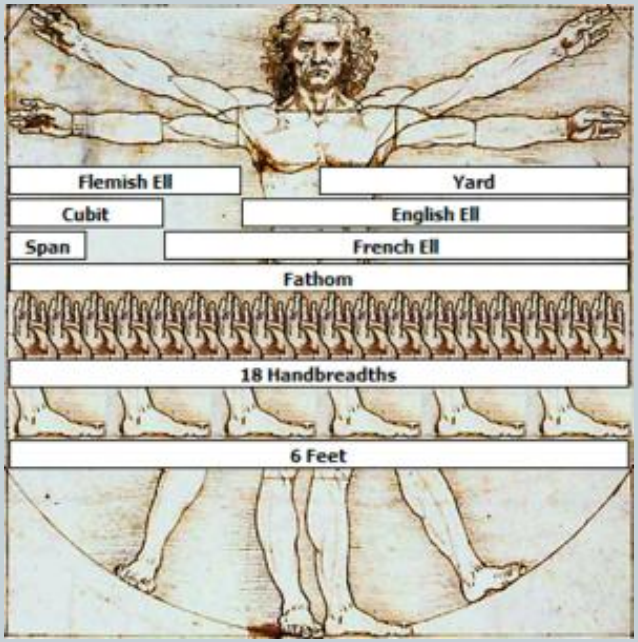
IFHE

Workshop Practice
TA 102

Lec – 4 & 5 :Measurements and Quality in Manufacturing



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Introduction

- Metrology:

  The science of measurement is known as metrology

- Measurement:

  Measurement is the act of determining the measurable properties of some object. Measurable properties could be diameter, length, hardness, weight, volume and even it can be electrical voltage and current.

- Inspection

  It is the examination of the part to determine whether or not it meets the specifications of the designer.

- Gauging

  the process of determining whether the dimension is with in specified limits or not is known as gauging.

- Testing

  testing is the process to know the performance of the product.

INSPECTION

Inspection process classified as

- Post processor
- Online inspection or Real time inspection

Definitions

Accuracy:

accuracy of measurement is defined as capability to get accurate measure of dimension.

accuracy of Manufacturing is how closely a measurement of a manufacturing part comes to the true or specified value.

Precision

it is the term for how close together are the many readings of the same measurement.

Tolerance

the permissible deviation of a dimension from the desired size is known as tolerance.

MEASURING AND INSPECTION INSTRUMENTS

- 1.Direct measuring Instruments

  2.In direct measuring Instruments

- 3.Gauges

Direct measuring Instruments

- IN DIRECT MEASURING INSTRUMENTS, THE DIMENSION TO BE MEASURED IS MEASURED BY A STANDARD *CALIBRATED* MEASURING INSTRUMENT , WHICH GIVES VALUE OF DIMENSION.
- A DIRECT MEASURING INSTRUMENT OBTAINS A MEASUREMENT VALUE THE ASSISTANCE OF ANY OTHER INSTRUMENT.

INDIRECT MEASURING INSTRUMENTS

- IN INDIRECT MEASURING INSTRUMENTS, ASSISTANCE OF ANOTHER MEASURING INSTRUMENT , IS REQUIRED TO GET THE MEASUREMENT.
- AN INDIRECT MEASURING INSTRUMENT, INEFFECT TRANSFERS THE MEASUREMENT FROM THE WORKPIECE TO A DIRECT MEASURING INSTRUMENT.

INDIRECT MEASURING INSTRUMENTS

- EXAMPLE SIMPLE CALLIPERS, COMPARATOR etc..

COMPARATOR

- A COMPARATOR IS AN INSTRUMENT FOR COMPARING THE UNKNOWN DIMENSION OF A WORKPIECE WITH ANOTHER KNOWN DIMENSION. UNLIKE MEASURING INSTRUMENTS, COMPARATORS INDICATE THE DEVIATION FROM THE SPECIFIED SIZE.
- VARIOUS COMPARATORS MECHANICAL, ELECTRICAL, PNEUMATIC, ELECTRONIC ARE USED FOR QUICK AND PRECISE MEASUREMENTS.

GAUGES

- A GAUGE IS AN INSTRUMENT USED TO DETERMINE DIMENSIONAL ACCEPTABILITY OF A PART, THAT IS, TO CHECK WHETHER A DIMENSION IS WITHIN THE TOLERANCE SPECIFIED.
- GAUGES AID US IN QUICKLY ARRIVING AT A CONCLUSION WHETHER A PART CAN BE ACCEPTED OR NOT.

