

Definitions and Designations of Geometrical Deviations

KES A-C004

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Remark

1. Scope of Application

This standard specifies the definitions and designations of the form deviations, orientational deviations, locational deviations, and run-outs, of the considered objects, hereinafter generically referred to as the “geometrical deviations”.

- Remarks
1. The methods of designation and diagrammatical indication of geometrical tolerances which are the permissible values of geometrical deviations shall be based on KES A-D006 (Indications of Geometrical Tolerances on Drawings).
 2. The types of geometrical deviations shall be as shown in Table 1 :

Table 1. Types of Geometrical Deviations

	Types	Applicable features
Form deviations	Straightness Flatness Circularity Cylindricity	Single features
	Profile of any line Profile of any surface	Single features or related features
Orientalional deviations	Parallelism Perpendicularity Angularity	Related features
Locational deviations	Positional deviation Coaxiality and concentricity Symmetricity	
Run-outs	Circular run-out Total run-out	

2. Definition of Terminology

The definitions of the main terms used in this standard shall be as follows :

(1) Feature

A point[Fig. 1(a)], line[Fig. 1(b)], axis[Fig. 1(c)], surface[Fig. 1(d)], or median surface [Fig. 1(e)] as the object of geometrical deviations.

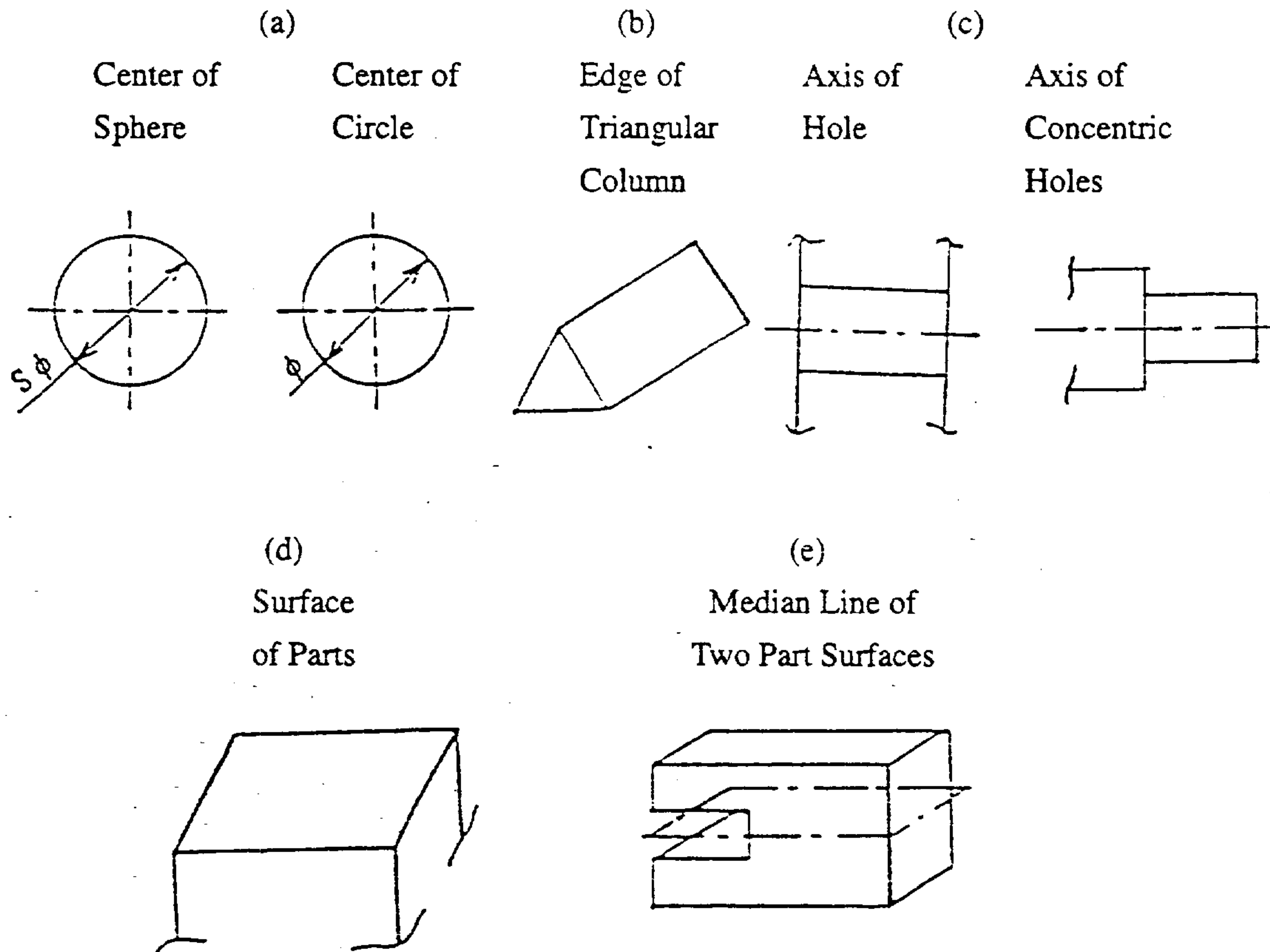


Fig. 1

(2) Single feature

A feature for which geometrical deviations are determined without relation to datum[Fig. 2(a), (b), (c)]s.

