

CONFIRMED
SEPTEMBER 1984

Specification for

Dimensional and quantity tolerances for steel drop and press forgings and for upset forgings made on horizontal forging machines

UDC 699.14 – 4 – 134:621.753.1 – 181

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

Co-operating organizations

The Iron and Steel Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Alloy Steels Association	Institution of Production Engineers*
Board of Trade	Institution of Structural Engineers
British Cast Iron Research Association	Iron and Steel Board
British Construction Steelwork Association	Iron and Steel Institute
British Electrical and Allied Manufacturers' Association	Joint Iron Council
British Iron and Steel Federation*	Lloyds' Register of Shipping
British Ironfounders' Association	Ministry of Defence, Army Department
British Mechanical Engineering Federation*	Ministry of Defence, Navy Department
British Railways Board	Ministry of Labour (H.M. Factory Inspectorate)
British Steel Castings Research Association	National Association of Drop Forgers and Stampers*
Council of Iron Producers	National Physical Laboratory (Ministry of Technology)
Council of Ironfoundry Associations	Oil Companies Materials Association
Crown Agents for Oversea Governments and Administrations	Royal Institute of British Architects
Engineering Equipment Users' Association	Shipbuilding Employers' Federation
Federation of Civil Engineering Contractors	Society of British Aerospace Companies Ltd.*
Institute of British Foundrymen	Society of Motor Manufacturers and Traders Ltd.*
Institute of Iron and Steel Wire Manufacturers	Stainless Steel Development Association
Institute of Marine Engineers	
Institution of Civil Engineers	
Institution of Mechanical Engineers (Automobile Division)	

The industrial organizations marked with an asterisk in the above list, together with the following were directly represented on the committee entrusted with the preparation of this British Standard:

British Internal Combustion Engine Manufacturers' Association	British Valve Manufacturers' Association
	Machine Tool Trades Association

This British Standard, having been approved by the Iron and Steel Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 30 January 1967

© BSI 01-2000

The following BSI references relate to the work on this standard:
Committee reference ISE/53
Draft for comment 66/14175

ISBN 0 580 04286 3

Amendments issued since publication

Amd. No.	Date of issue	Comments
6182	June 1967	
6342	January 1968	Indicated by a sideline in the margin

Contents

	Page
Co-operating organizations	Inside front cover
Foreword	v
Section 1. Dimensional tolerances for steel drop and press forgings	1
Scope	1
1 General remarks — drop and press forgings	1
1.1 Scope of Section 1	1
1.2 Tolerance grades	1
1.3 Special tolerances	1
2 Information required in determining tolerances — drop and press forgings	1
3 Categories of tolerances — drop and press forgings	3
3.1 Scope of categories	3
3.2 Definition of categories	3
3.2.1 First group of tolerances	3
3.2.1.1 Length, width and height tolerances	3
3.2.1.2 Mismatch tolerances	4
3.2.1.3 Residual flash (and trimmed flat) tolerances	5
3.2.1.4 Pierced hole tolerances	5
3.2.2 Second group of tolerances	5
3.2.2.1 Thickness tolerances	5
3.2.2.2 Ejector mark tolerances	5
3.2.3 Third group of tolerances	6
3.2.3.1 Straightness and flatness tolerances	6
3.2.3.2 Tolerances for centre-to-centre dimensions	6
3.2.4 Other categories of tolerances	7
3.2.4.1 Fillet and edge radii tolerances	7
3.2.4.2 Burr tolerances	7
3.2.4.3 Surface tolerances	7
3.2.4.4 Tolerances on draft angle surfaces	7
3.2.4.5 Eccentricity tolerances for deep holes	7
3.2.4.6 Tolerances for unforged stock	8
3.2.4.7 Tolerances for deformation of sheared ends	8
4 Use of tables — drop and press forgings	9
4.1 Table 1 and Table 2 or Table 7 and Table 8. Tolerances for length, width and height, residual flash (and trimmed flat), and mismatch	9
4.2 Table 3 and Table 4 or Table 9 and Table 10. Tolerances for thickness and ejector marks	9
4.3 Table 5 and Table 11. Tolerances for straightness and flatness; tolerances for centre-to-centre dimensions	9
4.4 Table 6 and Table 12. Tolerances for fillet and edge radii; tolerances for burrs	9
5 Design procedure — drop and press forgings	9
5.1 Information required by the forger	9
5.2 Preparation of forging drawings	10
5.3 Indication of dimensions on forging drawings	10
5.4 Indication of tolerances on forging drawings	10
5.5 Importance of forging drawing	10

