INTERNATIONAL STANDARD ISO 3040

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Technical drawings — Dimensioning and tolerancing cones

Dessins techniques — Cotation et tolérancement des éléments coniques

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FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3040 was drawn up by Technical Committee ISO/TC 10, *Technical drawings*, and circulated to the Member Bodies in February 1973.

It has been approved by the Member Bodies of the following countries :

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The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
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Technical drawings — Dimensioning and tolerancing cones

0 INTRODUCTION

For uniformity all the dimensions given in this International Standard are in metric units only. It should be understood that inch units could equally well have been used without prejudice to the principles established.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies methods of dimensioning and tolerancing cones on drawings.

2 REFERENCES

ISO/R 406, *Inscription of linear and angular tolerances.*

ISO/R 1101, *Technical drawings — Tolerances of form and of position — Part I : Generalities, symbols, indications on drawings.*

3 DEFINITION AND SYMBOLS

3.1 taper : The ratio of the difference in the diameters of two sections of a cone to their distance.

$$\text{Thus taper } C = \frac{D-d}{L} = 2 \tan\frac{\alpha}{2} \qquad \text{(see figure 1)}$$

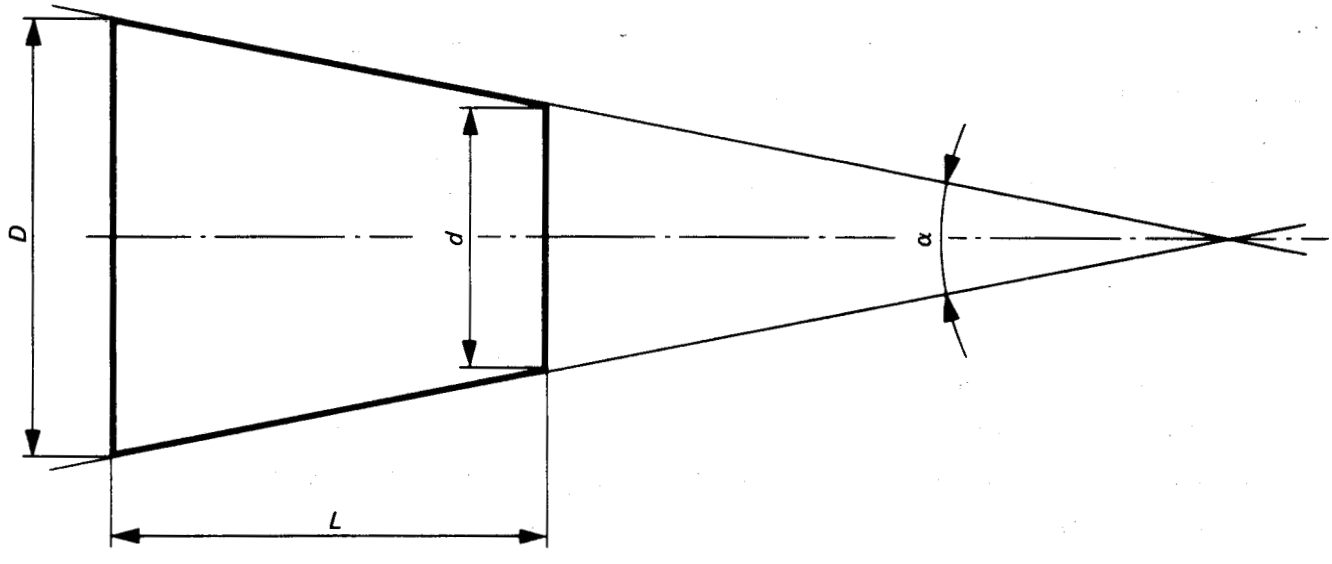

FIGURE 1

3.2 The following symbol indicates a taper and, correctly orientated, may be used to show the direction of the taper (see examples).

NOTE – Taper (as defined above) must not be confused with slope.