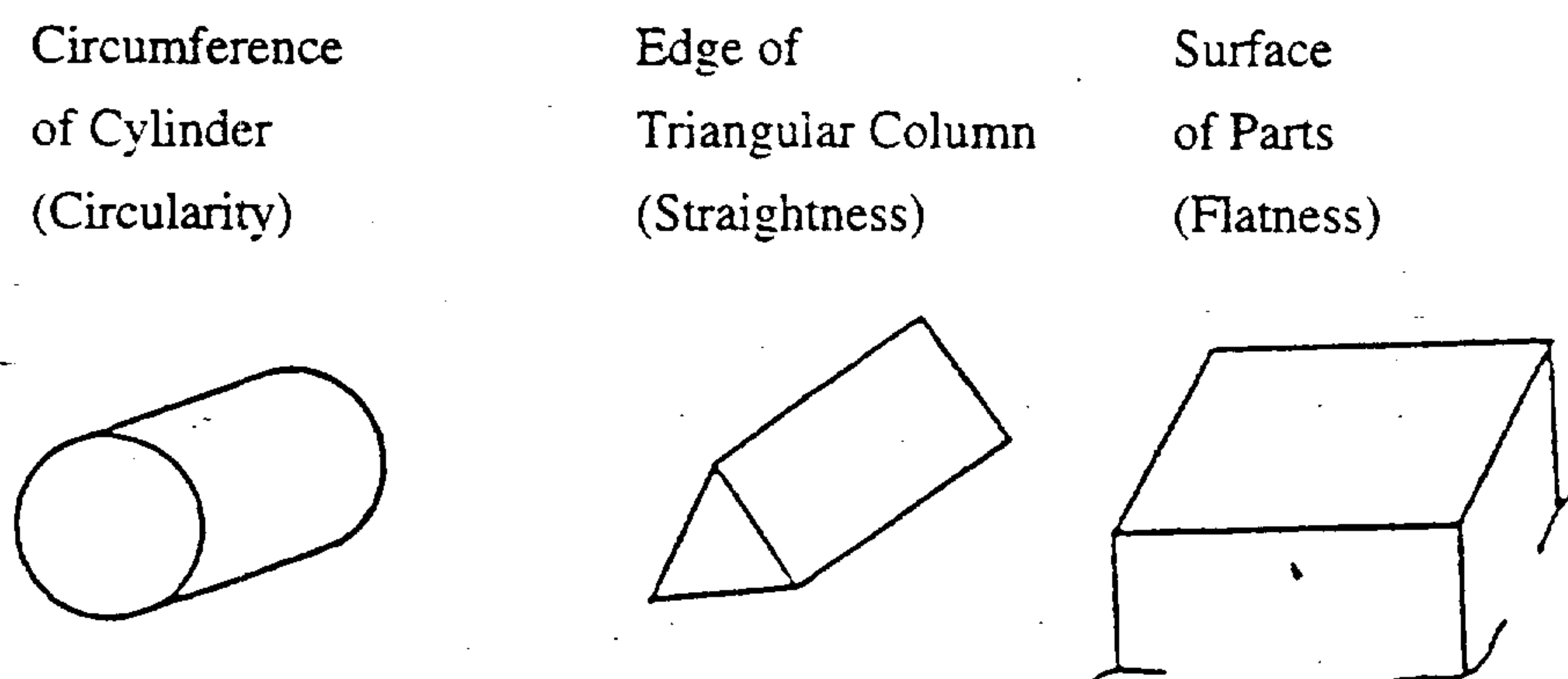


Fig. 2

(3) Related feature

A feature for which geometrical deviations are determined in relation to datums

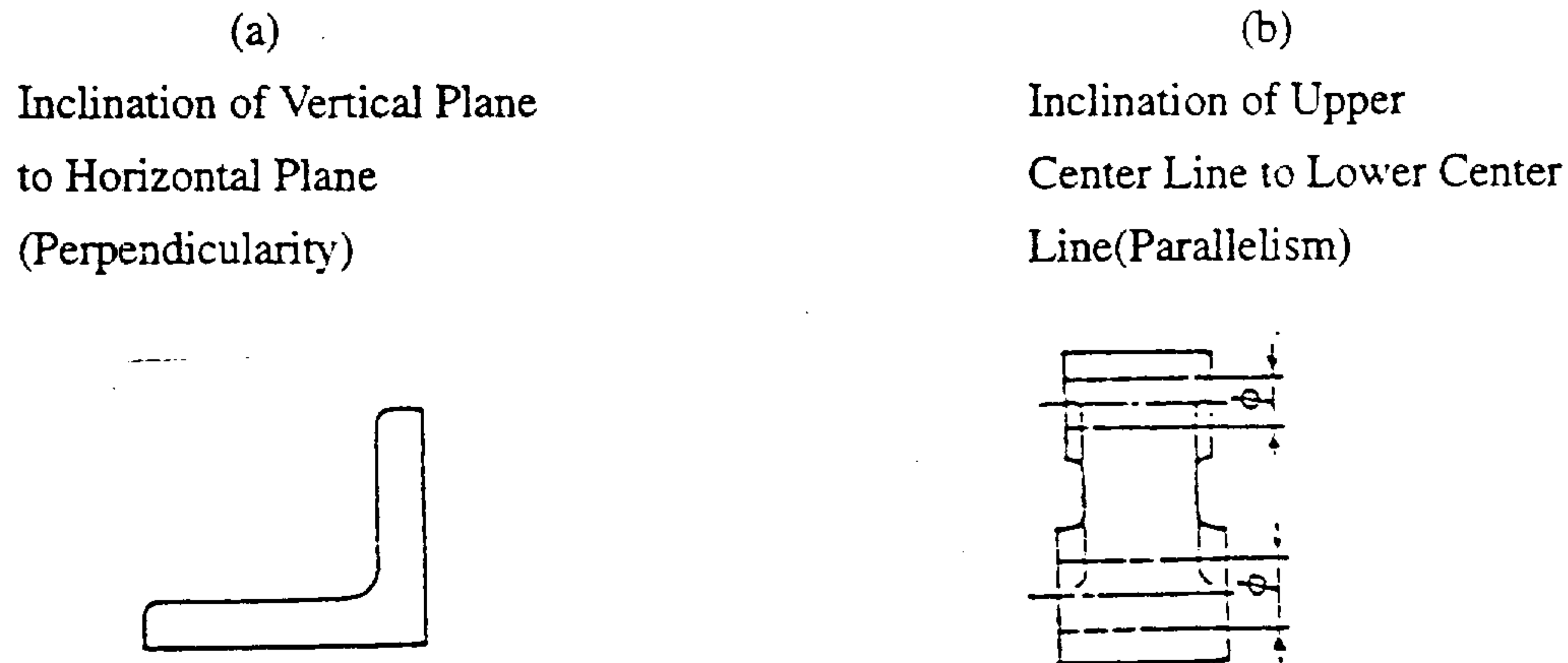


Fig. 3

(4) Datum

A theoretically exact geometrical reference established for determining the orientational deviation, locational deviation, runouts, and the like of a feature (Fig. 4)

For example, where the geometrical reference is a point, straight line, axial straight line ⁽¹⁾, plane, or median plane, it is referred to as a datum point, datum straight line, datum axial straight line, datum plane, or datum median plane, respectively.

Note ⁽¹⁾ The axial straight line means an axis without any form deviation, that is, an axis which is a geometrically exact straight line.

Remark: Details about datums shall be as specified in KES A-B018.

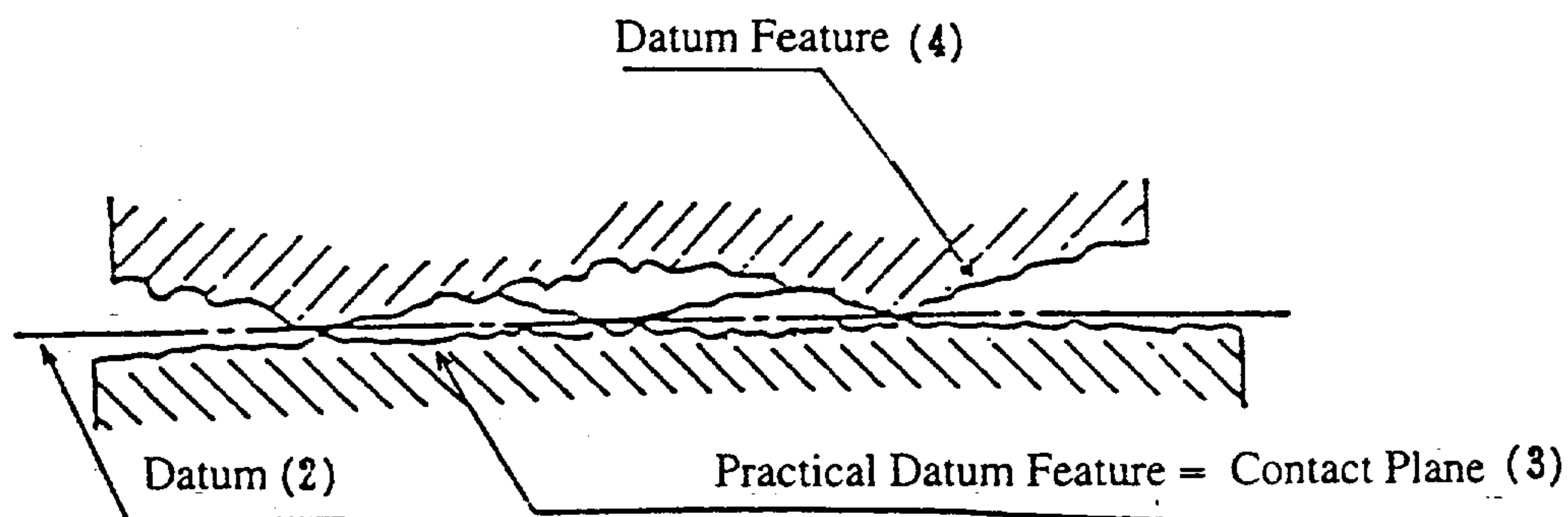


Fig. 4

Note ⁽²⁾ An absolutely correct feature that is invisible.