	Page
Section 2. Dimensional tolerances for steel upset forgings made on horizontal forging machines	12
6 General remarks — upset forgings	12
6.1 Scope of Section 2	12
6.2 Special tolerances	12
7 Definitions and principles of application — upset forgings	12
7.1 Definition of an upset portion of a forging	12
7.2 Application of tolerances to double-ended upset forgings	12
7.3 Definition of unforged stock	12
8 Information required in determining tolerances — upset forgings	12
9 Categories of tolerances — upset forgings	13
9.1 Scope of categories	13
9.2 Definition of categories	14
9.2.1 First group of tolerances	14
9.2.1.1 Diameter tolerances	14
9.2.1.2 Tolerances on step dimensions	14
9.2.1.3 Length tolerances	14
9.2.1.4 Tolerances for mismatch and eccentricity	15
9.2.1.5 Tolerances for local deviations from original bar stock diameter	15
9.2.1.6 Residual flash and trimmed flat tolerances	16
9.2.1.7 Tolerances on internal dimensions including diameters of holes	16
9.2.2 Second group of tolerances	16
9.2.2.1 Thickness tolerances	16
9.2.3 Third group of tolerances	16
9.2.3.1 Straightness and flatness tolerances	16
9.2.3.2 Tolerances for centre-to-centre dimensions	17
9.2.4 Other categories of tolerances	17
9.2.4.1 Fillet and edge radii tolerances	17
9.2.4.2 Tolerances for parting line fins and trimming burrs	17
9.2.4.3 Eccentricity tolerances for deep holes	18
9.2.4.4 Tolerances for deformation of sheared ends	18
9.2.4.5 Surface tolerances	18
9.2.4.6 Tolerances on draft angle surfaces	18
10 Use of tables — upset forgings	18
10.1 Table 1 and Table 7. Tolerances for diameter, length, residual flash (and trimmed flat), mismatch and eccentricity	18
10.2 Table 3 and Table 9. Tolerances for thickness	19
10.3 Table 5 and Table 11. Tolerances for straightness and flatness; tolerances for centre-to-centre dimensions	19
10.4 Table 6 and Table 12. Tolerances for fillet and edge radii; tolerances for parting line fins and trimming burrs	19
11 Design procedure — upset forgings	19
11.1 General	19
11.2 Indication of tolerances on drawings for upset forgings	19
Section 3. Tables of tolerances for use when specifying in metric units	21
Section 4. Tables of tolerances for use when specifying in inch units	28
Section 5. Quantity tolerances for steel drop and press forgings and for upset forgings made on horizontal forging machines	35
12 Quantity tolerances	35

