produces zero output for zero measured input similarly it should display output equipment to the known measured input near the full scale input value. If accuracy is to be maintained the instrument must be checked and recalibration if necessary. As far as possible the calibration should be performed under similar environmental condition with the environment of actual measurement



11. Magnification

- ▶ Magnification means increasing the magnitude of output signal of measuring instrument many times to make it more readable. The degree of magnification should bear some relation to the accuracy of measurement desired and should not be larger than necessary. Generally the greater the magnification the smaller is the range of measurement.