⁽³⁾ An actual plane that has a sufficiently correct feature used by contacting with the datum feature to establish a standard (Example : surface plate, bearing, mandrel).

⁽⁴⁾ An actual feature of an object used to establish a standard (Example : The surface or a hole of parts).

(5) Straight line feature

A feature which is specified to be a straight line from the functional point of view. For example, a cross-sectional profile line which appears on the cross-section when a plane feature is cut with a plane normal to it, an axis, a generator of cylinder, a knife edge, or the like.

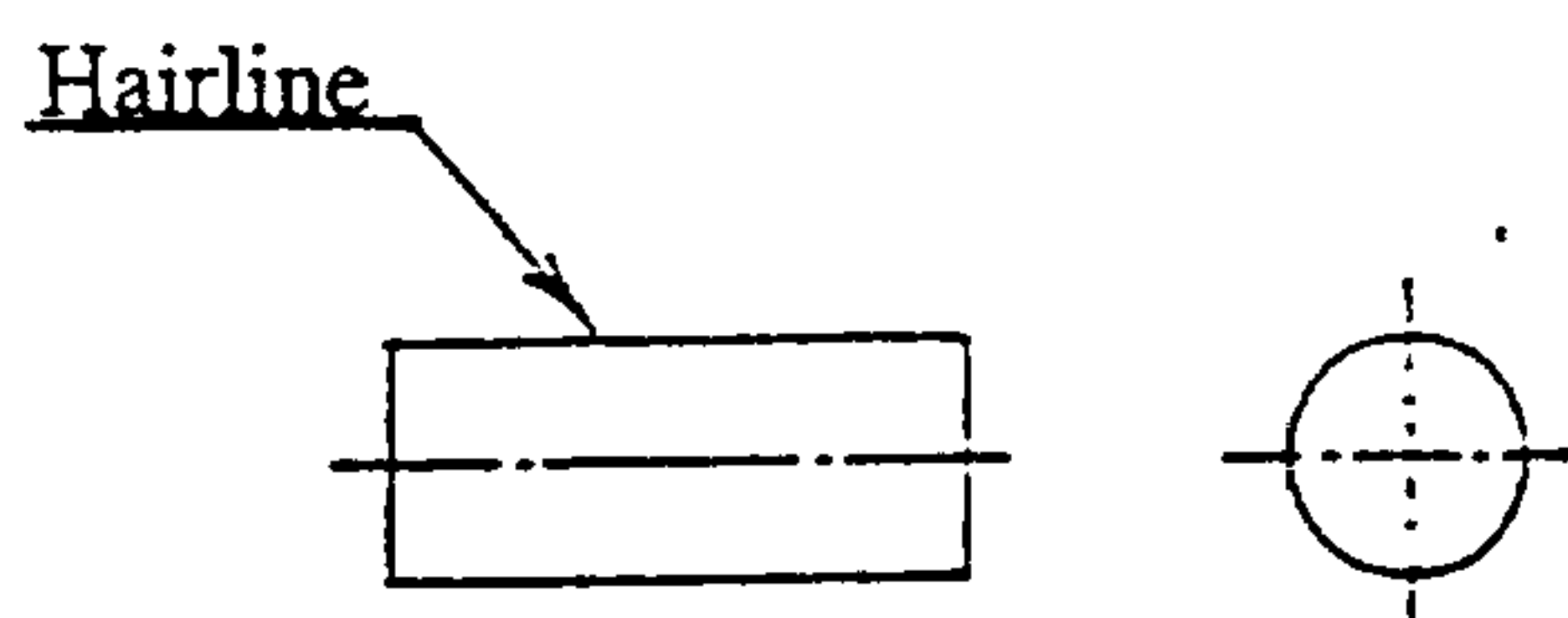


Fig. 5

(6) Axis

Among straight line features, the line connecting the centers of cross-sectional profile lines ⁽⁵⁾ on the respective cross-sections of a considered object specified to be a cylinder or rectangular parallelepiped.

Note ⁽⁵⁾ The center of a cross-sectional profile line means, in a considered object specified to be a cylinder, the center of the smallest circumscribed geometrically exact circle (in the case of a shaft) or that of the largest inscribed geometrically exact circle (in the case of a hole) of that cross-sectional profile line [Fig. 1(c)].