	Page
Appendix A Deviations of form — drop and press forgings	11
Appendix B Deviations of form — upset forgings	20
Figure 1 — Die lines	1
Figure 2 — Enveloping shapes of circular forgings	2
Figure 3 — Enveloping shapes of non-circular forgings	2
Figure 4 — Exception in determining complexity factor	2
Figure 5 — Types of dimensions	3
Figure 6 — Length and width dimensions between external surfaces	3
Figure 7 — Length and width dimensions between internal surfaces	4
Figure 8 — Length and width dimensions from a centre to a surface	4
Figure 9 — Mismatch	4
Figure 10 — Residual flash	5
Figure 11 — Trimmed flat	5
Figure 12 — Application of thickness tolerances to deep hubs. Base all thickness tolerances except those for overall thickness on dimension t shown above	6
Figure 13 — Application of straightness tolerances	6
Figure 14 — Dimensions to which centre-to-centre tolerances are applicable	6
Figure 15 — Dimensions to which centre-to-centre tolerances are not applicable (other than by negotiation)	7
Figure 16 — Fillet and edge radii	7
Figure 17 — Eccentricity tolerance for deep holes	8
Figure 18 — Tolerances for unforged stock and sheared ends	8
Figure 19 — Use of tables	9
Figure 20 — An upset portion of a forging	12
Figure 21 — A double-ended upset forging	12
Figure 22 — “Unforged” stock	12
Figure 23 — Exception in determining complexity factor	13
Figure 24 — Exception in determining complexity factor	13
Figure 25 — Application of tolerances based upon the largest diameter of an upset portion	14
Figure 26 — Step and thickness dimensions	14
Figure 27 — Length tolerances	15
Figure 28 — Typical length dimensions and tolerances for deformation of sheared ends	15
Figure 29 — Application of length tolerances to double-ended upset forgings	15
Figure 30 — Mismatch and eccentricity	15
Figure 31 — Local deviations from original actual bar stock diameter	16
Figure 32 — Residual flash	16
Figure 33 — Trimmed flat	16
Figure 34 — Exception to application of thickness tolerances	16
Figure 35 — Tolerances for centre-to-centre dimensions	17
Figure 36 — Fillet and edge radii	17
Figure 37 — Trimming burrs, punching burrs, and parting line fins	17
Figure 38 — Fin	17
Figure 39 — Eccentricity tolerance for deep holes	18
Figure 40 — Use of tables	19
Table A — Tolerances for deformation of sheared ends	8

	Page
Table B — Tolerances for deformation of sheared ends	18
Table 1 — Length, width, height, mismatch, residual flash and trimmed flat of drop, press and upset forgings (normal tolerances)	22
Table 2 — Length, width and height of drop and press forgings (close tolerances)	23
Table 3 — Thickness for drop, press and upset forgings and ejector marks for drop and press forgings (normal tolerances)	24
Table 4 — Thickness and ejector marks for drop and press forgings (close tolerances)	25
Table 5 — Straightness, flatness and centre to centre dimensions for drop, press and upset forgings	26
Table 6 — Fillet, edge radii and burrs for drop, press and upset forgings	27
Table 7 — Length, width, height, mismatch, residual flash and trimmed flat of drop, press and upset forgings (normal tolerances)	29
Table 8 — Length, width and height of drop and press forgings (close tolerances)	30
Table 9 — Thickness for drop, press and upset forgings and ejector marks for drop and press forgings (normal tolerances)	31
Table 10 — Thickness and ejector marks for drop and press forgings (close tolerances)	32
Table 11 — Straightness, flatness and centre to centre dimensions for drop, press and upset forgings	33
Table 12 — Fillet, edge radii and burrs for drop, press and upset forgings	34
Table 13 — Quantity tolerances for steel drop and press forgings and for upset forgings made on horizontal forging machines	35

Foreword

This standard makes reference to the following British Standards:

BS 2045, *Preferred numbers*.

BS 4114, *CM. Special slide rule for calculating tolerances (Metric units)*.

BS 4114, *CI. Special slide rule for calculating tolerances (Inch units)*.

This British Standard has been authorized by the Iron and Steel Industry Standards Committee. It is based on the co-operative project undertaken by the French, German and United Kingdom Drop Forging Associations.

Due acknowledgement is made to the work of the National Association of Drop Forgers and Stampers who were the instigators of the work which resulted in the proposals being prepared by the Special Tolerances Committee set up by the “Euroforge” Technical Committee.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 35 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. Dimensional tolerances for steel drop and press forgings

Scope

This British Standard specifies the dimensional and quantity tolerances for steel drop and press forgings and for upset forgings made on horizontal forging machines.

The tables showing dimensional tolerances in the British and metric system of measurement are not direct conversions as both are based on the R20 series of preferred numbers¹⁾.

