ENG 004 Lecture 14, Nov 13, 2012

Announcements

- Homework #5 due today
- Homework #6 posted after class
- Finish reading Chapter 9
- Office Hours 5-6

Topics

- Tolerances

Tolerances

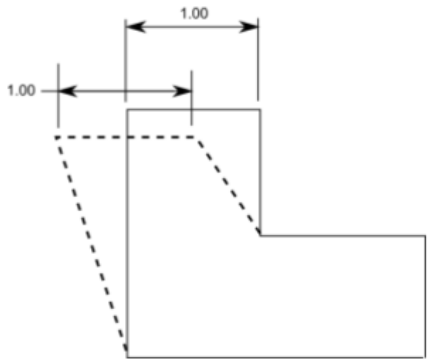
Tolerances are the allowable deviation in **size**, **location**, and **geometry** of a feature.

The primary role of dimensioning is to control the size or location of a feature.

Every dimension has to have a tolerance associated with it: X.XX±0.02

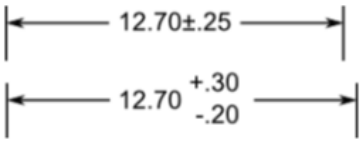
Traditional/Size-control Tolerancing

Does not control for the form (geometry) of the feature directly, it only controls the size or location

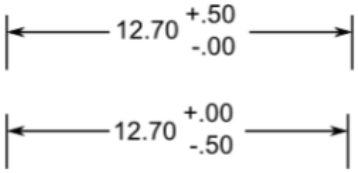


Traditional Tolerance Types

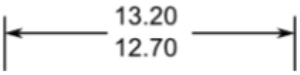