On the other hand, in a considered object specified as a rectangular parallelepiped, it means the center of the smallest circumscribed geometrically exact rectangle (in the case of a shaft) or that of the largest inscribed geometrically exact rectangle (in the case of a hole) of that cross-sectional profile line.

(7) Plane feature

A feature specified to be a plane from the functional point of view [Fig. 1(d)].

(8) Median surface

Among plane features, the surface containing the median point of the straight line connecting two corresponding points on two surfaces which are specified to be symmetric with respect to the plane [Plane 1(e)].

(9) Circular feature

A feature specified to be a circle from the functional point of view. For example, a circle as a plane figure or a circular cross-section of a revolutional surface (Fig. 6).

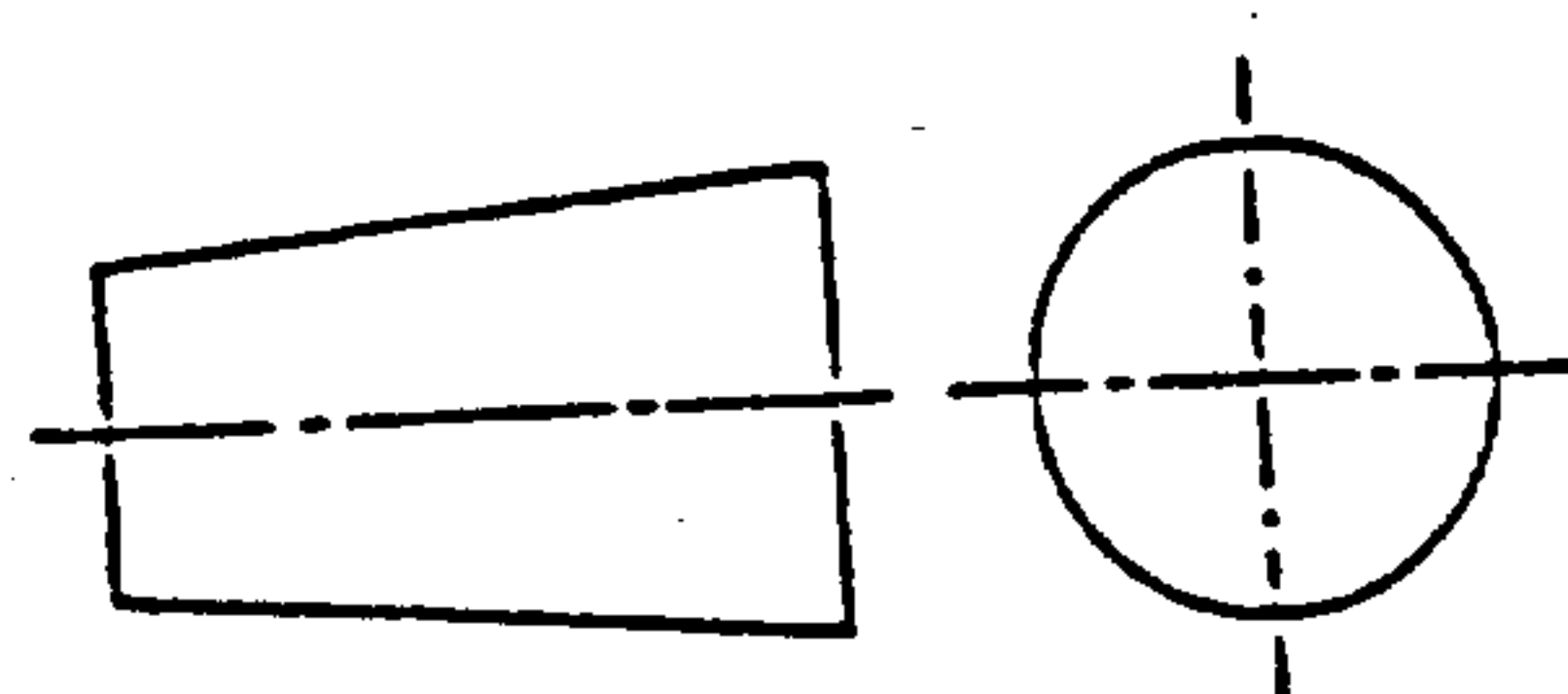


Fig. 6

(10) Cylindrical feature

A feature specified to be a cylindrical surface from the functional point of view(Fig. 7).