1 General remarks — drop and press forgings

1.1 Scope of Section 1. This section applies to hot drop forgings, as delivered, made in carbon and alloy steels under hammers and presses. The tolerances specified apply to forgings not exceeding 250 kg (560 lb) in weight or 2 500 mm (100 in) maximum dimension. Tolerances for heavier or larger forgings are subject to negotiation.

The tolerances shown in this section cover both forgings to normal requirements and forgings to a closer range of tolerances. However, there are certain to be occasional instances which necessitate the use of tolerances wider than those indicated, e.g. specially complicated designs and steels having particularly difficult forging characteristics. In such cases these standard tolerances can form only a basis on which to agree modifications appropriate to the particular circumstances.

Reference is made under “Special tolerances” to the procedure for dealing with requirements for tolerances closer than those given in the standard.

1.2 Tolerance grades. Alternative grades, F and E, of tolerances are provided for the various categories of dimensions as follows.

Quality F represents normal manufacturing standards for the production of steel drop forgings. This quality level can be achieved only by the use of sound production techniques and provides adequate dimensional accuracy for most applications.

Quality E provides closer tolerances to assist in accommodating those instances in which the normal manufacturing standards are inadequate. While quality E (close) tolerances may be applied to all dimensions on one forging, it is more economical to apply them only to those specific dimensions on which closer tolerances are essential. This quality should not be specified unless the additional forging cost entailed can be justified by a consequent saving in overall cost.

1.3 Special tolerances. The standard does not include ranges of special tolerances. Such requirements usually necessitate supplementary operations, e.g. hot or cold coining.

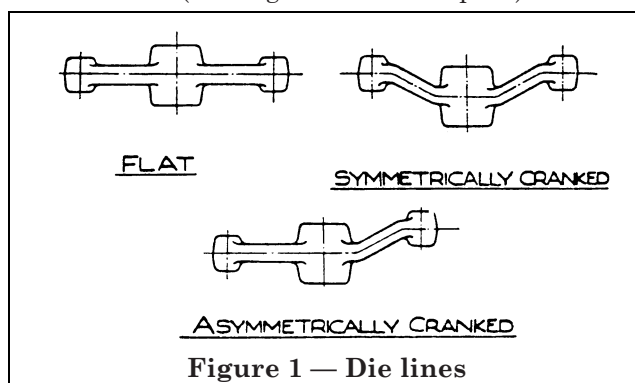
Considerations of this nature, whilst frequently encountered, are highly individual, and vary widely. They are best dealt with by consultation at the design stage and shall be agreed between the purchaser and the supplier. This approach will ensure that optimum use is made of the forging process in fulfilling the purchaser’s special requirements at the lowest additional cost.

2 Information required in determining tolerances — drop and press forgings

To determine the tolerances applicable to a given forging in accordance with Table 1 to Table 6 or Table 7 to Table 12 the following information is required in addition to the dimensions of the forging:

- 1) Weight of forging.
 - 2) Shape of die line.
 - 3) Type of steel used.
 - 4) Shape complexity factor of forging.
- 1) The *forging weight* is calculated.
 - 2) The *shape of die line* is determined as falling within one of the following categories:

EITHER Flat or symmetrically cranked.
OR Asymmetrically cranked.
(See Figure 1 for examples.)



¹⁾ BS 2045 “Preferred numbers”.

3) The *type of steel used* is determined as falling within one of the following categories:

- EITHER M1 Steel with carbon content not more than 0.65 % *and* total of specified alloying elements (Mn, Ni, Cr, Mo, V, W) not more than 5 %.
- OR M2 Steel with carbon content above 0.65 % *or* total of specified alloying elements (Mn, Ni, Cr, Mo, V, W) above 5 %.

To determine the category in which a steel falls, the maximum permitted contents of the elements in the steel specification shall be the values used.