Bilateral



Unilateral



Limits of Size

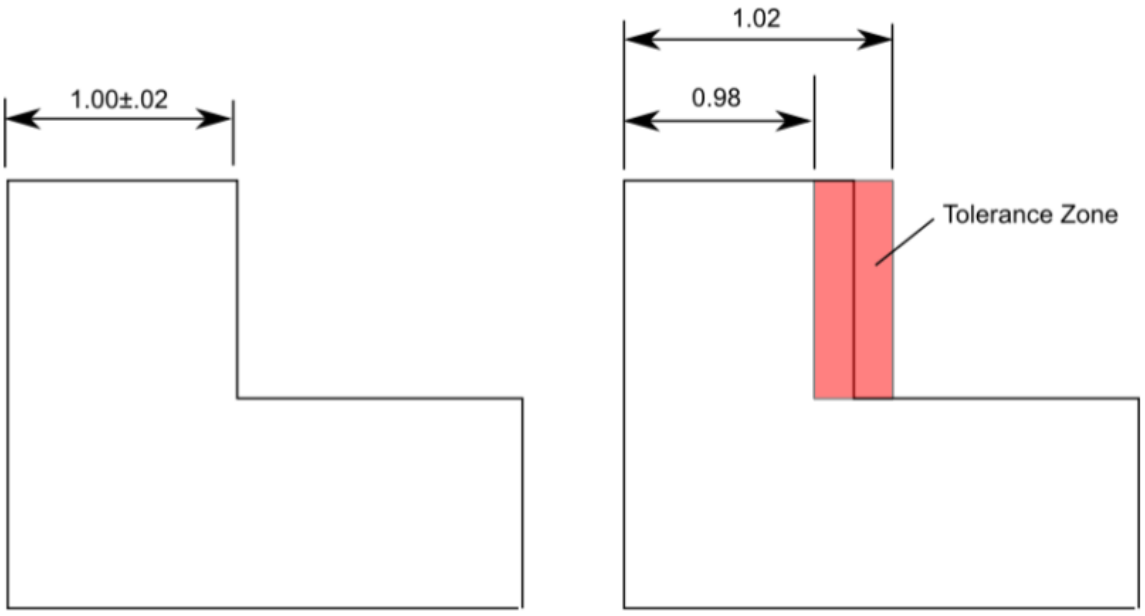


Default Tolerances

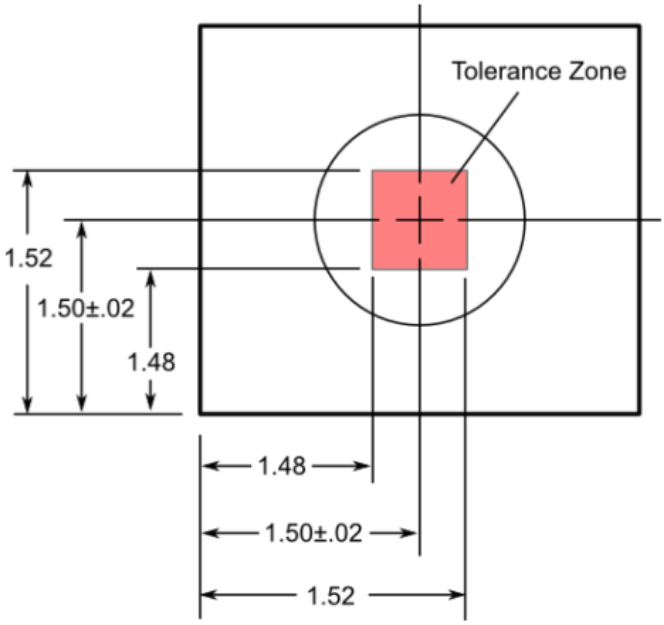
DIMENSIONS ARE IN INCHES AND DEGREES
TOLERANCES UNLESS OTHERWISE SPECIFIED:

X.X	= ±0.1	X/X	= ±1/32
X.XX	= ±0.03	X°	= ±1°
X.XXX	= ±0.005	X.X°	= ±.5°
X.XXXX	= ±0.0005	X.XX°	= ±.05°

Tolerance Zone - Size



Tolerance Zone - Location



Material Conditions

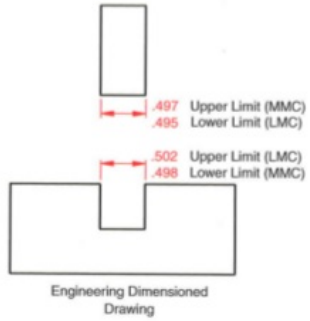
Maximum Material Condition (MMC)

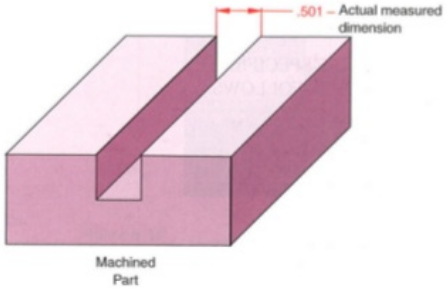
Size of a feature at one end of its tolerance zone where there is the most amount of material.

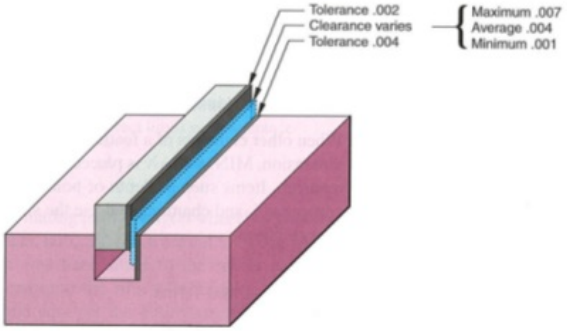
Least Material Condition (LMC)

Size of a feature at one end of its tolerance zone where there is the least amount of material.

