

Precision Measurement

Unit 1

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I. Measurement Systems

A. Metric (SI)

1. System International (French)
2. Factor of 10
3. Meter is the standard unit of measurement

B. Inch-Pound System (USCS)

1. United States Customary System
2. Used mainly by the US.
3. Factors are not standard numbers 4, 8, 16 etc.
4. Inch and foot is the standard

C. Classes of Measuring Tools

1. Basic and semi-precision tools
 - a. used for quick measurement
 - b. accuracy is only to fractional amounts usually $1/32$
 - c. steel rule is most common
2. Precision Measuring Tools
 - a. used for measurements that are less than fractional
 - b. specialized tools
 - c. micrometer is the most used

D. Care of Measuring Tools

1. clean periodically
2. never lay anything on top of measuring tools
3. store measuring tools in cabinets or in separate boxes
4. never drop

II. Measuring With Rules

A. Inch Steel Rules

1. Spring-tempered rule
 - a. 8ths and 16ths on one side, 32nds and 64ths on the other

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2. **Flexible Rule**
 - a. usually pocket size (6")
 - b. measures $1/64$, $1/32$, $1/16$, $1/8$
3. **Hook Rule**
 - a. Used for measuring accurately from the end of a work piece
 - b. Used for adjusting calipers
4. **Short-length Rules**
 - a. used for measuring small openings
 - b. usually 5 interchangeable small rules from $1/4$ " to 1"
5. **Decimal Rules**
 - a. Inch is divided into 10ths instead of 16ths.

B. Measuring With Rules

1. Read from a graduation that is not worn.
2. Stand the rule on its edge, so graduation lines contact the work surface.
3. Remove all burs from the work piece
4. Lay the work piece flat
5. Make sure the rule is clean.

III. Calipers, Squares and Surface Plates

A. Outside Calipers

1. Two legs that are bowed out and attached by an adjustable spring.
2. Used for measuring round and flat objects.

B. Inside Calipers

1. Two legs that are parallel and are bent outwards at the bottom.
2. Used for measuring the diameter of holes and keyways.

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C. Precision Squares

1. Used mainly for inspection.
2. Used to check surface flatness.
3. Used to check right angles and squareness.
4. Used to check less expensive squares.

D. Surface Plates

1. Rigid block of cast iron or granite
2. Used when a flat reference plane is needed.
3. Used for precise layout and inspection.
4. Very expensive.
5. Granite is best
 - a. rustproof
 - b. non-magnetic
 - c. not affected by temperature
6. Surface plates are used extensively by machine shops.

IV. Micrometers

*Most commonly used of all precision measuring devices.

A. Sizes

1. Standard Inch
 - a. measures to one-thousandth of an inch (.001)
 - b. most measure from 0"-1"
 - c. Specialized measure up to 64" in increments of 1"
 - d. Vernier Micrometer measures to one-ten thousandth of an inch (.0001)

B. Types of Micrometers

1. Standard anvil-for measuring round faces.
2. Blade type anvil-for measuring grooves, slots, and recesses.
3. Disc type anvil-for measuring extremely thin plastic film
4. Mul-T anvil- has a round and flat anvil that one end is interchangeable for measuring cylinder walls.

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5. Screw thread anvil-measures the pitch of screw threads.
6. Tubular frame micrometer-measure up to 64"

C. Micrometer Parts

1. Frame-holds all the parts together
2. Anvil-fixed measuring face
3. Spindle-movable measuring face
4. Sleeve-holds the spindle and is graduated into equal parts of .025.
5. Thimble-movable part around the sleeve and is divided into equal graduations .001.
6. Friction thimble and ratchet stop-prevents too much pressure from being applied to the anvil and "springing" the threads.

D. Care of the Micrometer

1. Never drop.
2. Never place tools on top of the micrometer.
3. Never measure moving work.
4. Clean oil and dust off of before measuring.
5. Keep the anvils clean.
6. Do not over tighten.

V. Vernier Calipers

*Used for measuring the inside and outside of a flat or round object.

A. Types of Vernier Calipers

1. 25-division vernier caliper-read like a micrometer.
2. 50-division vernier caliper-double the number of divisions which makes more accurate readings possible. These are more difficult to read.
3. Dial Calipers- measures the same as the 25 and 50 division vernier calipers. Instead of a vernier scale there is a dial which is easier to read. It is important to not drop these, as it will alter the dial setting.