4) The *complexity factor* of a forging is the ratio of the weight²⁾ of the forging to the weight²⁾ of the overall shape necessary to accommodate the maximum dimensions of the forging.

$$S = \frac{W_{\text{forging}}}{W_{\text{overall shape}}}$$

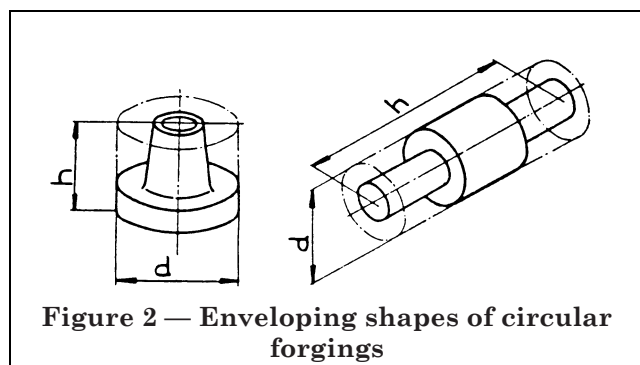


Figure 2 — Enveloping shapes of circular forgings

The enveloping shape of a *circular* forging (see Figure 2) is the circumscribing cylinder the weight of which is calculated from the formula:

$$W_{\text{overall shape}} = \frac{3.14d^2}{4} \cdot h \cdot \gamma$$

where γ = specific gravity (7.83 g/cm³) (0.283 lb/in³)

h = height, or length, of cylinder.

For a *non-circular* forging the overall shape is constituted by the smallest rectangular block that will encompass the forging (see Figure 3).

$$W_{\text{overall shape}} = l \cdot b \cdot h \cdot \gamma$$

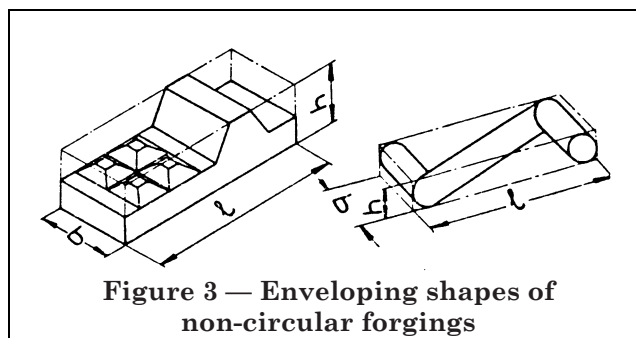


Figure 3 — Enveloping shapes of non-circular forgings

The resulting complexity factor is determined as falling within one of the following categories:

S4: Up to and including 0.16.

S3: Above 0.16 up to and including 0.32.

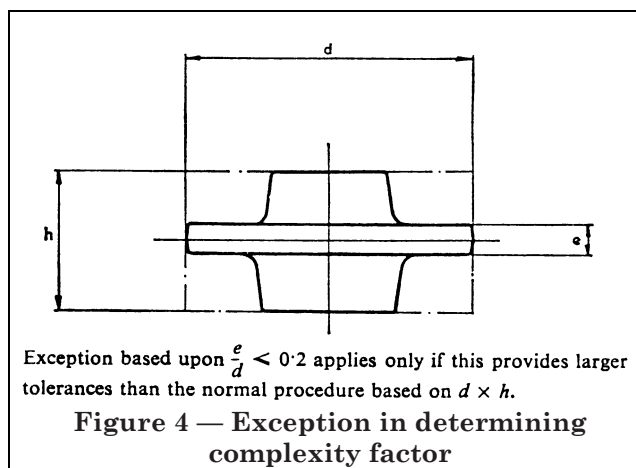
S2: Above 0.32 up to and including 0.63.

S1: Above 0.63 up to and including 1.

EXCEPTION

In determining the complexity factor for thin disks or flanges there is an exception to the above procedure when the expression e/d does not exceed 0.20, where d is the diameter and e is the corresponding thickness of the disk or flange.

In such cases the factor S4 is used; the weight to be taken into consideration is only that of a cylinder having diameter d and height e . This special procedure is not applied if larger tolerances will result from use of the normal procedure as shown in Clause 2 4) (see Figure 4).



