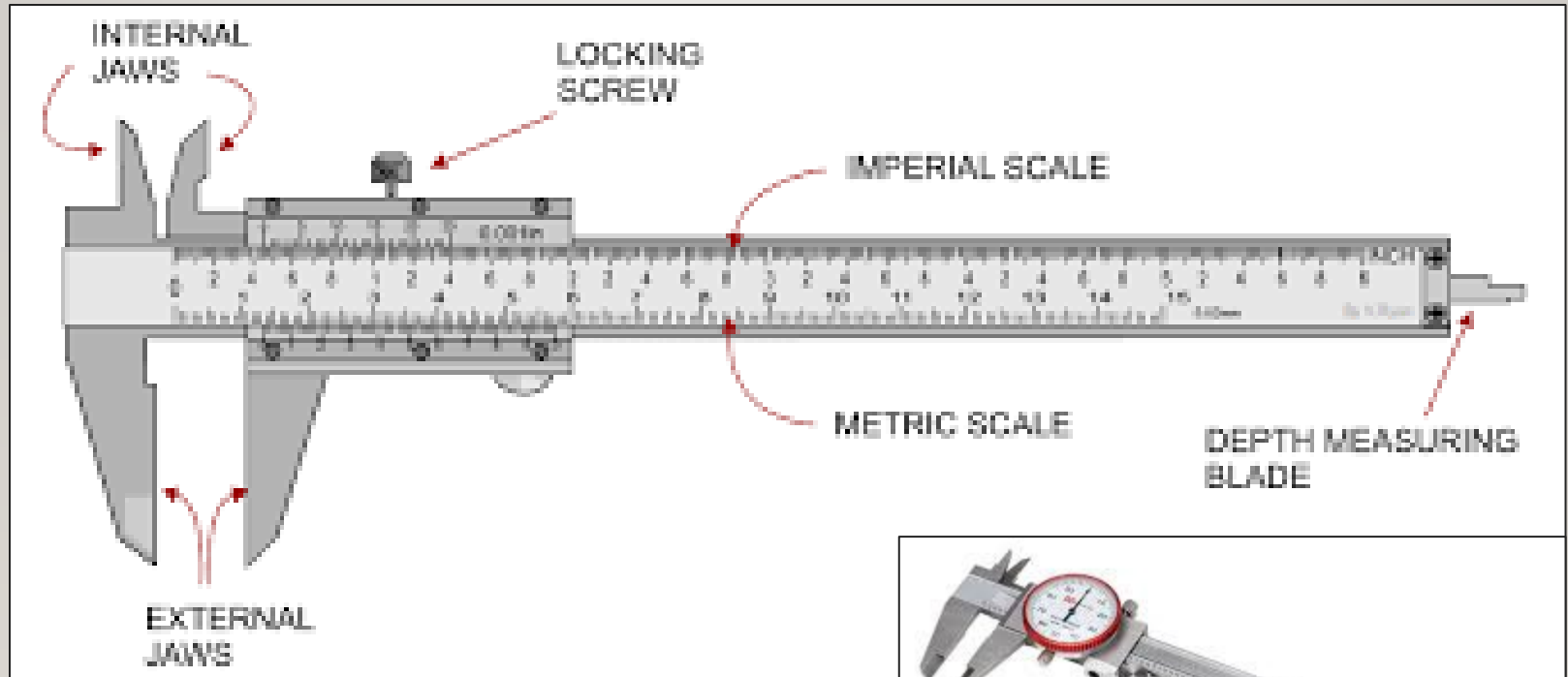# BEGINNING MACHINING

MEASURING TOOLS AND MEASUREMENTS
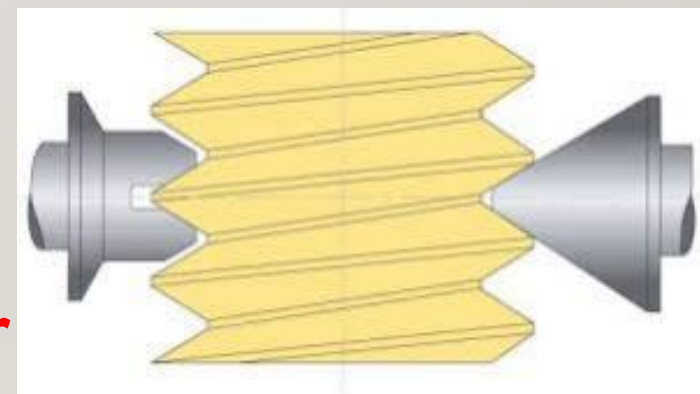
TOOLS OF THE TRADE