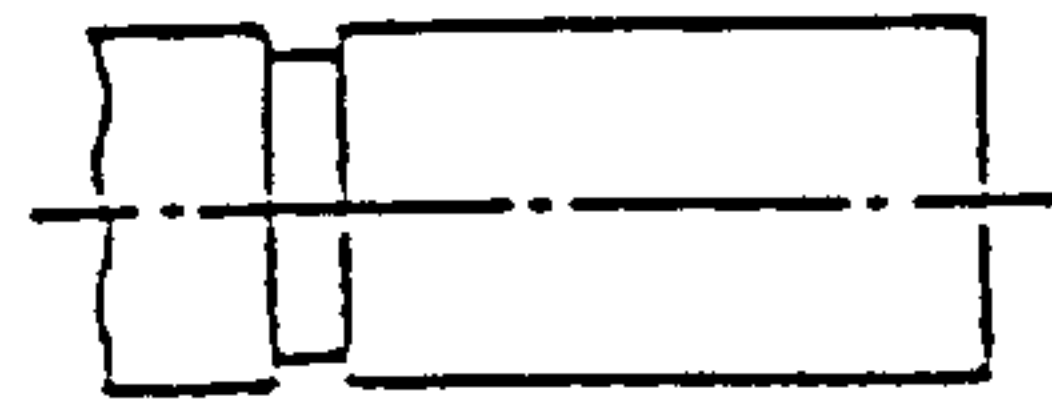


Fig. 7

(11) Profile of line

The outline as an element of a surface specified to have a given form from the functional point of view(Fig. 8).



Fig. 8

(12) Profile of surface

A surface specified to have a given form from the functional point of view(Fig. 9).

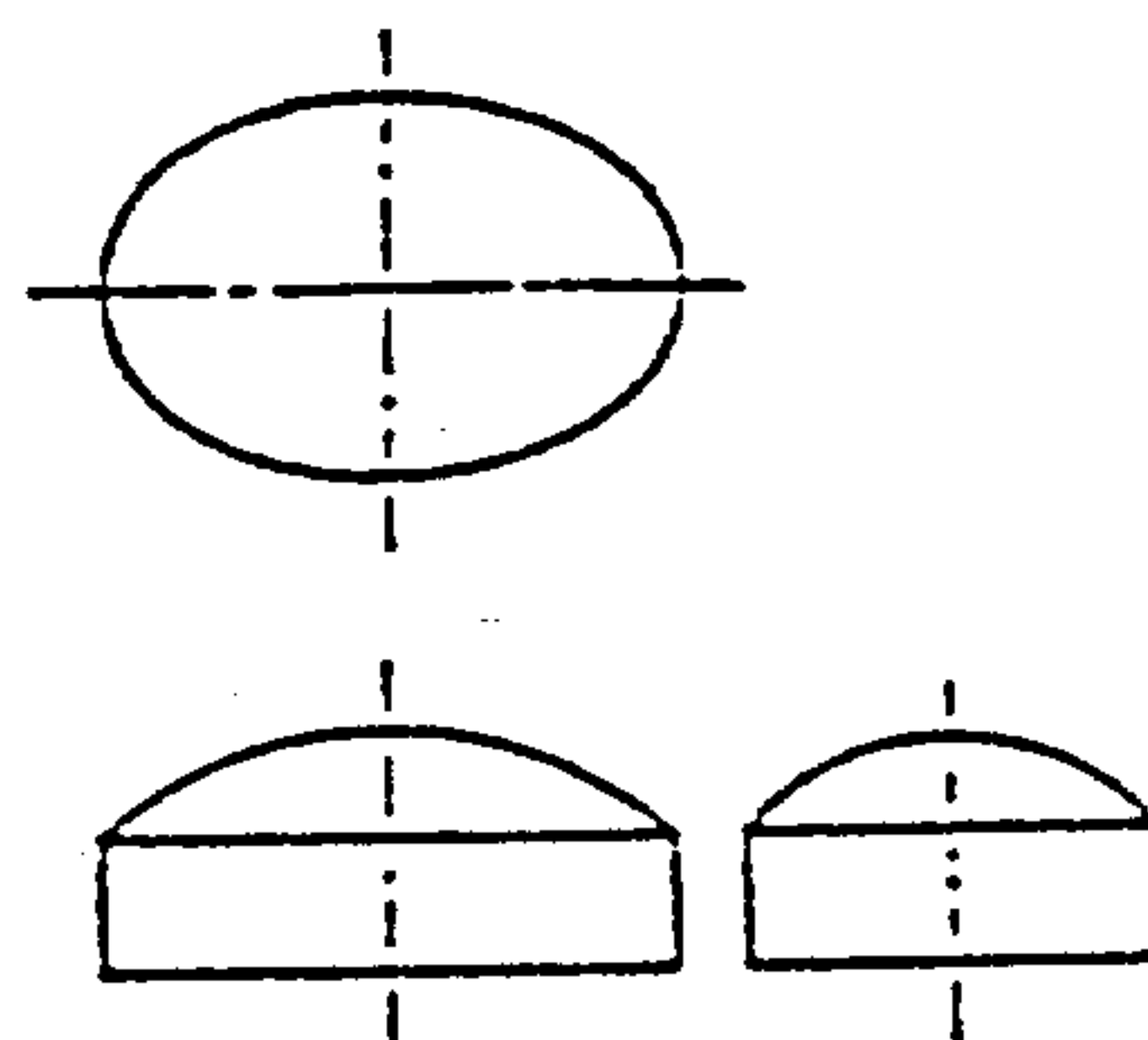


Fig. 9

3. Table for the Area Designating Geometrical Deviations and Variations

The table for the area designating geometrical deviations and variations are as in the Table 2.

