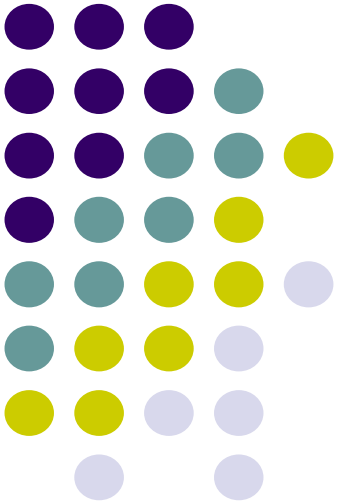
ME 472 – Engineering Metrology and Quality Control

Chp 1 - Introduction to Metrology and Quality



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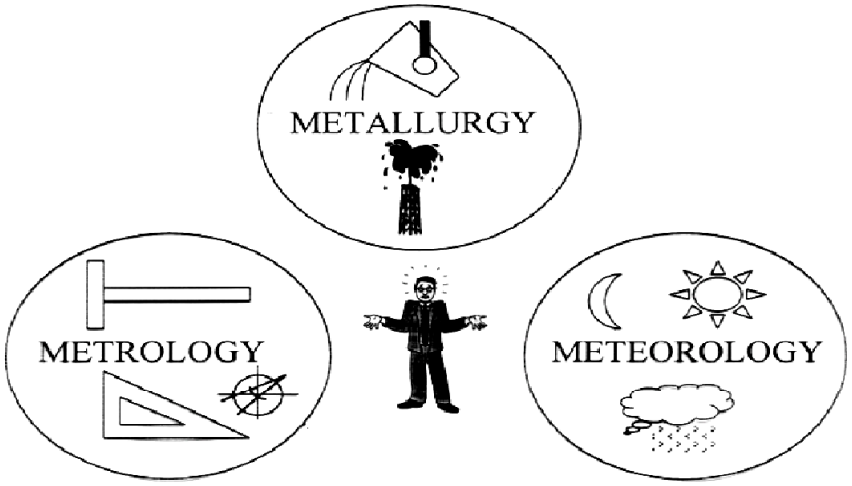
Definition of Metrology

Metrology

- Comes from greek “metron” (measure) and –logy.
- It refers to **science of measurement**, including all theoretical and practical aspects of measurement.



Measurement

- It is the procedure of **comparing an unknown quantity to a known standard** by means of consistent system of units.
- **Provides a numerical value of quantity** within certain limits of accuracy and precision.

Inspection

- It is the procedure in which **part characteristics (e.g. dimension) are examined** whether they conform to design specification.
- Many inspection procedures rely on measurement techniques while others use ga(u)ging methods (simply determine whether the part passes or fails inspection).

Definition of Quality

Product Quality

- It refers to a product's fitness for use.
- It is the totality of features that bear on a product's ability to satisfy a given need.

Need for Quality

- Quality is a very important aspect of manufacturing.
- It is a big issue (wide rage of topics like TQM, Six Sigma, Taguchi, ISO Standards, etc.)
- Needed for interchangeable manufacturing.
- Basic concept of standardization and mass production.
- Components of a product must fit together, assemble properly and be replaceable.
- Quality should be built into a product.
- Prevention of defects is a major goal.

Measure of Quality

High Quality Product

☺ performs its functions reliably

☺ performs its functions for a long time

☺ performs its functions conveniently

Low Quality Product

☹ does not perform its function reliably

☹ fails or breaks after short time of use

☹ difficult to use

GOAL

Continuous Quality Improvement

(functionality, reliability, durability, …)

Inspection & Measurement

What? When? How?

What to Inspect?

Inspection specific to PRODUCTS

- Electronic parts (circuits, chips, etc.)
- Machine elements (engines, brakes, gears, etc.)
- Heat and thermodynamic components (engines, fuel injectors, etc.)
- Medical and Bio-related products (implants, dental devices, surgical parts, etc.)
- Aerospace components (turbine blades and discs, airplane body, etc.)
- …

Inspection specific to PROCESSES

- Chip removal processes (turning, milling, drilling, etc.)
- Chipless manufacturing (casting, molding, forging, etc.)
- Non-traditional methods (EDM, ECM, laser ablation/cutting, etc.)
- …

When to Inspect?

Inspection AFTER production

- x costly production steps already complete
- x high cost of rejection or rework
- x difficult to test for all possible defects
- x difficult to identify responsibility for defect

Inspection DURING production

- ✓ defects found early, at each production step
- ✓ reduced cost of rejection or rework
- ✓ facilitates continuous process improvement

How to Inspect?

Measurement of DIMENSIONS

- Linear measurements (length, thickness, etc.)
- Angular measurements (taper, angle, etc.)
- Measurement of surface texture (roughness, waviness, etc.)
- Measurement of geometric shape (roundness, flatness, squareness, etc.)
- Measurement of screw threads and gears
- …

Inspection for DIMENSIONAL ACCURACY

- post-process (traditional)
- in-process (modern trend)

DIMENSIONAL TOLERANCES

- permissible variation in dimensions
- directly affects product quality and cost

Scale of Measurement

Large scale (low frequency) measurements

- Measurements at macro levels
  - Dimension (length, angle, etc.)
  - Tolerance
  - Form error (contour measurement)

Medium scale (medium frequency) measurements

- Measurements at meso levels
  - Surface texture/topography (waviness)
  - Geometric shape (flatness, roundness, etc.)

Small scale (high frequency) measurements

- Measurements at micro levels
  - Surface texture/topography (surface roughness)