Repeatability. The repeatability of an instrument is its ability to display the same reading for repeated applications of the same value of the quantity being measured.

Reproducibility. The reproducibility of an instrument is its ability to display the same reading when it is used to measure a constant quantity over a period of time or when that quantity is measured on a number of occasions.

Resolution. The resolution of an instrument is the smallest change in the quantity being measured that will produce an observable change in the reading of the instrument.

Response time. When the quantity being measured changes, a certain time, called the response time, has to elapse before the measuring instrument responds fully to the change.

Sample rate. Some instruments, e.g. digital voltmeters, take samples of the variable at regular intervals. The greater the sample rate, i.e. the greater the number of samples taken per second, the more readily the instrument readings mirror a rapidly changing input.

Sensitivity. The sensitivity of an instrument is:

$$\text{sensitivity} = \frac{\text{change in instrument scale reading}}{\text{change in the quantity being measured}}$$

i.e. the rate of change of output of the system with respect to the input.

Sensitivity drift. The sensitivity drift is the amount by which the sensitivity changes as a result of changes in environmental conditions.

Signal to noise ratio. The signal to noise ratio is the ratio of the signal level V_s to the internally generated noise level V_n. It is usually expressed in decibels, i.e.

$$\text{signal to noise ratio in dB} = 20 \log_{10}(V_s/V_n)$$

转换速率 ***Slew rate.*** The slew rate is the maximum rate of change with time that the output can have.

Span. The span of an instrument is the limits between which readings can be made.

Stability. The stability of an instrument is its ability to display the same reading when it is used to measure a constant quantity over a period of time or when that quantity is measured on a number of occasions.

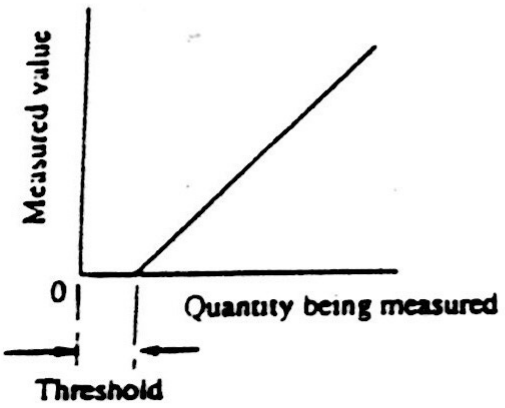


Figure 2.4 Threshold

Threshold. The threshold is the minimum value a signal must have reached before the instrument responds and gives a detectable reading (Figure 2.4). It is the dead space when the input starts from a zero value.

Time constant. A system when subject to an abrupt change in input, i.e. a step input, takes time to attain its final output (Figure 2.5). The time constant is the time taken for it to reach 63.2% of this final output. See Chapter 4.

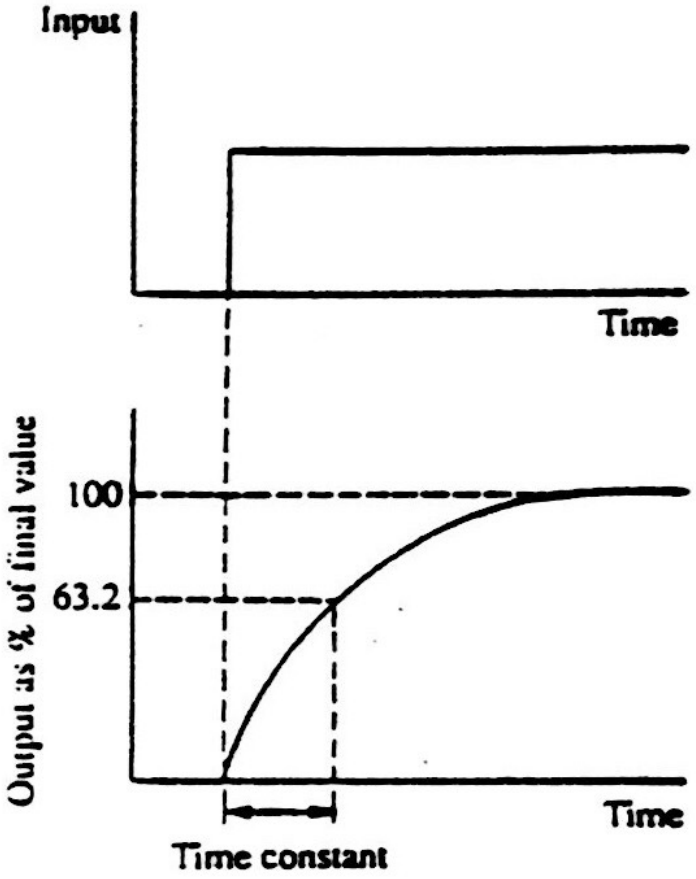


Figure 2.5 Time constant

Transfer function. The transfer function is the ratio of the output of a system, or an element of that system, to its input.

$$\text{Transfer function} = \frac{\text{output}}{\text{input}}$$

True value. This is the value with zero error.

Word. See binary word.

Zero drift. This term is used to describe the change in the zero reading of an instrument that can occur with time.

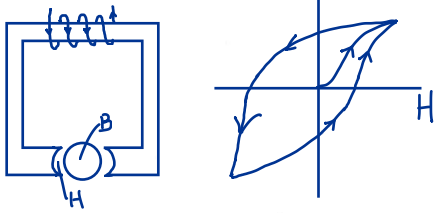
Table 2–1: SELECTING INSTRUMENTATION TRANSDUCERS

Characteristics of the Input Variable

- Range (maximum and minimum values to be measured)
- Overload protection
- Frequency response
  - Transient response
  - Resonant frequency

Transducer Input/Output Relation

- Accuracy
- Repeatability
- Linearity
- Sensitivity
- Resolution
- Friction
- Hysteresis/backlash 磁滞现象／后冲
- Threshold/noise level
- Stability
  - Zero drift
  - Loss of calibration with time



磁滞现象：铁磁或亚铁磁物质经过加磁场磁化到饱和后，去掉磁场，这些物质仍保留有剩余的磁化强度

Overall System

- Output characteristics
- Size and weight
- Power requirements
- Accessories needed
- Mounting requirements
- Environment of transducer location
- Crosstalk
- Effect of presence of transducer on measured quantity
- Need for corrections dependent on other transducers

Measurement Reliability

- Ease and speed of calibrating and testing
- Time available for calibration prior to and/or during use
- Duration of mission
- Stability against drift of zero point and proportionality constant
- Vulnerability to sudden failure (probability of proper performance for a given life time)
- Fail safety (will transducer failure represent system failure or invalidate data from other transducers)
- Failure recognition (will transducer failure be immediately apparent so that subsequent erroneous data can be rejected)

Purchase

- Availability and delivery; is item off-the-shelf?
- Any development necessary for operation
- Availability of calibration and test data from manufacturer
- Price
- Previous experience with seller