Slope, which is not the subject of this International Standard, is the inclination of the line representing the inclined surface of a wedge expressed as the ratio of the differences in the heights at right angles to the base line, at a specified distance apart, to that distance.

$$\text{Thus slope} = \frac{H-h}{L} = \tan\beta \qquad \text{(see figure 2)}$$

If necessary the following symbol for slope may be used to show the direction of the slope :

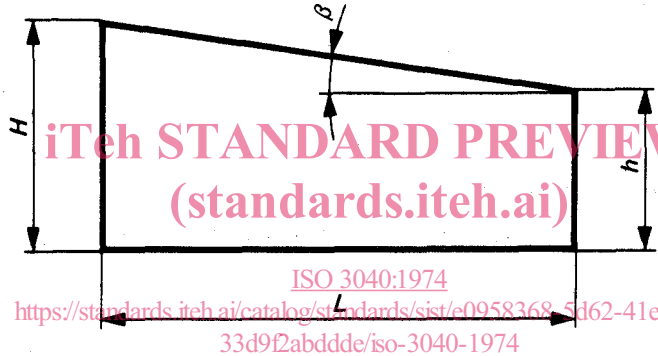

FIGURE 2

4 DIMENSIONING

4.1 The following dimensions may be used, in different combinations, to define the size, form and position of cones :

a) the taper, specified either by the included angle or as a ratio, e.g. :
   - 0,3 rad
   - 35°
   - 1 : 5
   - 0,2 : 1
   - 20 %

b) the diameter at the larger end;

c) the diameter at the smaller end;

d) the diameter at a selected cross-section, this cross-section may be within or outside the cone;

e) the dimension locating a cross-section at which the diameter is specified;

f) the length of the cone.

Figures 3 to 6 show some typical combinations of dimensions.

4.2 No more of these dimensions than are necessary shall be specified. However, additional dimensions may be given as "auxiliary" dimensions in brackets for information, for example half the included angle.