Exception based upon $\frac{e}{d} < 0.2$ applies only if this provides larger tolerances than the normal procedure based on $d \times h$.

Figure 4 — Exception in determining complexity factor

²⁾ If desired, the complexity factor may be calculated as the ratio of the volume of the forging to the volume of the overall shape.

3 Categories of tolerances — drop and press forgings

3.1 Scope of categories

3.1.1 *First group of tolerances* (Table 1 and Table 2 or Table 7 and Table 8)

Length, width and height tolerances

Mismatch tolerances

Residual flash (and trimmed flat) tolerances

Pierced hole tolerances.

3.1.2 *Second group of tolerances* (Table 3 and Table 4 or Table 9 and Table 10)

Thickness tolerances

Ejector mark tolerances.

3.1.3 *Third group of tolerances* (Table 5 or Table 11)

Straightness and flatness tolerances

Tolerances for centre-to-centre dimensions.

3.1.4 *Other categories of tolerances*

Fillet and edge radii tolerances (Table 6 or Table 12)

Burr tolerances (Table 6 or Table 12)

Surface tolerances

Tolerances on draft angle surfaces

Eccentricity tolerances for deep holes

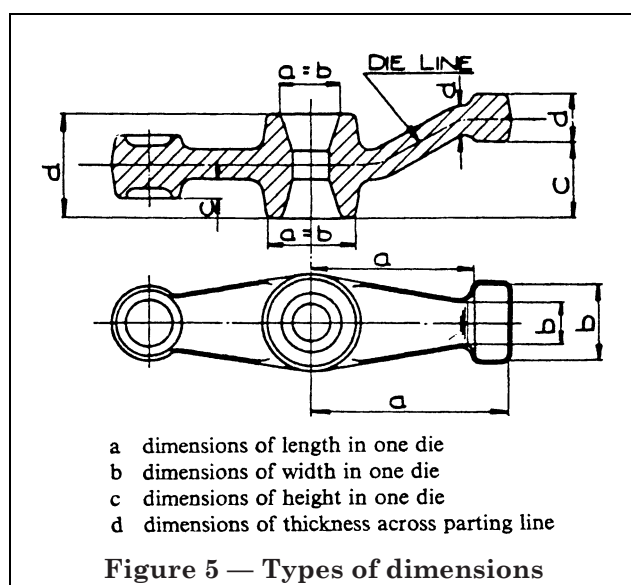
Tolerances for unforged stock

Tolerances for deformation of sheared ends.

3.2 Definition of categories

3.2.1 *First group of tolerances* (Table 1 and Table 2 or Table 7 and Table 8).

3.2.1.1 *Length, width and height tolerances* (see Figure 5).



Except for certain centre-to-centre dimensions (see 3.2.3.2), length, width and height tolerances relate to all dimensions of length, width and height (including diameters) on one side of the parting line. All variations, including those due to die wear and shrinkage, are included in the length, width and height tolerances. Length and width tolerances are to be applied in directions parallel to the main die parting plane, or as nearly so as practical considerations will permit.

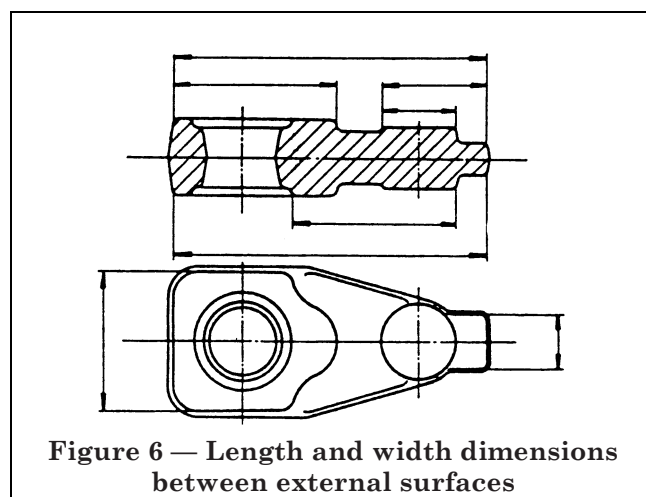
Length, width and height tolerances comprise the following:

Tolerances on dimensions to external and internal forged surfaces;

Tolerances on dimensions from an axis to a single surface;

Tolerances on dimensions of length, width and height of steps within one die.