Caliper

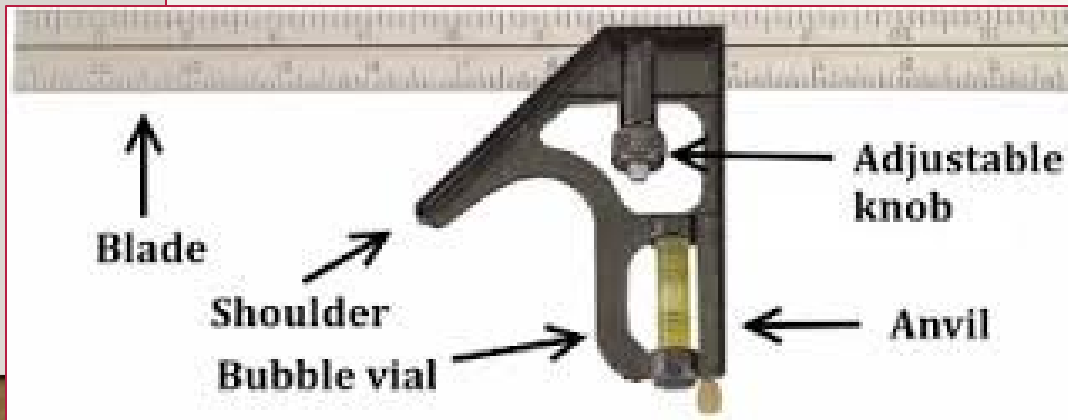# TOOLS OF THE TRADE

Micrometer

0"-1"

1"-2"