Material Conditions





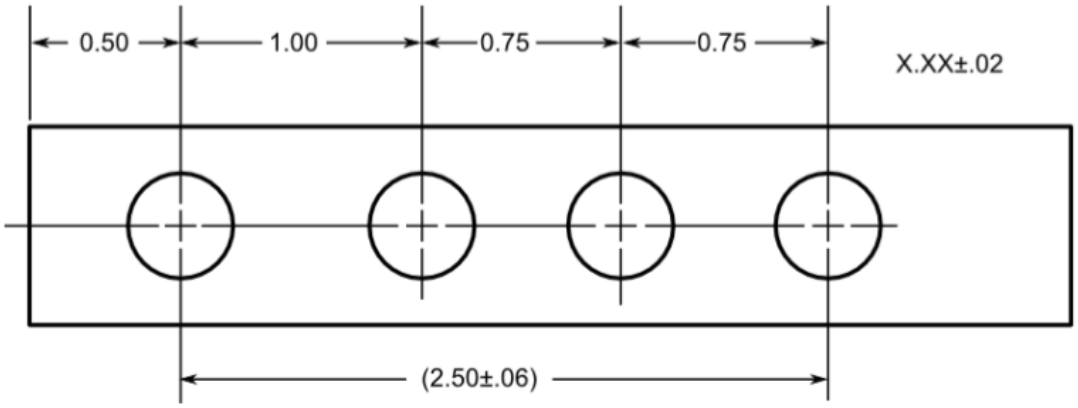


Tolerance Stackup

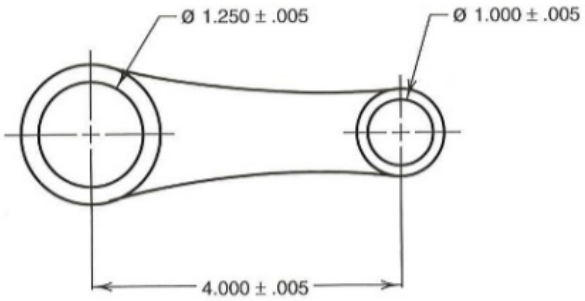
Tolerances always add!

