BISHNUPUR PUBLIC PRIVATE ITI

SUBJECT : Trade Theory

Date: 24th July, 2020 Time : 11.20am to 12.00pm

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1.1 Limits Fits and Tolerance

Two extreme permissible sizes of a part between which the actual size is contained are called limits. The relationship existing between two parts which are to be assembled with respect to the difference on their sizes before assembly is called a fit. Tolerance is defined as the total permissible variation of a size. It is the difference between maximum limit and minimum limit of size.

1.2 Fits

When two parts are to be assembled the relation resulting from the difference between their sizes before assembly is called a fit. The fit signifies the range of tightness or looseness which may result from the application of a specific combination of allowances and tolerances in the design of mating parts.

1.2.1 Types of Fits

The three types of fits are shown in Fig. 1.1 The disposition of tolerance zones for the three classes of fit are shown in Fig. 1.2.

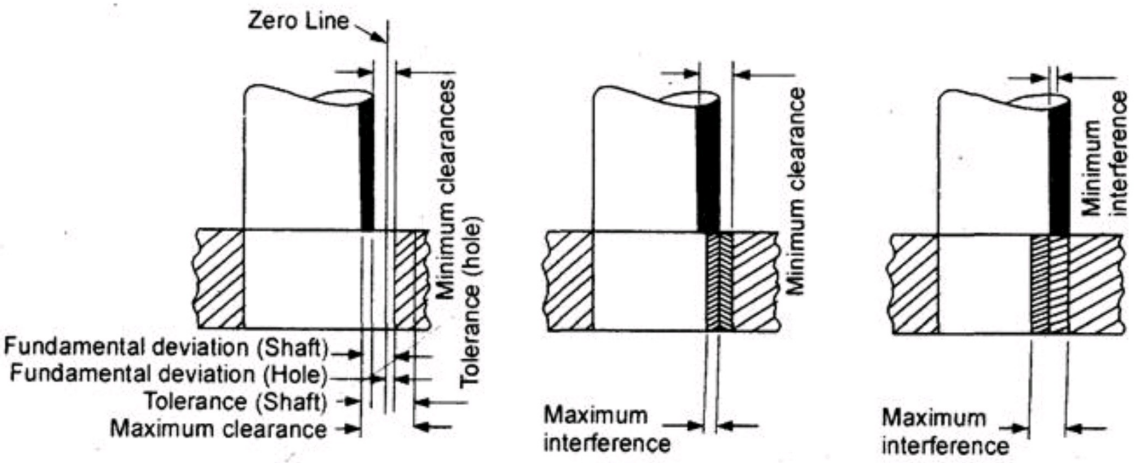


Fig. 1.1 Types of fits

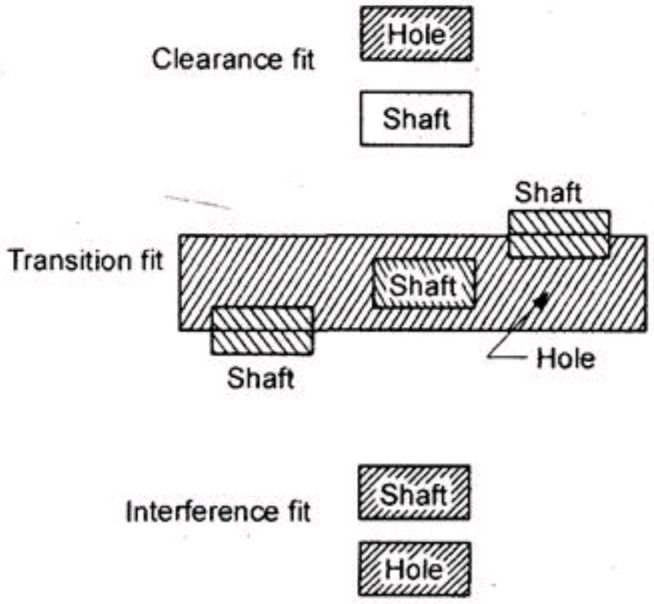


Fig. 1.2 Disposition of tolerance zones for the three classes of fit

There are three general types of fit between the mating parts

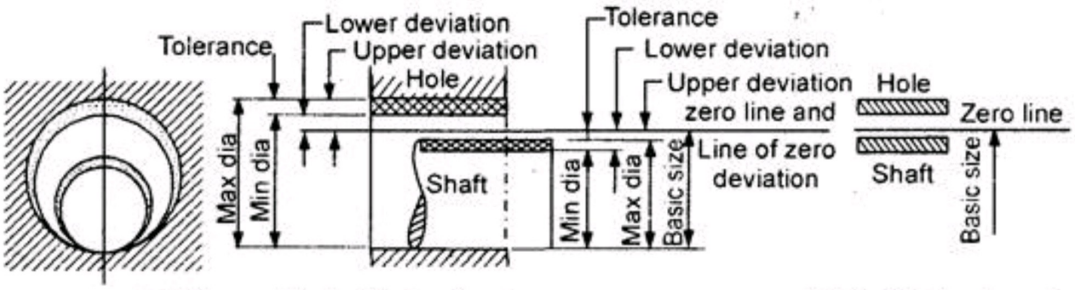
1. Clearance fit: A clearance fit is one having limits of size so prescribed that a clearance always results when mating parts are assembled.