GAUGES

- GAUGING IS PREFERRED TO MEASURING WHEN THE QUANTITY IS LARGE.
- GAUGING IS FASTER, EASIER AND RESULTS IN LOWER INSPECTION COST.

GAUGES

- GAUGES ARE NOT GENERAL PURPOSE INSTRUMENTS.
- EACH GAUGE IS SPECIFICALLY DESIGNED FOR A SPECIFIC DIMENSION OF A SPECIFIC PART.
- A GAUGE IS DESIGNED TO CHECK ACCEPTABILITY OF A SPECIFIC DIMENSION
- MINIMUM SKILL AND TIME IS REQUIRED FOR ITS USE.

QUALITY

- QUALITY is a characteristic property consisting of several well-defined considerations such as SURFACE FINISH , FUNTIONALITY, ACCURACY, PERFORMANCE, Etc..
- QUALITY is defined as fitness for purpose.

Reliability

- It is defined as the probability of a product functioning in the intended life under the normal operating conditions.

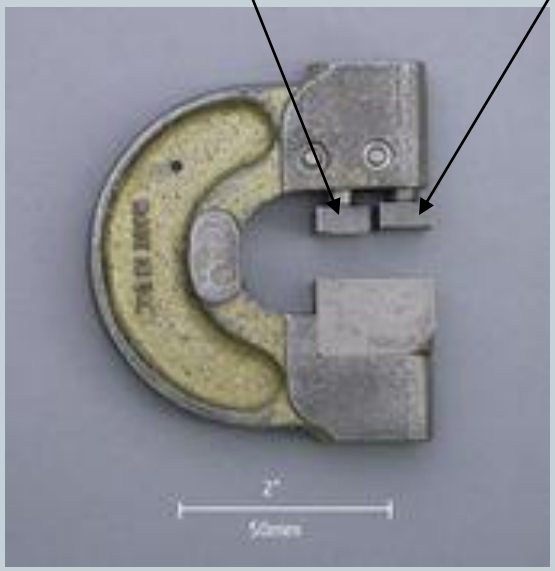
SURFACE FINISH

- Surface finish or Surface texture is the amount of geometric irregularity produced on the surface of an object during fabrication.
- surface finish is important for the proper functioning of mating surfaces.
- Part such as gear and piston require good surface finish for reducing friction.