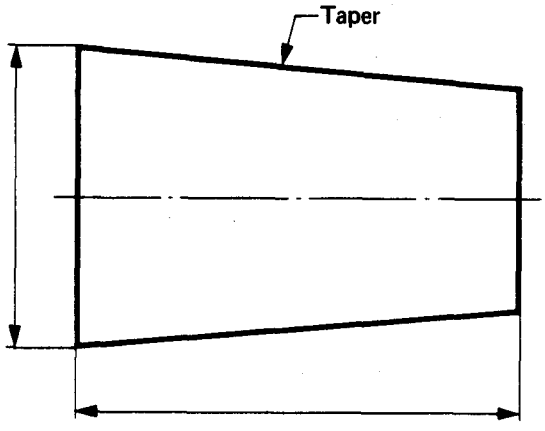

FIGURE 3

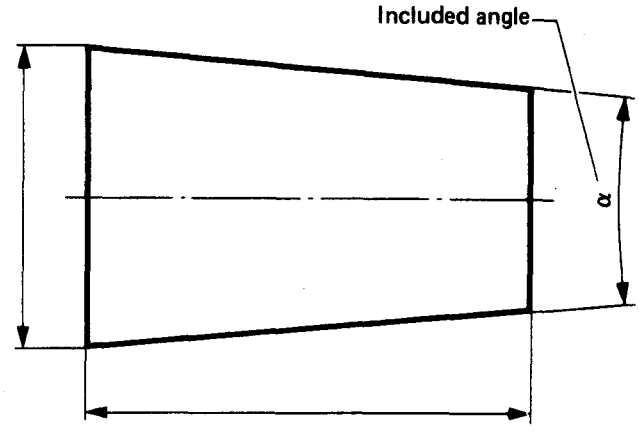

FIGURE 4

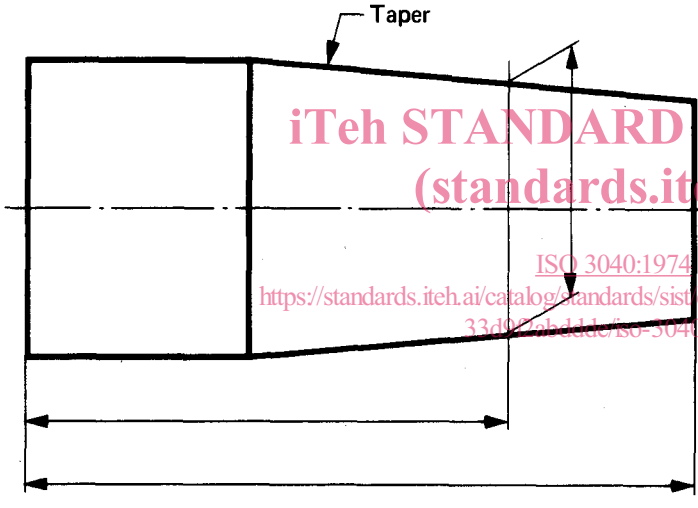

FIGURE 5

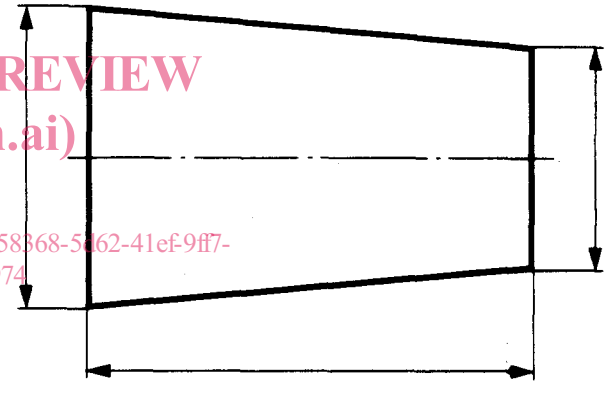

FIGURE 6 (*see* 6.3)

4.3 When a taper of standardized series is concerned (in particular morse or metric taper) the tapered feature may be designated by specifying the standard series and appropriate number.

5 TOLERANCING

5.1 General

5.1.1 There are two methods of specifying the accuracy of cones, as shown in 5.2 and 5.3.

5.1.2 On the right-hand side of the figures the tolerance zones are shown.

5.1.3 It should be noted that errors of form may exist, provided that every part of the surface lies inside the tolerance zone. In practice it may not be permitted to absorb the whole of the tolerance zone by errors of form. When restrictions in this regard are necessary this shall be indicated by appropriate tolerances of form.

5.1.4 The datum dimensions (which may be linear or angular) and the toleranced sizes define the tolerance zone within which the conical surface shall be contained.

5.1.5 A datum dimension (enclosed in a frame) is a dimension which defines the exact location of a point, line, plane or conical surface, the real position of which is controlled by a means other than by direct tolerancing of this dimension.

It may be used to define the exact position of a cross-section of a cone at which the diameter is allowed to vary within specified limits. It may also be used to define the exact diameter of a cross-section of a cone, the position of which is allowed to vary within specified limits.

5.1.6 It should be noted that where the method of dimensioning shown in figures 8 and 9 is used, either the diameter or the position will be a datum dimension (enclosed in a frame).

5.1.7 The choice of the tolerancing method and of the values of the tolerances depends on the functional requirements.

5.2 Method I : Basic taper method

5.2.1 In this method the tolerances limit the variation of penetration of mating surfaces, each surface being required to remain within two limiting profiles of the same taper corresponding to the maximum and minimum material conditions.

5.2.2 The tolerance zone limiting the cone is established by a tolerance either on diameter or on position.

By convention the prescribed or resulting tolerances of the diameter of the feature applies at all cross-sections throughout its length (see figures 7 to 9).