0.7±0.2 + 0.5±0.3 = 1.2±0.5

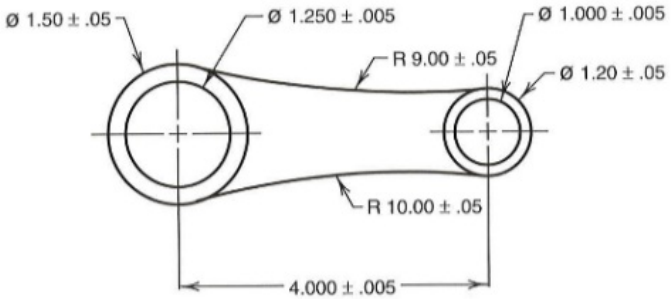
0.7±0.2 - 0.5±0.3 = 0.2±0.5



Functional Dimensioning

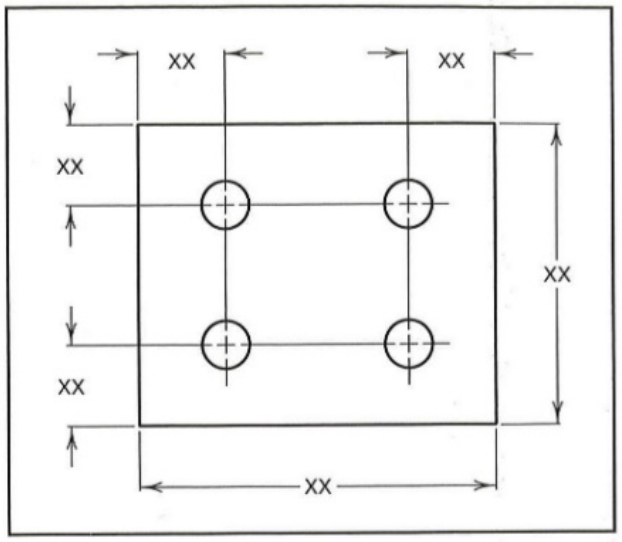


Functional dimensioning
Step 1

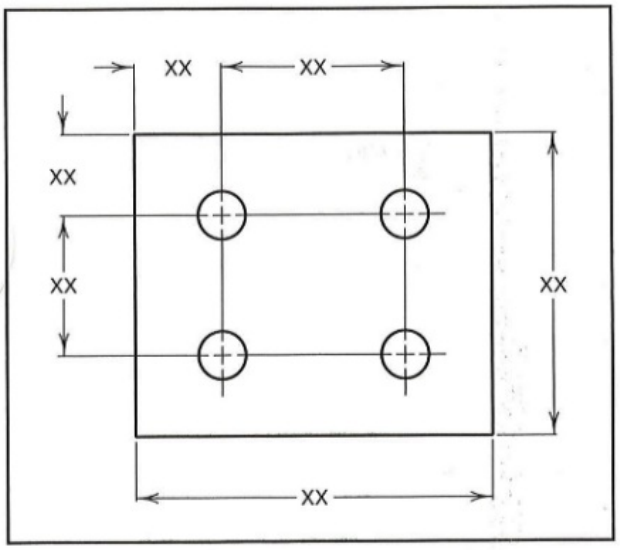


Functional dimensioning
Step 2

Functional Dimensioning



(A) No!



(B)

Classes of Fit

An assembly of two parts creates a "fit" whose functional characteristic is determined by the differences in the parts' associate sizes.

Clearance Fit

The MMC of the hole is always greater than the MMC of the shaft: $MMC_{hole} > MMC_{shaft}$

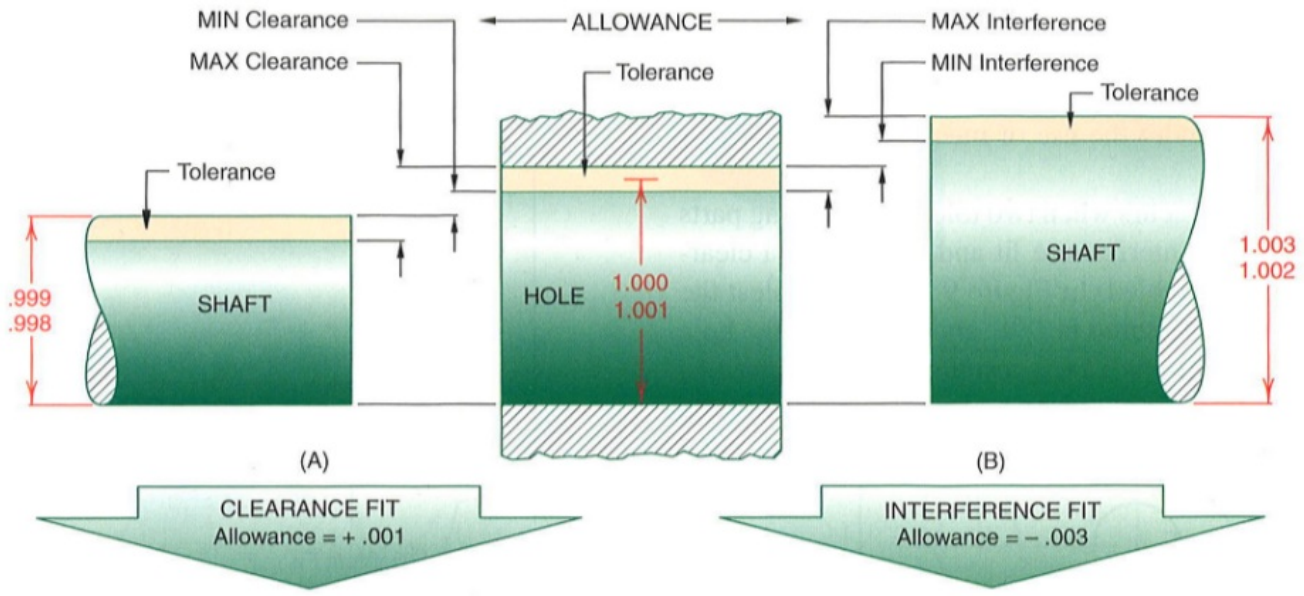
Interference Fit

Both the MMC and the LMC of the hole are less than the MMC and LMC of the shaft, respectively