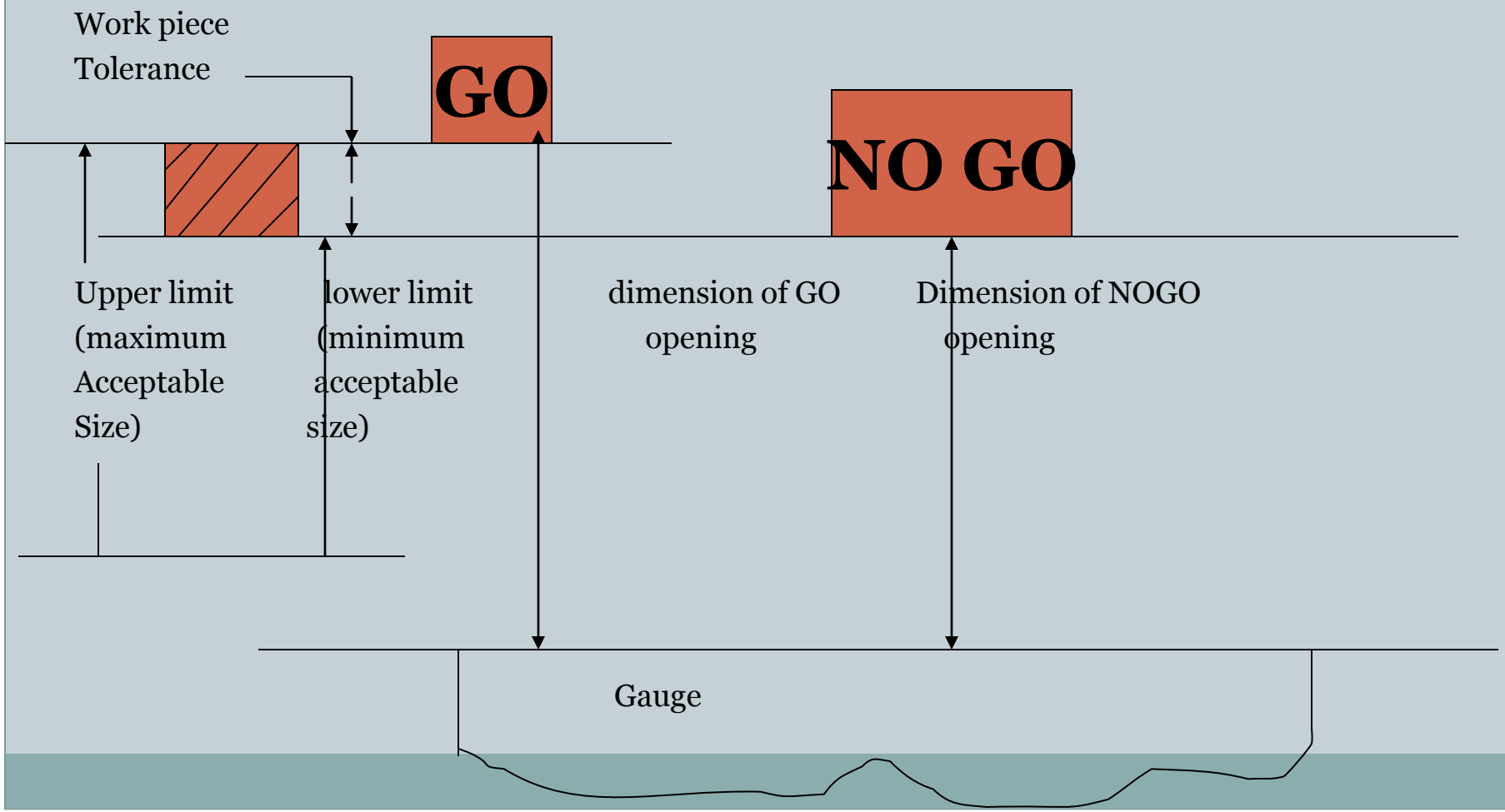
Gauges

- A gauge is an instrument used to determine dimensional acceptability of a part.
- A gauge is designed to check the acceptability of a specific dimension so that minimum time and skill is required for its use.

A simple GO NOGO gauge



GO – NOGO Dimensions



Limits and Fits

- A system of limits and fits helps in :

1. Interchangeability and ease of assembly.
2. Eliminating the need for minor rectifications (fitting) during assembly.
3. Eliminating unnecessary effort being spent in producing dimensions to a higher degree of accuracy or surface finish than what is needed for satisfactory operation.

Tolerance

- It is the acceptance of an error of manufacturing.
- The difference between the maximum and minimum limit of size of a part , that is total permissible variation of size, is called tolerance.
- Tolerance may have upper and lower deviations from the nominal size.

- Nominal size or basic size is the exact or theoretical size specified on the basis of design considerations.
- Unilateral Tolerance:

  A unilateral Tolerance is one that applies in one direction from the nominal size , and the permissible variation in the other direction is zero.

EX : $24^{+0.030}_{-0.000}$

- Bilateral tolerance:

  the tolerance is split is to two parts(equal or unequal) and applied on either side of the nominal size.