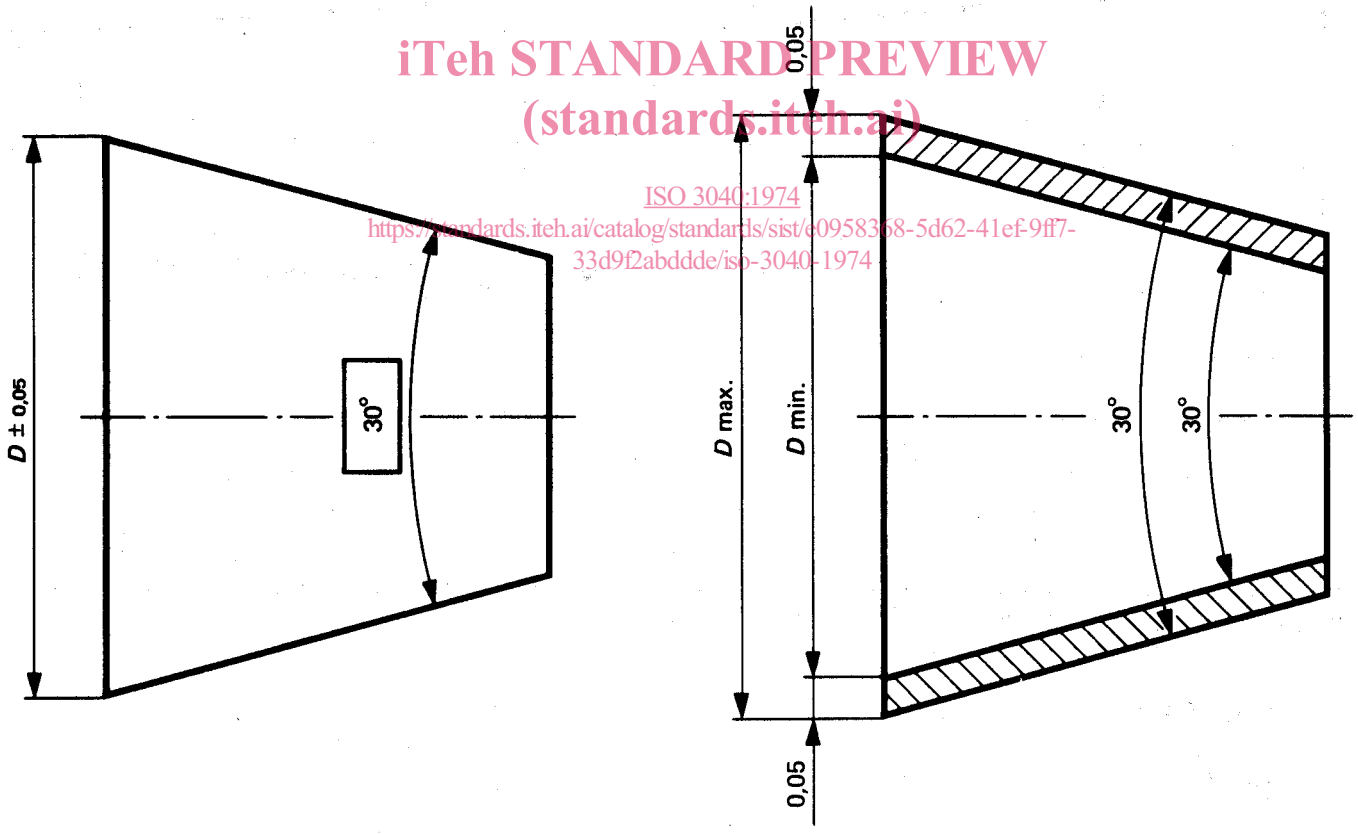

FIGURE 7

5.2.3 The surface of the cone may lie anywhere within the tolerance zone (see also 5.1.3).

5.2.4 Figure 7 illustrates a cone dimensioned by the basic taper method and where the size at one end of the feature is specified by a toleranced dimension.