Length, width and height tolerances are shown in Table 1 and Table 2 or Table 6 and Table 7 as applied to dimensions between external surfaces (see Figure 6), i.e. with a dispersion of $+\frac{1}{3}$, $-\frac{1}{3}$ for all length and width tolerances and also all height tolerances unless the more restrictive step height tolerances are required.



For dimensions between internal surfaces (see Figure 7), the signs should be reversed so that the tolerance dispersion is $+\frac{1}{3}$, $-\frac{2}{3}$.

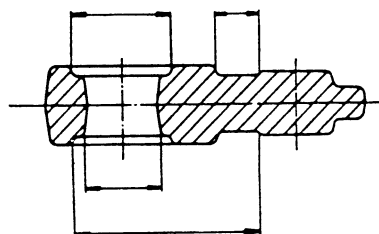


Figure 7 — Length and width dimensions between internal surfaces

When applying length, width and height tolerances to a forging, the tolerances for the *greatest* dimension of length (i.e. the overall length) should be applied, wherever possible, to *all* dimensions of length and similarly for dimensions of width and dimensions of height. This should be done to obviate unnecessary minor variations between tolerances, thus facilitating drawing preparation and simplifying inspection procedures. In those instances where the variation is of importance (e.g. where there is a large difference in dimensions of length), individual tolerances may be applied from Table 1 and Table 2 or Table 7 and Table 8 to those dimensions where this is considered necessary. The application of such tolerances should be kept to a minimum and, in these instances, the tolerances shall be indicated clearly against the appropriate dimension(s) on the forging drawing.

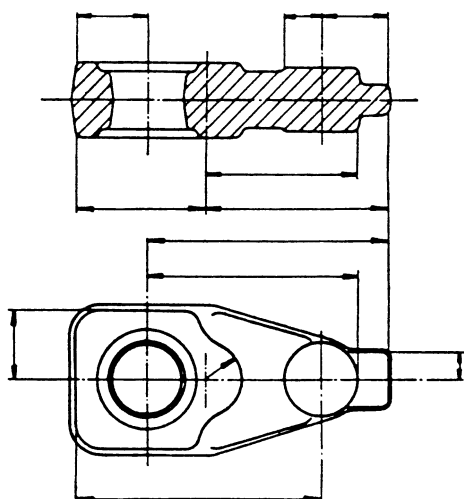


Figure 8 — Length and width dimensions from a centre to a surface

For dimensions from a centre to a surface (see Figure 8) and for dimensions on steps within one die, the tolerances for the greatest length, width and height shall apply wherever possible. Where more restrictive tolerances are required, they shall be indicated against the appropriate dimension on the drawing and shall be $+\frac{1}{3}$, $-\frac{1}{3}$ of the total tolerances shown in Table 1 and Table 2 or Table 7 and Table 8.

3.2.1.2 Mismatch tolerances. Mismatch tolerances indicate the permissible extent of misalignment between any point on one side of the parting line and the corresponding point on the opposite side, in directions parallel to the main parting line of the dies.

Mismatch tolerances are applied independently of any other tolerances.

Measurement. In measuring mismatch, accuracy depends upon making due allowance for surplus metal caused by uneven die wear. For that reason measurements should be made at areas of the forging least affected by die wear.

Formula for calculating mismatch. With reference to Figure 9, mismatch at any position relative to the length or width of a forging may be calculated as follows:

$$m = \frac{a_2 - a_1}{2}$$

where m = mismatch;

a_1 = lesser *projected* length or width dimension, measured parallel to the main parting line of the dies;

a_2 = corresponding greater *projected* length or width dimension, measured parallel to the main parting line of the dies.