EX : $24^{+0.025}_{-0.005}$

FITS

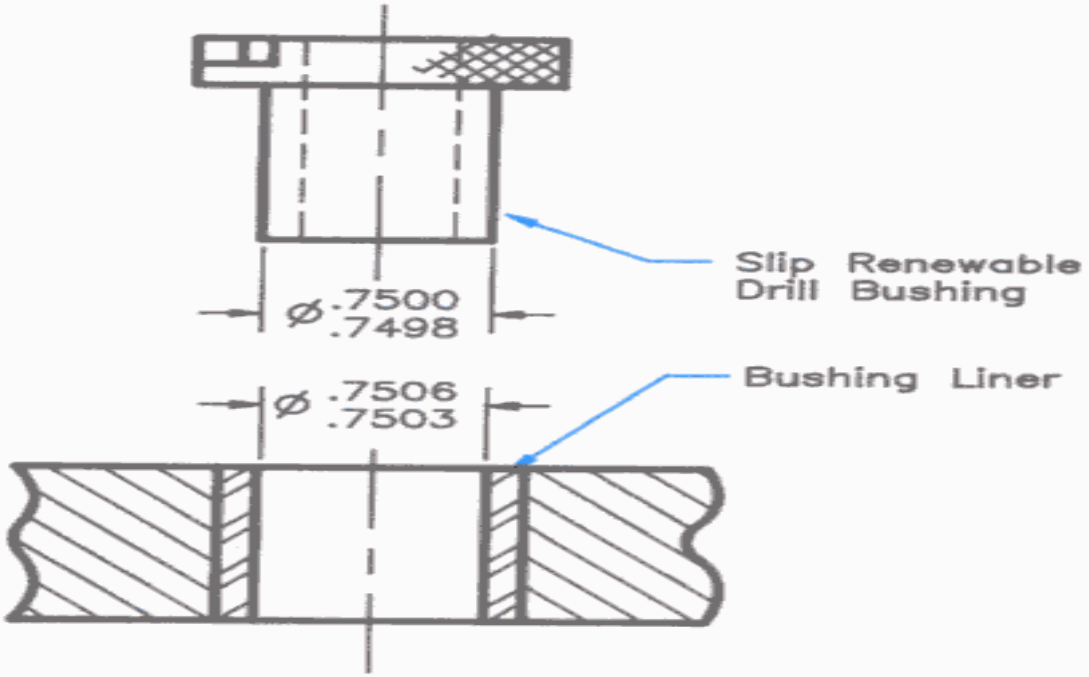
- Fit is general term used to signify the relative degree of tightness or looseness of assembled parts, which decides the relative movement between mating parts.
- Two parts can fit each other in three ways:

1. Clearance fit
2. Interference fit
3. Transition Fit

Clearance fit:

- It is one in which two assembled parts are always free to move relative to each other
- The difference between the size of the hole and the size of the shaft is defined as clearance
- The shaft maximum diameter is smaller than the hole minimum diameter.

examples: door hinges, shafts and bearing, wheel and axle etc.,



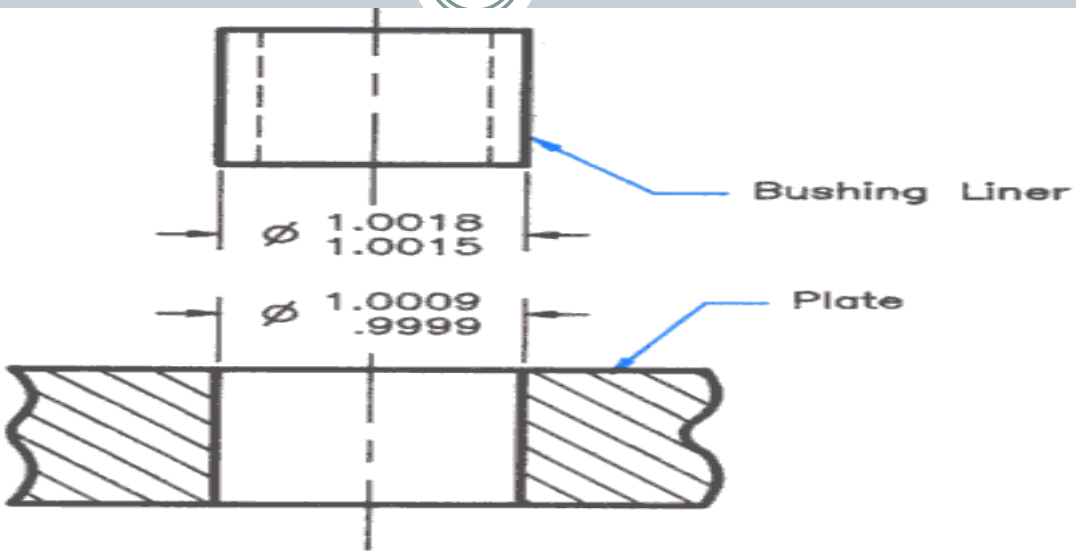
	Smallest Hole	.7503
—	Largest Shaft	.7500
	Allowance	.0003

Figure 3-42. Proper calculation of a clearance fit will result in limits of size that provide clearance between the features for all possible size combinations.

Interference fit:

- Mating parts are joined tightly together and no relative motion is possible.
- The size of hole is always smaller than the size of the shaft.
- The shaft minimum diameter is larger than the hole maximum diameter.

- It is used for permanent and semi-permanent assembly of parts.
- Example: dowel pins and bearings in casting.