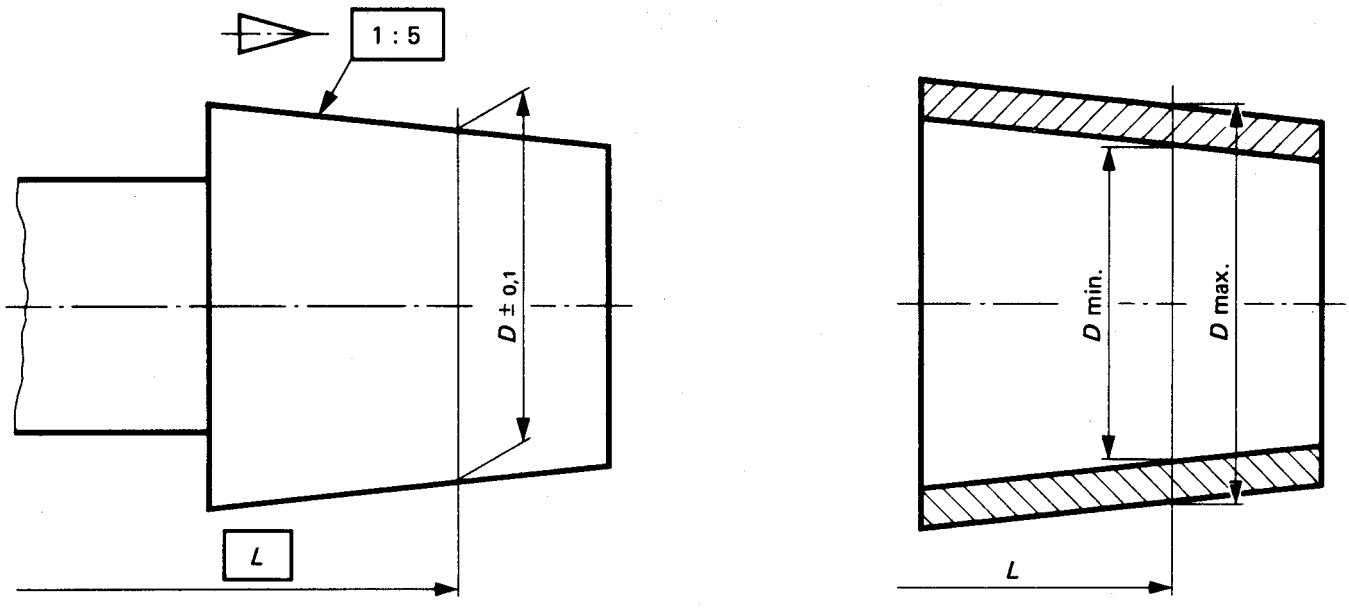

FIGURE 8

5.2.5 Figure 8 illustrates a cone dimensioned by the basic taper method and where the size is controlled by a toleranced dimension at a cross-section located by a datum dimension enclosed in a frame.

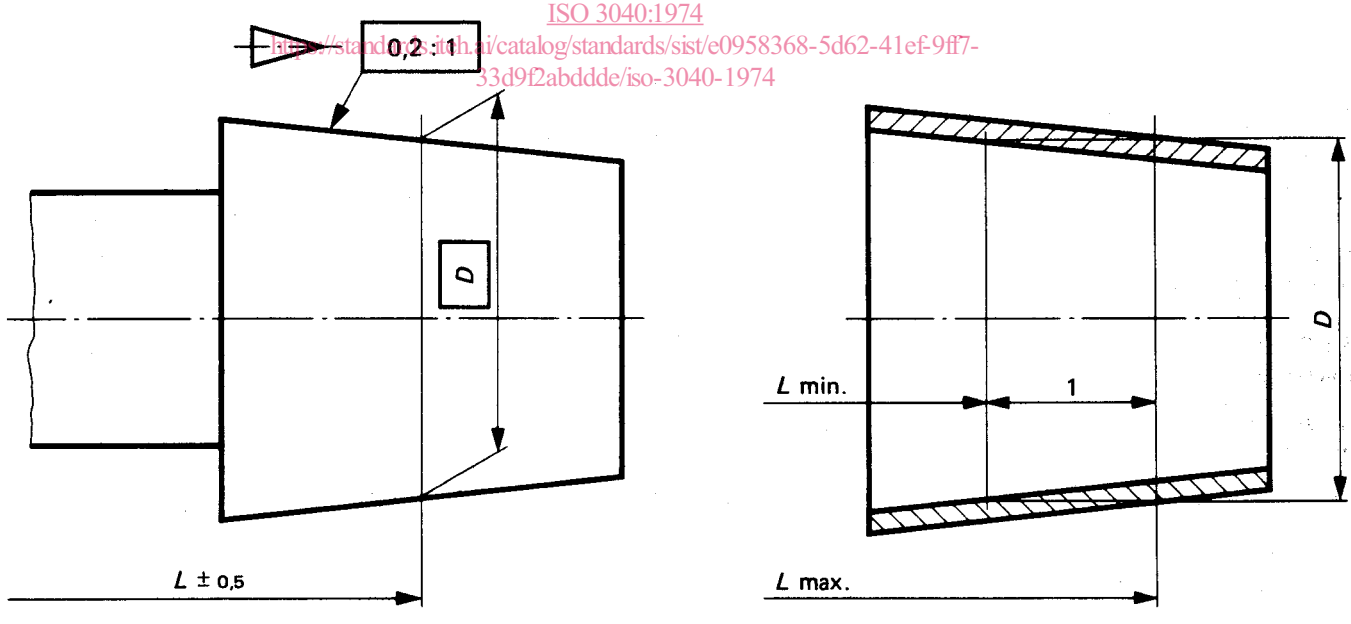

FIGURE 9

5.2.6 Figure 9 illustrates a cone dimensioned by the basic taper method and where the diameter of a cross-section is a datum dimension. This cross-section is located within specified limits in relation to the left side of the feature.

