Accuracy, Precision and Tolerance

Dimensional Measurements

- Primary purposes:
  - Describe a physical object
    - Quantify size
  - Construct a physical object
    - Dimensions are needed for manufacturing
  - Control the way in which an object is produced
    - Controlled measurements and tolerances allow repeatability and interchangeability of manufactured parts

Accuracy, Precision, Tolerance

- *Accuracy* implies *the ability to hit what is aimed at*
  - In manufacturing, this would be a specified dimension
- *Precision* refers to *the repeatability of a process*
- *Tolerance* refers to the allowable variation of a specified dimension
  - 1.015 ± .001 ==> Tolerance = ±.001
  - Thus the allowable range of the dimension = 1.014 to 1.016 inches (1.015 - .001 = 1.014; 1.015 + .001 = 1.016)

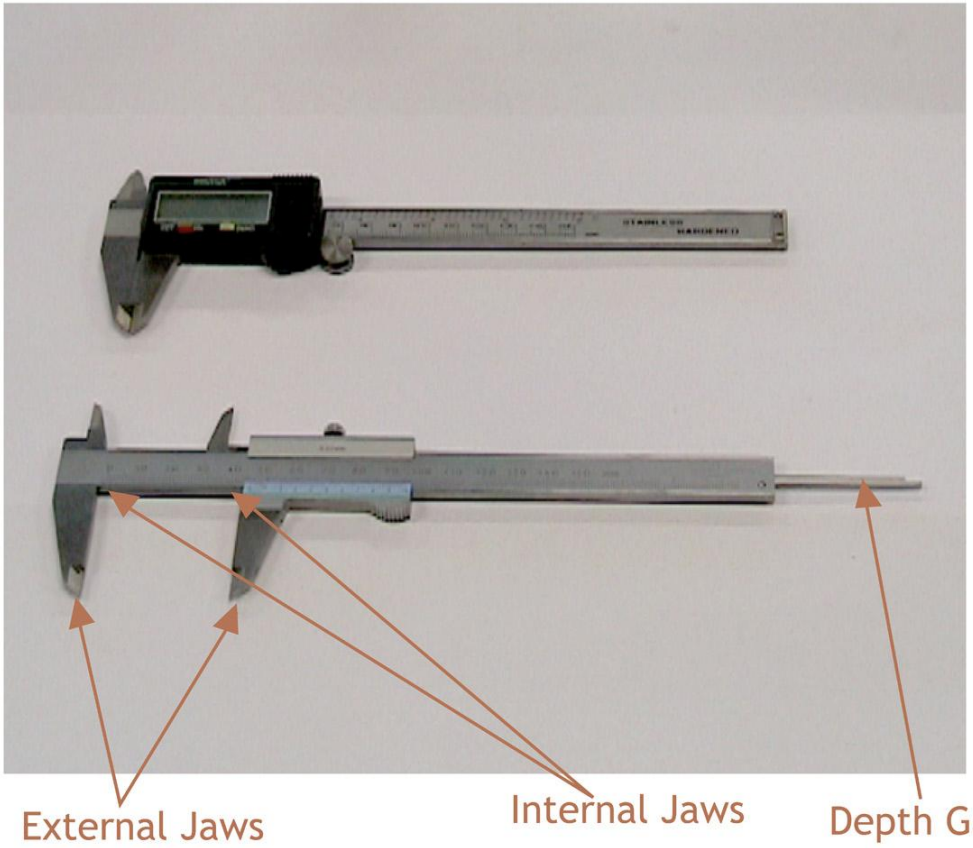
Basic Measurement Systems

- British Imperial
  - Inch common fractions: Inches are divided into equal parts: halves, quarters, eights, sixteenths, etc.
  - Inch decimal fractions: Inches are divided into tenths, hundredths, thousands, etc.
- Decimal Inch System
  - Promoted by Ford Motor Company in late 1920's
  - Essentially used inch decimal fractions to specify dimensions
  - Coined *mil* to mean 1/1000 or 0.001 inch
  - *Microinch* = 10^{-6} inches (one-millionth of an inch)