Pitch Micrometer

Starrett

TOOLS OF THE TRADE

Combination Square

Blade

Shoulder

Bubble vial

Adjustable knob

Anvil
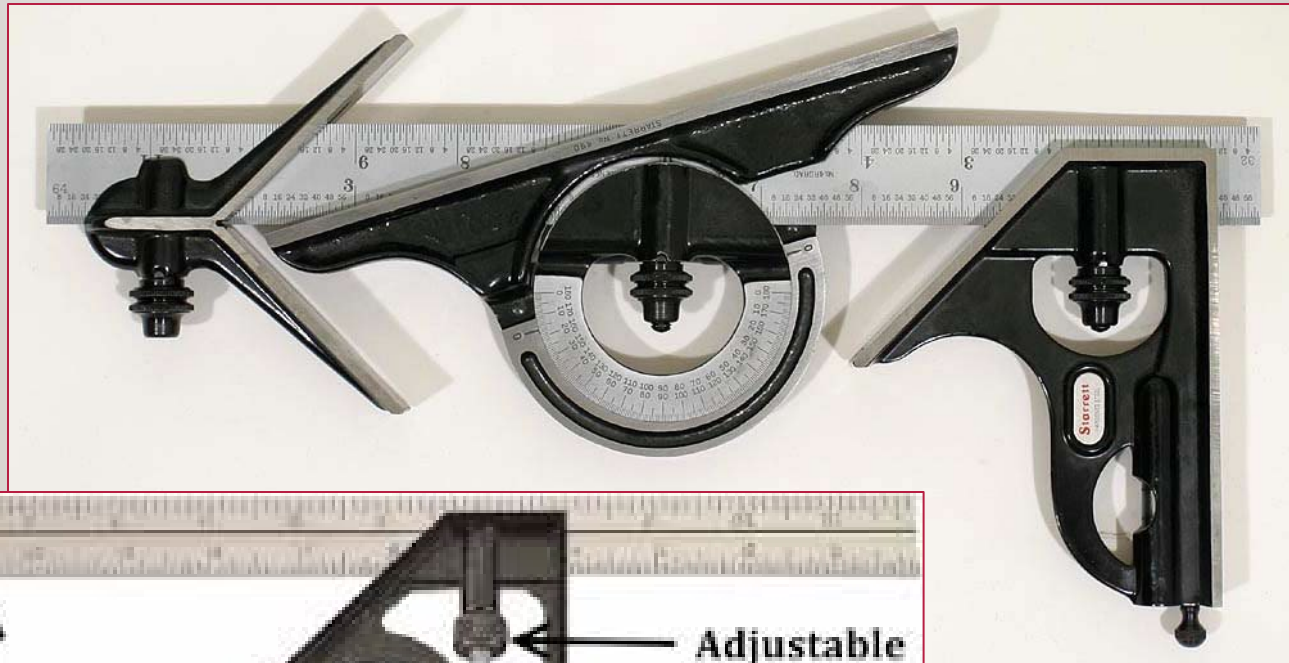
TOOLS OF THE TRADE

Dial Indicators

MEASUREMENT

Micrometer

BARREL · THIMBLE

0 1 2 3 4 5 6 7

20
15
.001

.025 · .100
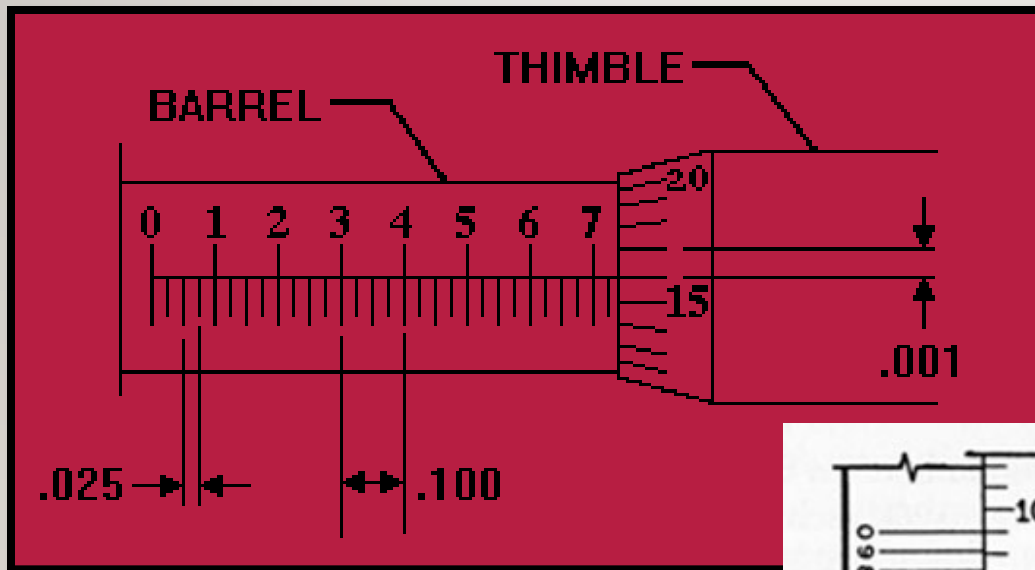
- Thousandth of an Inch Video