5.2.7 The basic taper method according to figures 7, 8 or 9 may not be suitable for use in cases where the variation in taper, arising from the necessary tolerances on diameter or position would not be acceptable.

This may be overcome by the use of figure 10 or method II.

5.2.8 Where it is necessary to apply restrictive conditions limiting the effective variation of the taper within the tolerance zone, the following methods shall be used :

a) by a reference to a written note specifying the permissible limit of the actual taper;

b) by indicating a restrictive angularity tolerance to the generating lines with respect to the axis (see figure 10) in accordance with ISO/R 1101.

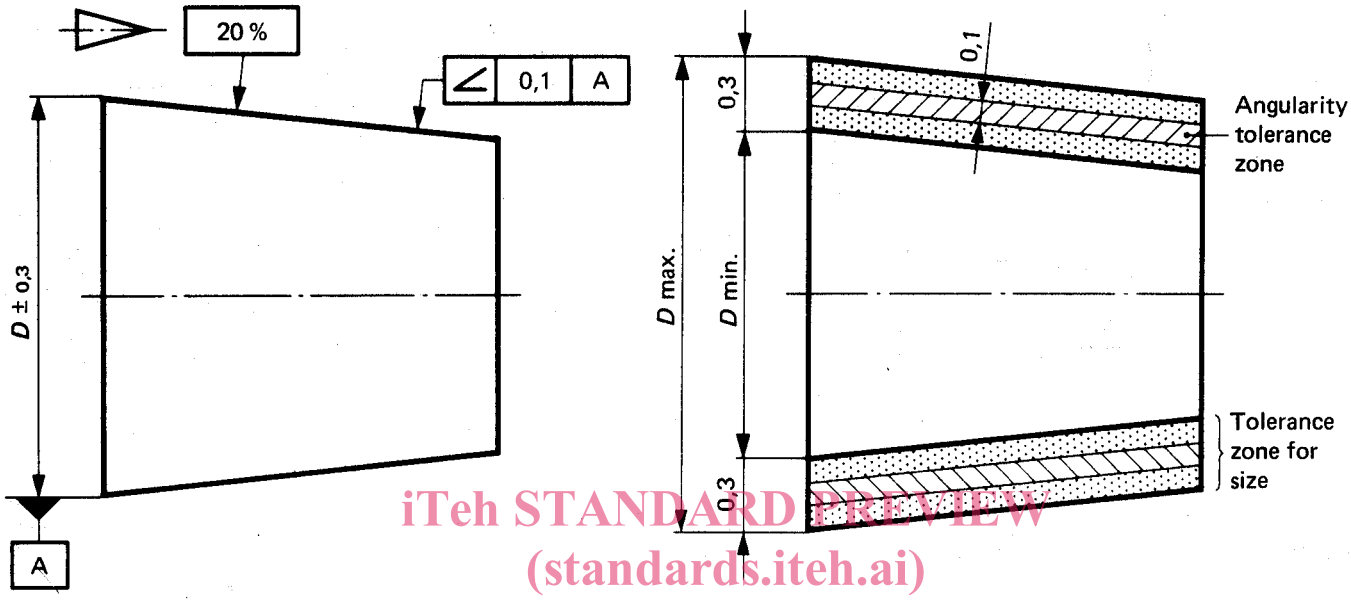

FIGURE 10

NOTE — The tolerance zone for angularity (including straightness) may lie anywhere within the tolerance zone for size.

5.3 Method II — Toleranced taper method

5.3.1 In this method the numerical value of the tolerance of size applies only at the cross-section at which the dimension is shown on the drawing and NOT at every cross-section as in the case in the basic taper method.

5.3.2 The accuracy of the taper for a cone is specified directly by a tolerance on that taper and is independent of the tolerance on the size.

In the case of an angle the tolerance is expressed as given in ISO/R 406. In the case of a ratio the tolerance applies to the numerator.

The tolerance on the taper may be specified as unilateral or bilateral as required, e.g. :

- (3,5 ± 0,5) : 12
- (1 ± 0,1) : 50
- (5 ± 0,1) %
- 25° ± 30′

If not otherwise stated, the units of the tolerance are the same as those of the nominal dimension.