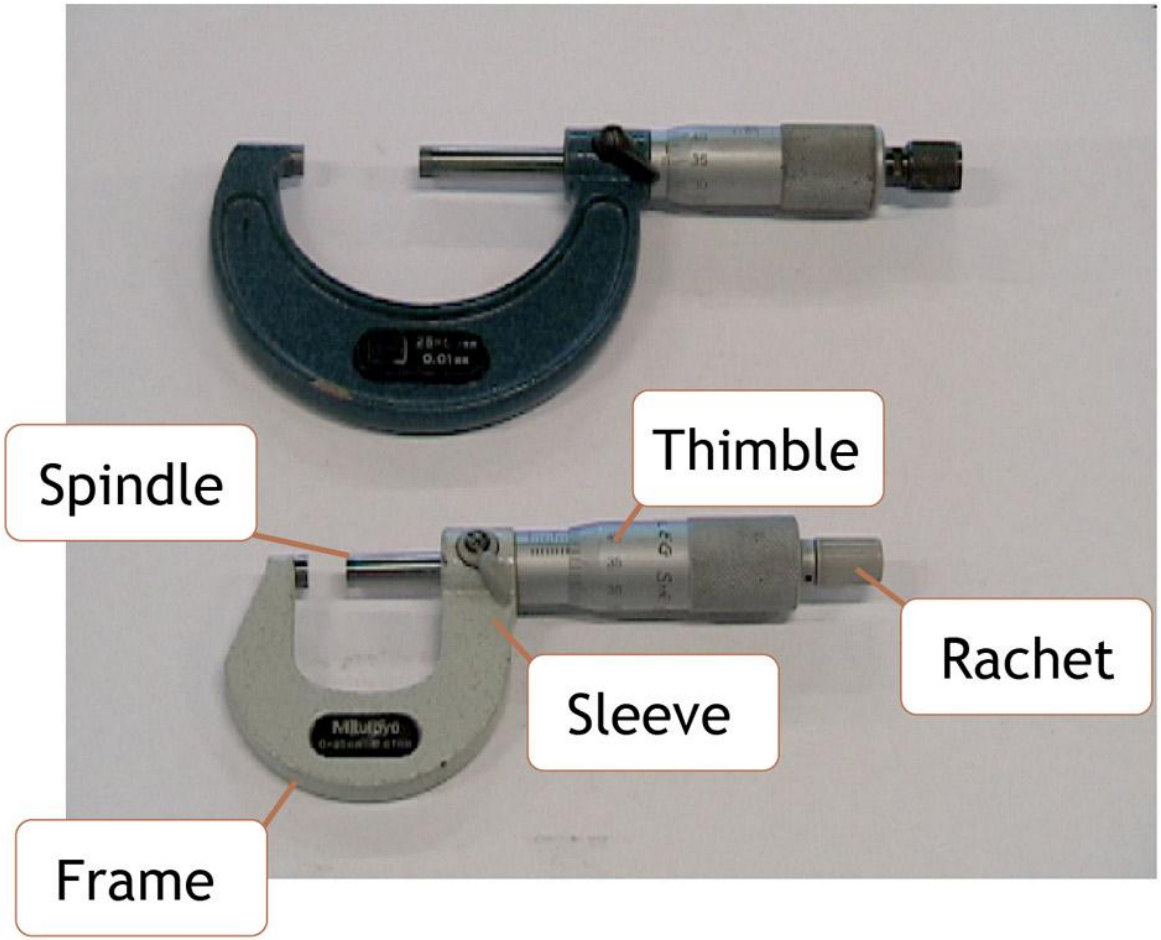
Basic Measurement Systems (cont)

- Metric System
  - Correctly called the SI system
  - Units for manufacturing purposes are most commonly specified in millimeters
    - 1 mm = 0.03937 inch = 39.37 mils
  - *Micron* = 10^{-6} meters (one-millionth of a meter)

Precision Instruments: Micrometers & Verniers



A Vernier Calliper can be used to measure a variety of dimensions across a wide range of components. The accuracy achieved is within 0.01mm



Micrometers are available in a range of sizes; 0 -25, 25 - 50, 50 - 75 & so on. The accuracy achieved is 0.01mm

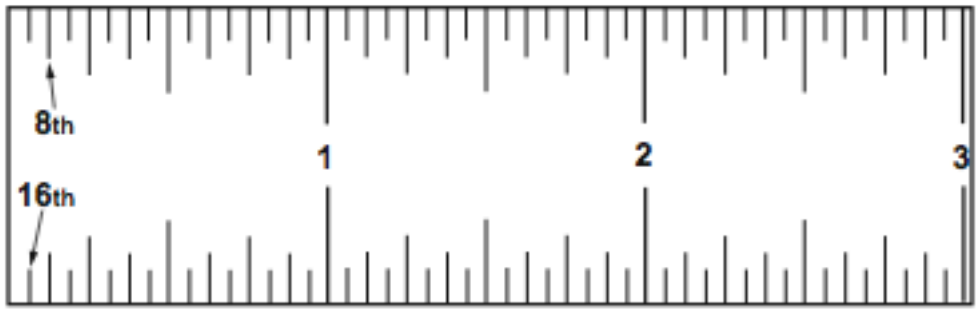
PRECISION MEASUREMENT

A. STEEL RULES

- Also called rulers or scales.
- Range in length from 1 - to - 48 inches.
- Most common is spring tempered 6-inch.

1. Fractional-Inch Rule

- Divided in fractions of an inch. Such as 1/2, 1/4, 1/8, 1/16 or smaller.
- Bottom number indicates number of spaces within an inch.



Fractional-Inch rule in 8ths and 16ths.

2. Review of Reducing Fractions

- Reducing does not change the value of a fraction.
- Divide numerator (top number) and denominator (bottom number) by same number.

Reduce 2/8

$2 \div 2 = 1$
$8 \div 2 = 4$

2/8 = 1/4

Reduce 16/32

a. $16 \div 2 = 8$
$32 \div 2 = 16$

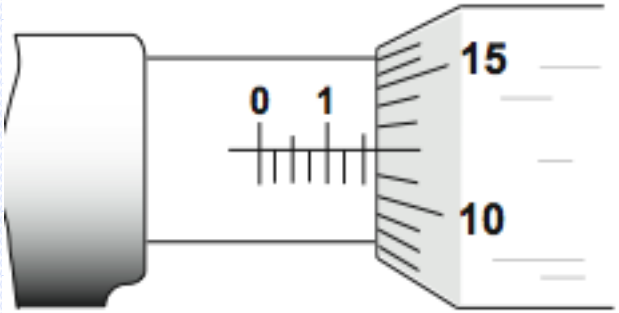
b. $8 \div 2 = 4$
$16 \div 2 = 8$

c. $4 \div 2 = 2$
$8 \div 2 = 4$

d. $2 \div 2 = 1$
$4 \div 2 = 2$

16/32 = 1/2

Micrometer Reading



1. Line “1” visible, plus two other lines:

“1” = .100
+ 2 @ .025 = .050
.150

2. Index line coincides with 12 on thimble:

12 x .001 = .012

.100 – Line marked “1”
.050 – 2 extra vertical lines
.012 – Thimble reading
.162 – Total reading