10
5
0
20
15

0 1 2

09876543210

15
10

0 1 2 3

.200
.075
.011
.0002
.2862

.200
.025
.022
.0000
.2470
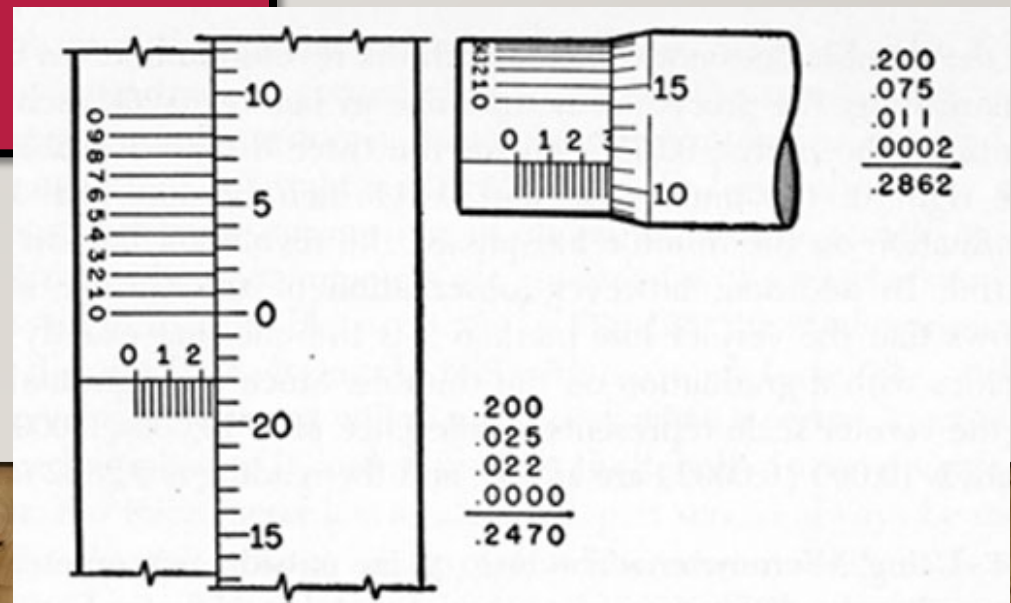
MEASUREMENT
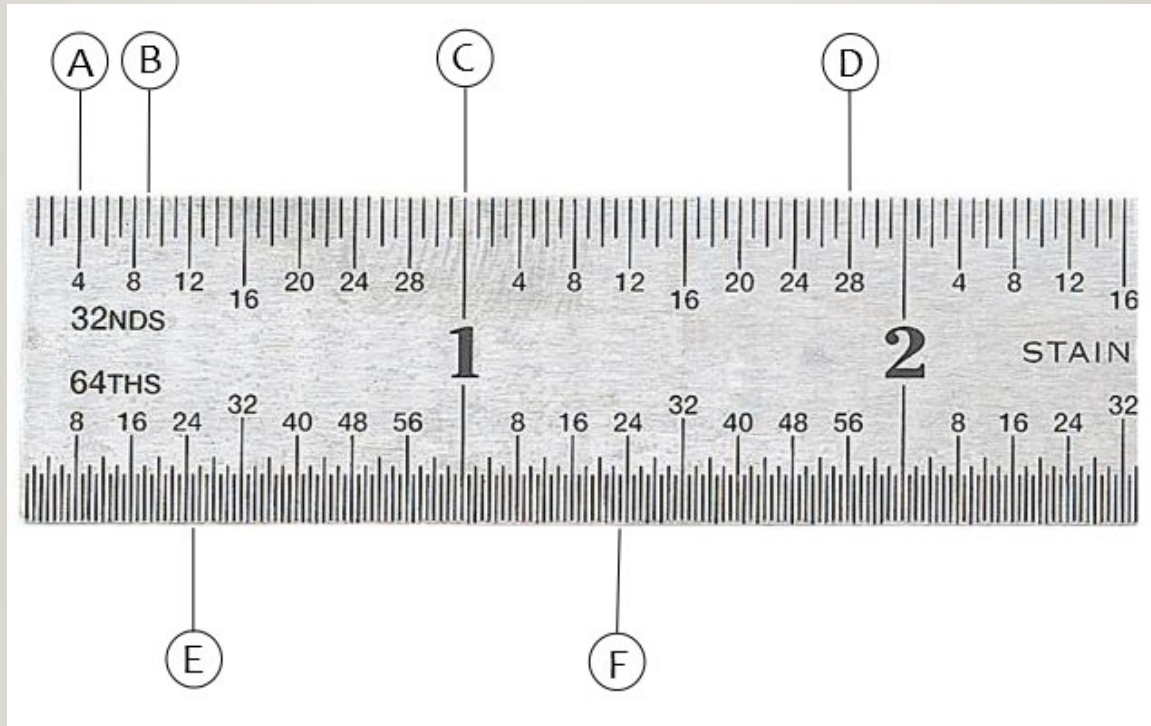
FEEDS AND SPEEDS

Table 16. Recommended Feed in Inches per Tooth (f_t) for Milling with High-Speed Steel Cutters