Table 2. Table for the Area
Designating Geometrical Deviations and Variations

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Area designating deviations			inside of circle or sphere	middle of concentric circle	middle of 2 lines with same length or parallel lines	inside of cylinder	middle of cylinder with the same axis	middle of 2 sides with same distance or parallel planes	inside of square column
Value of deviations			diameter of circle or sphere	distance in radii of 2 circles	distance between 2 lines or 2 straight lines	diameter of cylinder	difference of radii in 2 cylinders	distance between 2 planes or 2 parallel planes	distance of 2 planes of square column
Geometrical deviations									
4.1	Straightness	(1) 1 direction						○ *	
		(2) two directions normal to each other							
		(3) unspecified direction				○ *			○ *
		(4) surface element			○ *				
4.2	flatness							○ *	
4.3	cylindricity			○ *					
4.4	circularity						○ *		
4.5	profile of line				○				
4.6	profile of surface							○	
4.7	parallelism	(1) straight line feature and datum straight line	(a) 1 direction					○	
			(b) 2 directions normal to each other						○
			(c) unspecified direction			○ *			
		(2) straight line feature or plane feature and datum plane						○	
		(3) plane feature and datum straight line						○ *	
4.8	perpendicularity	(1) straight line feature or plane feature and datum straight line						○	
		(2) straight line feature and datum plane	(a) 1 direction					○	
			(b) 2 directions normal to each other						○
			(c) unspecified direction			○ *			
		(3) plane feature and datum plane						○ *	
4.9	angularity	(1) straight line feature and datum straight line	(a) on the same plane					○	
			(b) not on the same plane					○	
		(2) straight line feature and datum plane						○	
		(3) plane feature and datum straight line or datum plane						○	
4.10	orientational deviations	(1) point		○					
		(2) straight line feature	(a) 1 direction					○	
			basis : on 1 plane		○				
			(b) 2 directions normal to each other						○
			(c) unspecified direction			○			
		(3) plane feature						○	
4.11	coaxiality	coaxiality				○ *			
		basis : concentricity		○					
4.12	symmetry	(1) axial line	(a) datum median plane					○	
			(b) datum axis direction straight line						○
			(2 directions normal to each other)						
		(2) median surface	(a) datum axis direction straight line (1 direction)					○	
			(b) datum median plane					○	

Remarks 1. Circular run-out of 4.13 and total run-out of 4.14 are omitted.
2. *mark indicates satisfaction of minimum requirement.

4. Definition and Indication of Deviations

4.1 Straightness

Straightness shall mean the size of deviation of a straight line feature from the geometrically exact straight line, hereinafter referred to as the “geometrical straight line”. Straightness shall be represented as “straightness ____mm” by the following methods according to the size of the region occupied by a straight line feature.

(1) Straightness in one direction

Straightness in one direction shall be represented by the distance (f) between the two planes in the case where the distance between the two parallel planes becomes minimum when the considered straight line (L) is held between the two geometrically exact parallel planes, hereinafter referred to as the “two geometrical parallel planes”, normal to that direction (Fig. 10).