$MMC_{hole} < MMC_{shaft}$

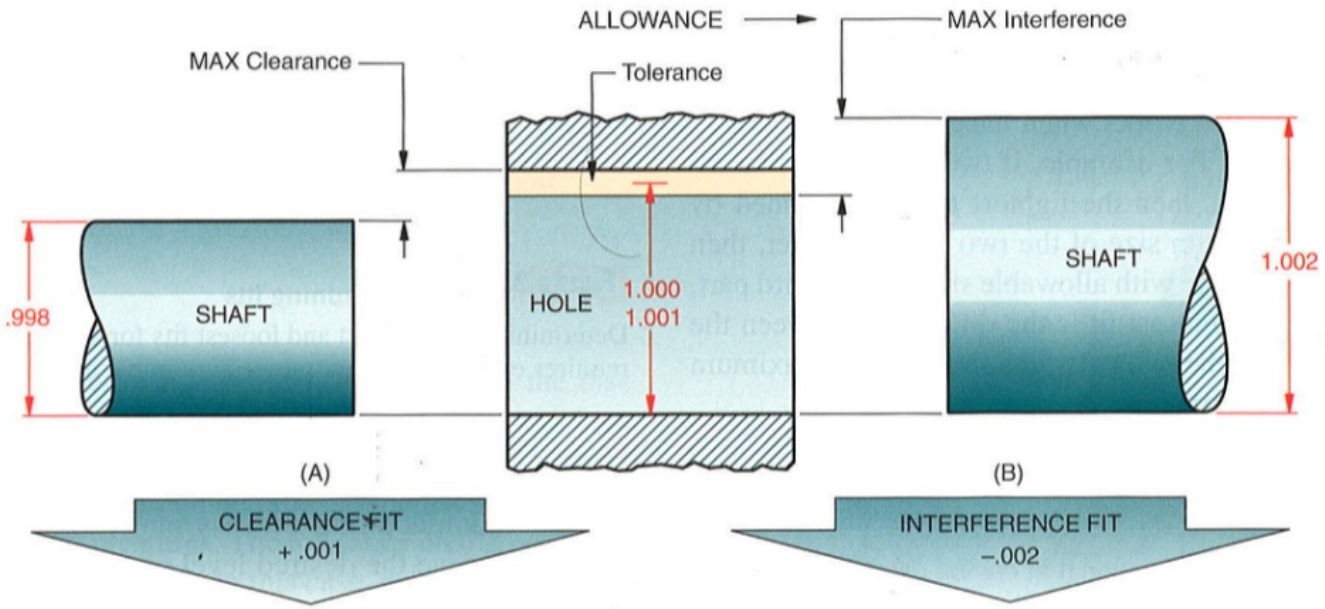
$LMC_{hole} < LMC_{shaft}$

Clearance and Interference

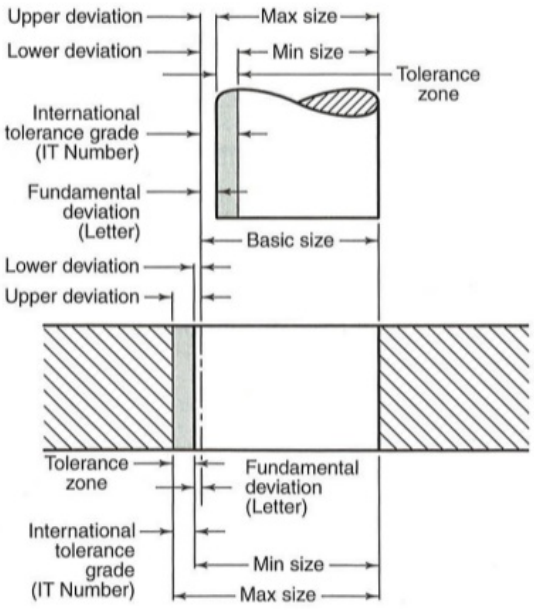


Allowance always equals smallest hole minus largest shaft