Material	Hardness Bhn	End Mills Depth of Cut .250" Cutter Diameter 3/8	3/4	1 and up	End Mills Depth of Cut .050" Cutter Diameter 1/8	3/8	3/4	1 and up	Plain or Slab Mills	Form Relieved Cutters	Face Mills and Shell End Mills	Slotting and Side Mills
		Feed per Tooth, Inch										
Plain Carbon Steels, AISI 1010 to 1030	-150	.002	.004	.006	.001	.003	.006	.008	.005-.008	.004	.006-.012	.005-.008
	150-200	.002	.003	.005	.001	.003	.006	.007	.005-.008	.004	.006-.012	.004-.006
AISI B1111, B1112, B1113	140-180	.002	.004	.006	.001	.004	.006	.008	.005-.010	.005	.008-.012	.005-.008
AISI 1040 to 1095	120-180	.002	.004	.006	.001	.003	.006	.008	.005-.008	.004	.006-.012	.005-.008
	180-220	.002	.003	.005	.001	.003	.006	.007	.005-.008	.004	.006-.010	.003-.006
	220-300	.001	.001	.002	.0005	.002	.003	.003	.003-.006	.003	.004-.008	.002-.005
Alloy Steels having less than 3% Carbon content. Typical examples: AISI 1320, 2317, 2515, 3120, 3125, 3316, 4012, 4028, 4128, 4320, 4620, 4720, 4820, 5024, 5120, 6120, 6325, 8627, 9315.	125-170	.002	.004	.005	.001	.004	.006	.008	.005-.008	.004	.006-.012	.005-.008
	170-220	.002	.004	.005	.001	.003	.006	.008	.004-.008	.004	.006-.010	.003-.006
	220-280	.001	.002	.003	.0005	.002	.003	.004	.003-.005	.003	.005-.008	.003-.005
	280-320	.0005	.001	.002	.0005	.001	.002	.003	.002-.004	.002	.003-.005	.002-.004
Alloy Steels having 3% Carbon or more. Typical examples: AISI 1330, 1345, 2330, 2345, 3130, 3150, 4030, 4063, 4130, 4140, 4150, 4340, 4640, 5080, 5150, 51100, 6290, 6440, 6475, 8650, 9262, 9445, 9850.	170-220	.002	.004	.005	.001	.003	.006	.008	.005-.008	.004	.006-.010	.003-.006
	220-280	.002	.002	.003	.0005	.002	.003	.004	.003-.006	.003	.005-.008	.003-.005
	280-320	.0005	.001	.002	.0005	.001	.002	.003	.002-.005	.002	.003-.005	.002-.004
	320-380	...	.001	.002	...	.001	.002	.002	.002-.004	.002	.002-.004	.002-.004
Tool Steel	200-250	.002	.003	.004	.001	.003	.004	.004	.003-.006	.004	.005-.008	.003-.006
	250-300	.001	.002	.003	.0005	.002	.003	.003	.002-.004	.003	.003-.005	.002-.004
Gray Cast Iron	150-180	.003	.005	.006	.001	.004	.007	.007	.008-.012	.005	.008-.014	.006-.010
	180-220	.002	.004	.005	.001	.003	.006	.006	.006-.010	.004	.006-.012	.005-.008
	220-300	.001	.003	.003	.0005	.003	.004	.004	.004-.008	.003	.004-.006	.003-.005
Ferritic Malleable Iron	110-160	.003	.005	.007	.001	.005	.006	.008	.008-.014	.006	.008-.016	.006-.010
Pearlitic Malleable Iron	160-200	.002	.004	.005	.001	.003	.006	.008	.008-.012	.005	.008-.014	.006-.010
	200-240	.002	.002	.003	.001	.002	.003	.004	.005-.010	.004	.006-.012	.005-.008
	240-300	.0005	.001	.002	.0005	.002	.002	.003	.004-.008	.003	.004-.008	.003-.005

FEEDS AND SPEEDS

FEEDS AND SPEEDS

Spindle Speed Formula: (Based on H.S.S. Tooling)		$\dfrac{CSx4}{D}$
Feed Rate Formula		$F_m = f_t \times n_t \times N$

Cutting Speeds for High Speed Steel cutting Tools

 Aluminum – 200fpm

 Steel – 90fpm

F_m = Feed rate in inches per minute

F_t = feed in inches per tooth (from Machinery's Handbook)

n_t = Number of cutting teeth on the tool

N = Spindle Speed (CS x 4 / D)