5.3.3 The surface of the cone may lie anywhere between the extreme position resulting from the accumulated tolerances of the linear dimensions on the one hand and on the taper tolerance on the other hand, provided that the tolerance on the taper is respected.

For graphical representation of the taper tolerance zone in figures 11, 12 and 13 it is assumed that the generating lines are straight lines.

For the interpretation of straightness see ISO/R 1101, section 2, note 1. The direction of the generating lines of the cone is defined by the direction of two straight lines a minimum distance apart and enveloping the actual generating lines. These two straight lines must therefore be inclined within the limits given by the taper tolerance. Further, the generating lines must not exceed the limits of size at points where the dimensions are specified.

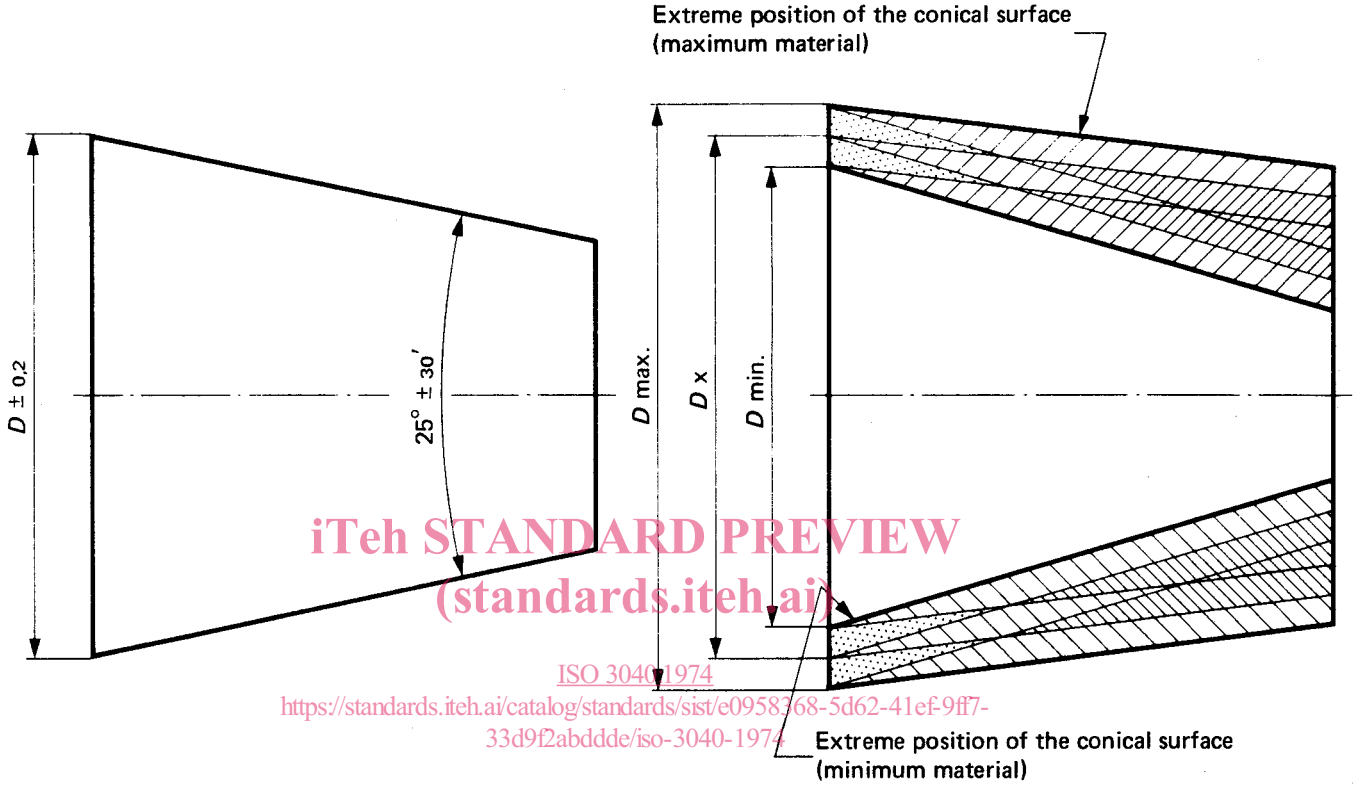

FIGURE 11

5.3.4 Figure 11 illustrates a cone dimensioned by the toleranced taper method and where the size of the larger end is toleranced.