2. Interference fit: An interference fit is one having limits of size so prescribed that an interference always results when mating parts are assembled.

3. Transition fit: A transition fit is one having limits of size so prescribed that either a clearance or interference may always result when mating parts are assembled.

1.3 Terminology

The terminology used in fits and tolerances is shown in Fig. 1.3. The important terms are



(a) Diagram illustrating basic size deviations and tolerances.

(b) Simlified schematic diagram of clearance fit.

1.3 Terminology for fits and tolerances

Basic size: It is the exact theoretical size arrived at by design. It is also called nominal size.

Actual size: The size of a part as may be found by measurement.

Maximum limit of size: The greater of the two limits of size.

Minimum limit of size: The smaller of the two limits of size.

Allowance: It is an intentional difference between maximum material limits of mating parts. It is a minimum clearance or maximum interference between mating parts.

Deviation: The algebraic difference between a size (actual, maximum, etc.) and the corresponding basic size.

Actual deviation: The algebraic difference between the actual size and the corresponding basic size.

Upper deviation: The algebraic difference between the maximum limit of size and the corresponding basic size.

Upper deviation of hole = ES (& art Superior)

Upper deviation of shaft es

Lower deviation: The algebraic difference between the minimum limit of size and the corresponding basic size.

Lower deviation of hole = El (Ecart Inferior)

Lower deviation of shaft = ei

Upper deviation Lower deviation + Tolerance

Zero line: It is the line of zero deviation and represents the basic size.

Tolerance zone: It is the zone bounded by the two limits of size of the parts and defined by its magnitude, i.e. tolerance and by its position in relation to the zero line.

Fundamental deviation: That one of the two deviations which is conveniently chosen to define the position of the tolerance zone in relation to zero line, as shown in fig. 1.4.

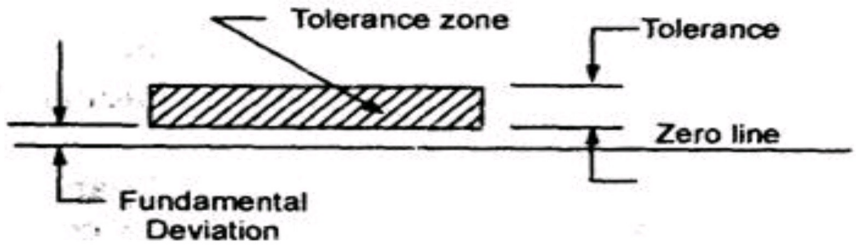


Fig. 1.4 Disposition of fundamental deviation and tolerance zone with respect to the zero line

Basic shaft: A shaft whose upper deviation is zero.

Basic hole: A hole whose, lower deviation of zero.

Clearance: It is the positive difference between the hole size and the shaft size.

Maximum clearance: The positive difference between the maximum size of a hole and the minimum size of a shaft.

Minimum clearance: The positive difference between the minimum size of a hole and the maximum size of a shaft.

1.4 Standard Tolerances

There are 18 standard grades of tolerances as specified by BIS with designations ITOI, ITO and IT to IT 16.

Table 1.1 Standard tolerances.

Grade	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16
Value	7i	10i	16i	25i	40i	64i	100i	106i	200i	400i	640i	1000i

Table 1.2 Tolerance grade in various manufacturing processes.

Tolerance grade	Manufacturing process that can produce
16	Sand casting : flame cutting
15	Stamping
14	Die casting or moulding ; rubber moulding
13	Press work, tube rolling
12	Light press work ; tube drawing
11	Drilling, rough turning, boring, precision tube drawing
10	Milling, slotting, planing, metal rolling, or extrusion.
9	Worn capstan or automatic ; horizontal or vertical boring
8	Centre lathe turning and boring, reaming, capstan or automatic in good condition.
7	High quality turning, broaching, honing
6	Grinding or fine honing
5	Machine lapping, diamond or fine boring, fine grinding.

1.5 Hole Basis and Shaft Basis for Fits

1. Hole basis system: In this system, the different clearances and interferences are obtained in associating various shafts with a single hole, whose lower deviation is zero.

2. Shaft basis system: In this system, the different clearances and interferences are obtained in associating various holes with a single shaft, whose upper deviation is zero.

1.6 Selection of Fits

Hole basis system is the most commonly used system because due to the fixed character of hole production tools, it is difficult to produce holes with odd sizes. Commonly used types of fits are given in Table 1.3. Shafts 'a' to 'h' produce clearance fit, 'j' to 'n' transition fit, and 'p' onwards interference fit with hole.

Table 1.3 commonly used fits

Type of fit	Class of shaft	With holes			Remarks
		H6	H7	H8	
Clearance	d		d8	d8	Loose running fit used for plummer block bearings, loose pullyes, etc.
	e	e7	e8	e8-e9	Easy running fit used for properly lubricated bearings. Finer grades are used for heavily loaded bearings of turbogenerators, electric motors, etc.
	f	f6	f7	f8	Normal running fit used for normal grease or oil lubricated bearings where temperature changes are not too much. This fit may be used for bearings of small electric motors, pumps, or bearings of gear box shaft, etc.
	g	g5	g6	g7	It is close running fit or sliding fit or spigot and location fit.
	h	h5	h6	h7-h8	It is precision sliding fit or fine spigot or location fit.

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