MAXIMUM INTERFERENCE

Smallest Hole	.9999
— Largest Shaft	1.0018
Allowance	—.0019

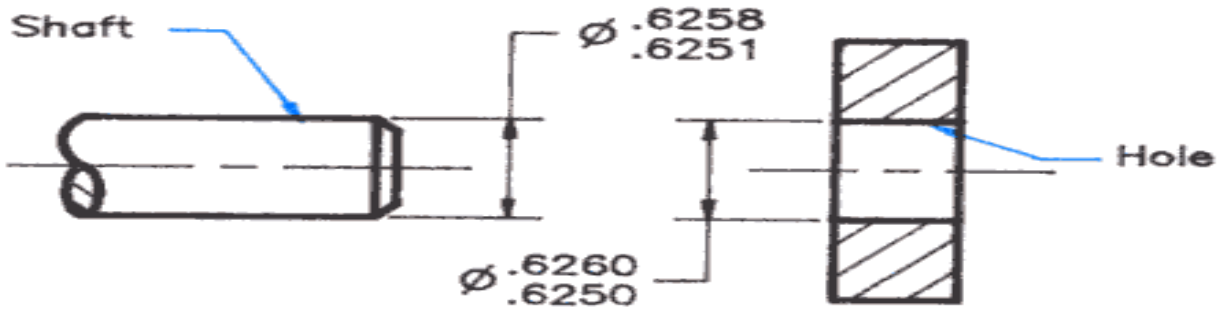
MINIMUM INTERFERENCE

Largest Hole	1.0009
— Smallest Shaft	1.0015
	—.0006

Figure 3-43. A negative allowance value between two features indicates that an interference fit exists.

Transition fit:

- Transition fit has limits of size of hole and shaft such that either a clearance or an interference fit may result when two specific parts from the lot are assembled.
- The shaft maximum diameter and hole minimum have an interference fit, while the shaft minimum diameter and hole maximum diameter have a clearance fit



Smallest Hole	.6250
− Largest Shaft	.6258
Allowance	−.0008

Interference

Largest Hole	.6260
Smallest Shaft	.6251
	.0009

Clearance

Figure 3-44. A transition fit results in a clearance fit at one extreme of the applied tolerance limits, and an interference fit at the other extreme.

Quality Control

- A systematic control of various factors that effect the quality of the product is termed quality control.
- A quality control system performs inspection, testing and analysis to conclude whether the quality of manufactured component is as per laid standards or not.

Zero Quality Control

If every job is done correctly, all the time, then there is no requirement of quality control. This is called ‘zero quality control’ developed by Japanese.

ISO 9000

International organization for standardization based in Geneva, Switzerland(1947) – comprising 130 member countries. Each country is represented by its respective national standards body.(India – Bureau of Indian standards). It facilitates in development of goods for sale in international market.

EXAMPLE 1

Find the type of fit obtained in the following type:

Size of Hole: $29.00^{+0.013}_{+0.0}$ mm

Size of shaft: $29.00^{+0}_{-0.013}$ mm

Maximum size of hole=29+0.013

= 29.013mm

Minimum size of hole = 29+0 = 29mm

Maximum size of shaft = 29 mm

minimum size of shaft = 29-0.013

= 28.987 mm

Max. clearance = Max. size of hole – Min size of shaft

= 29.013-28.987

= 0.026mm

Min. clearance = Min size of hole – Max. size of shaft

= 29 – 29 = 0 mm

Since, both clearances are greater than or equal to zero, the resulting fit is clearance fit.

PROBLEM 2

Determine the type of fit that can be obtained if the sizes of the hole and shaft are:

Size of Hole: $50.00^{-0.026}_{-0.065}$ mm

Size of shaft: $50.00^{-0}_{-0.011}$ mm

Maximum size of shaft = 50mm

minimum size of shaft = 50-0.011

= 49.989 mm

Maximum size of hole=50-0.026

= 49.974 mm

Minimum size of hole = 50 – 0.065 = 49.935mm

Max. clearance = Max. size of hole – Min size of shaft

= 49.974 - 49.989

= -0.015 mm

Min. clearance = Min size of hole – Max. size of shaft

= 49.935 - 50 =-0.065 mm

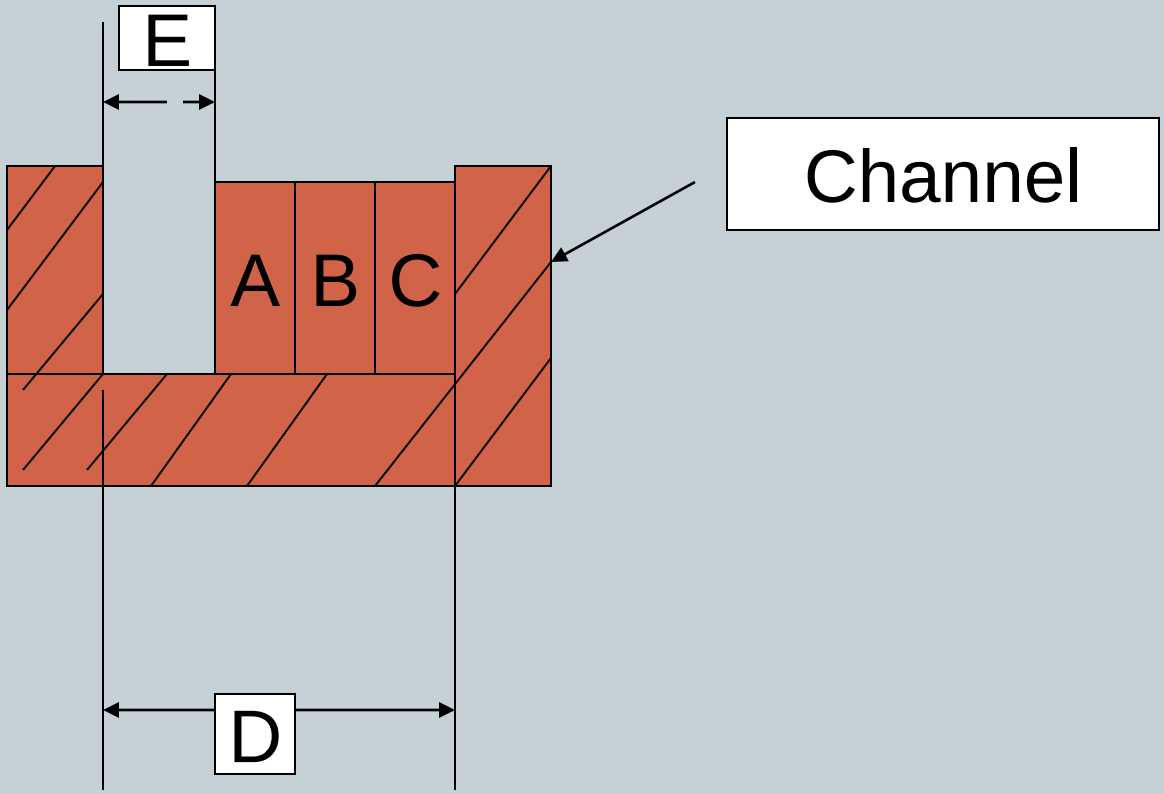
Since, both clearances are negative, it results in interference fit.

PROBLEM 3

Three blocks A,B and C are to be assembled in a channel of dimension D. except for the tolerances to be assigned to D, all the other basic sizes and tolerances are known. Determine the tolerance that must be assigned to D if it is essential that the minimum gap E is not less than 0.005mm. The dimensions of the blocks are as follows:

A = 0.75 $\pm$ 0.003 mm B = 1.00 $\pm$ 0.005 mm

C = 1.125 $\pm$ 0.004 mm and the basic dimension of channel D = 2.894 mm.


E
A
B
C
Channel
D

$$(0.750+0.003)+(1+0.005)+(1.125+0.004)+(0.005) = (2.894 - X)$$

$$X = 0.002 \text{ mm}$$

$$D = 2.894 \pm 0.002 \text{ mm}$$

Problem 4

- The nominal size of a part is 30 mm. the standard tolerance selected for this part is 0.010 mm. Express the size of the part using unilateral and Bilateral tolerances.

- $30.00\ ^{+0.010}_{-0}$ or $30.00\ ^{+0}_{-0.010}$

- 30.00 ± 0.010

Problem 5

- The dimensions of three shafts and holes are given in the table. For each assembly, identify the type of fit and compute the allowance (clearance / interference)

SIZE OF HOLE	SIZE OF SHAFT
a) $25.00\ ^{+0.02}_{-0}$	$25.00\ ^{+0}_{-0.02}$
b) 25.00 ± 0.05	25.00 ± 0.05
c) $25.00\ ^{+0}_{-0.025}$	$25.00\ ^{+0.025}_{-0}$

a) Clearance = +0.06
b) Transition
c) Interference = - 0.06