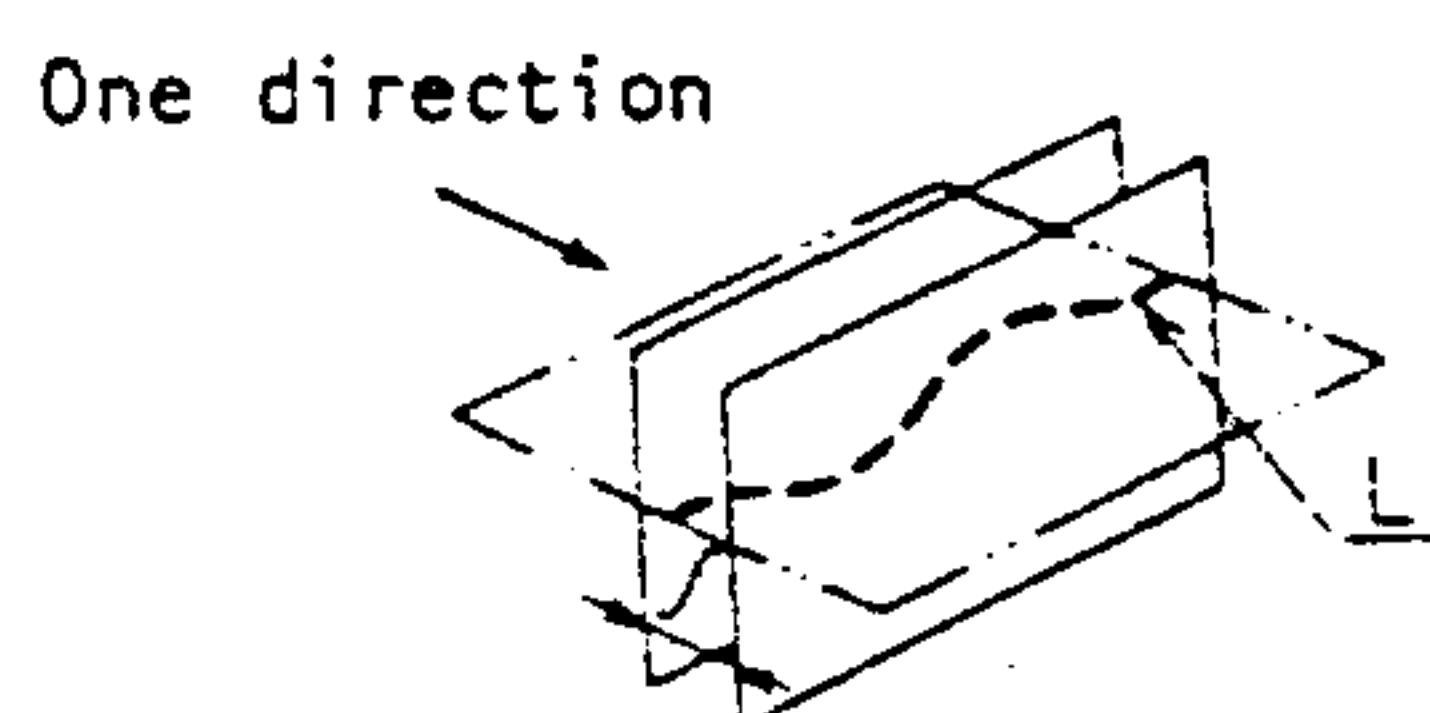


Fig. 10

Remark: Where the said direction is, for example, a horizontal direction or a vertical direction, the straightness shall be referred to as “straightness in horizontal direction” or “straightness in vertical direction”, respectively.

(2) Straightness in two directions normal to each other

Straightness in two directions normal to each other [for example, the horizontal and vertical directions referred to in the Remark 4.1 (1)] shall be represented by the distances (f_1, f_2) between two planes (that is, the lengths of two sides of the rectangular parallelepiped defined by two sets of two parallel planes) in the case where the two distances between two parallel planes respectively become minimum when the considered straight line feature (L) is held between two sets of two geometrical parallel planes respectively normal to those two directions (Fig.11).

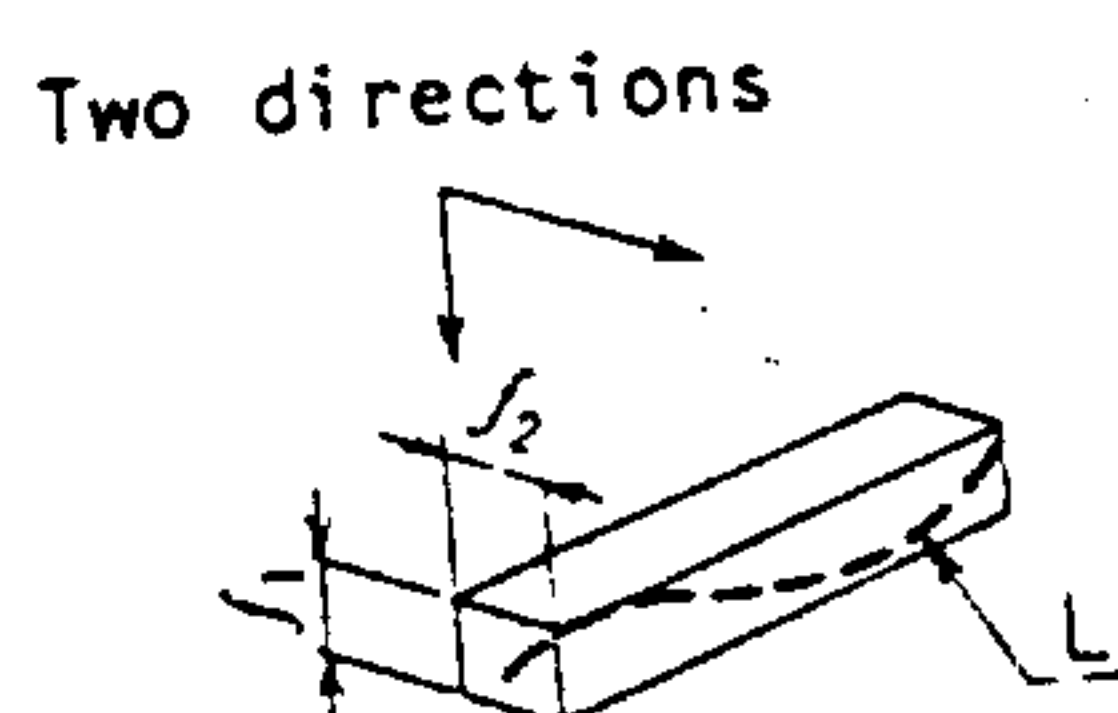


Fig. 11

(3) Straightness without specified directions

Straightness in the case where no directions are specified (for example, the straightness of the axis of a cylinder) shall be represented by the smallest diameter (f) of the cylinder among the geometrical cylinders containing the whole of the considered straight line feature (L) (Fig. 12).