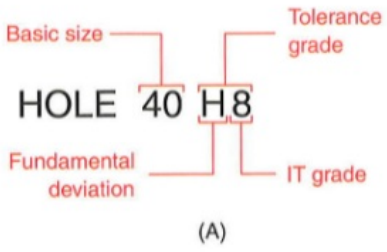
Transition Fit



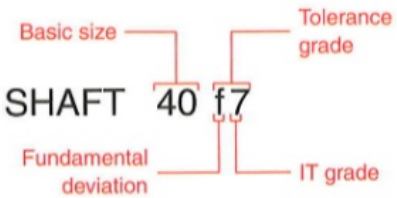
Metric Fit Classifications



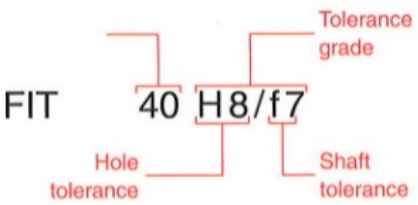
Metric Fit Notation



(A)



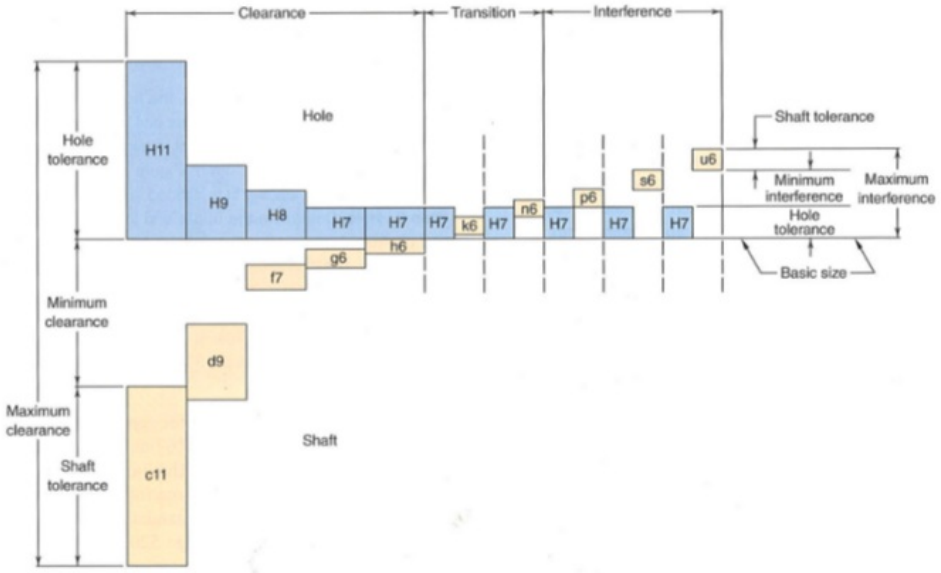
(B)



(C)

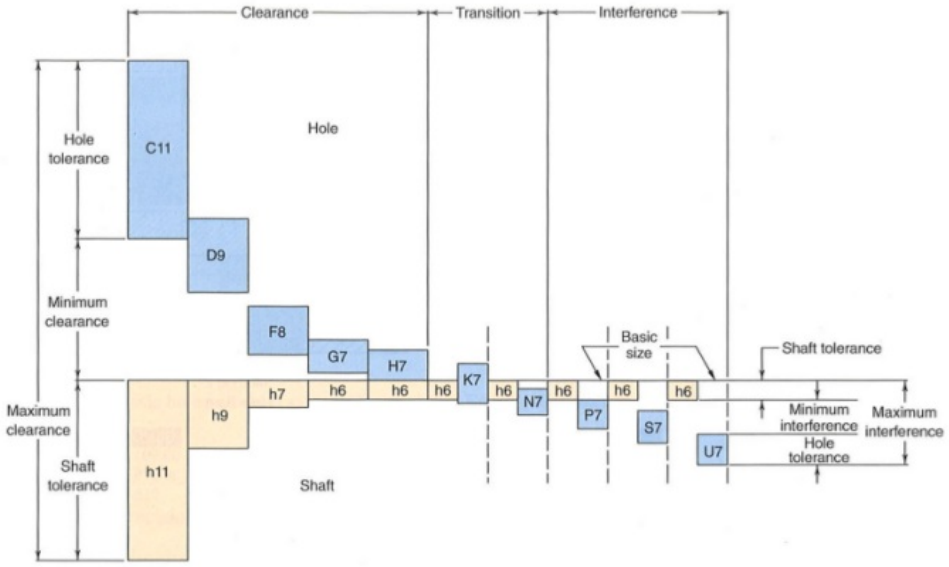
Metric Preferred Hole Based System

Minimum hole size is the basic size

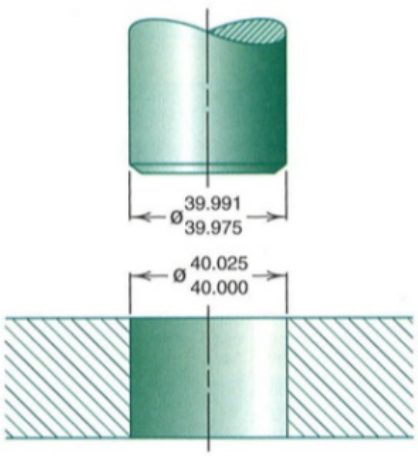


Metric Preferred Shaft Based System

Minimum shaft size is the basic size

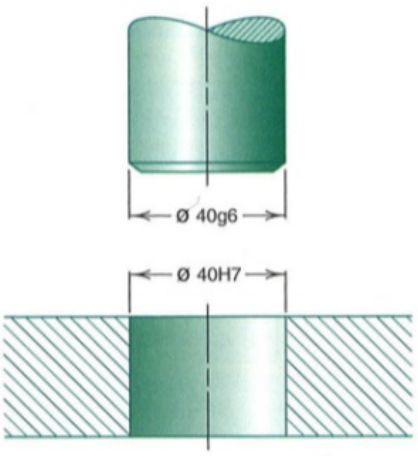


Metric Fit Note Form



Method 1
Limit Form

Hole		Shaft	
40.025		39.991	
40.000		39.975	
.025	Hole tolerance	.016	Shaft tolerance



Method 2
Note Form

Hole		Shaft	
40.025		39.991	
40.000		39.975	
.025	Hole tolerance	.016	Shaft tolerance

English Preferred Precision Fits

Running and Sliding Fits [RC]

The loosest fits. Used when shaft must move freely in a hole. Always has clearance, position is not critical.

Clear Locational Fits [LC]

Tighter than RC. Shaft and hole may be same size (line-to-line fit). Location is more important than RC.

Transition Locational Fits [LT]

Transition between LC and LN. May have slight clearance or may have slight interference.

Interference Locational Fits [LN]

Can be line-to-line, but almost always shaft is larger than the hole. Position/location very important.

Force and shrink fits [FN]

Pure interference fits. Used to secure parts together.

English Preferred Precision Fits

Basic Size

Theoretical nominal size to which the tolerance limits are applied.

Basic Hole System

Smallest hole is set as the basic size. Most common due to drill tooling

Basic Shaft System

Largest diameter of the shaft is assigned as the basic size. Less popular.

Basic Hole and Shaft Systems