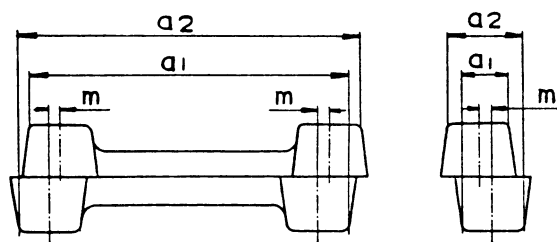


Figure 9 — Mismatch

3.2.1.3 Residual flash (and trimmed flat) tolerances.

Variations in trimming may produce either a residual flash or a trimmed flat. The positive (residual flash) and negative (trimmed flat) values permitted are given in Table 1 and Table 2 or Table 7 and Table 8. The residual flash is measured from the body of the forging to the trimmed edge of the flash, as indicated in Figure 10. The position of the trimmed flat is measured relative to the theoretical point at which the draft angles meet (see Figure 11).

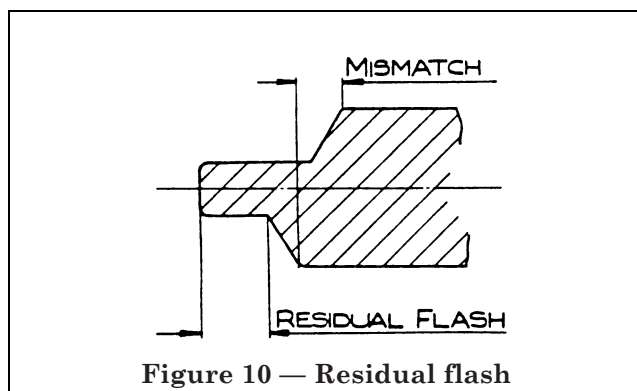


Figure 10 — Residual flash

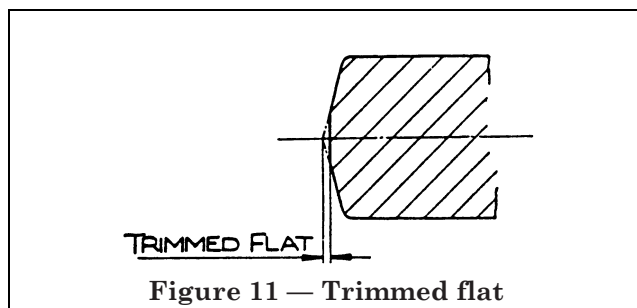


Figure 11 — Trimmed flat

Residual flash and trimmed flat tolerances are applied independently of, and in addition to, any other tolerances.

3.2.1.4 Pierced hole tolerances. Tolerances for dimensions of pierced holes shall be taken from Table 1 or Table 2, or Table 7 or Table 8 but the positive and negative dispersions shall be reversed. Normally the tolerances for the greatest dimension of length (or diameter) of the forging will be applied but, if more restrictive tolerances are required, those for the specific dimension of the pierced hole may be used. In the latter case the tolerances shall be indicated against the appropriate dimension on the forging drawing.

3.2.2 Second group of tolerances (Table 3 and Table 4 or Table 9 and Table 10).

3.2.2.1 Thickness tolerances (see Figure 5).

Thickness tolerances govern permissible variations in any dimension which crosses the parting line of the dies. All variations in thickness, due to die-closure, die-wear and shrinkage are included in the thickness tolerances.

The characteristics of the drop forging process require that, for any given forging, *all* tolerances for thickness dimensions are uniform. The tolerances are determined from Table 3 and Table 4 or Table 9 and Table 10 in accordance with the *greatest* thickness dimension of the forging.

Where more restrictive tolerances are required for application to individual dimensions of thickness, supplementary operations are involved. Such special tolerances should be negotiated between the purchaser and the supplier in accordance with 1.3.

EXCEPTION

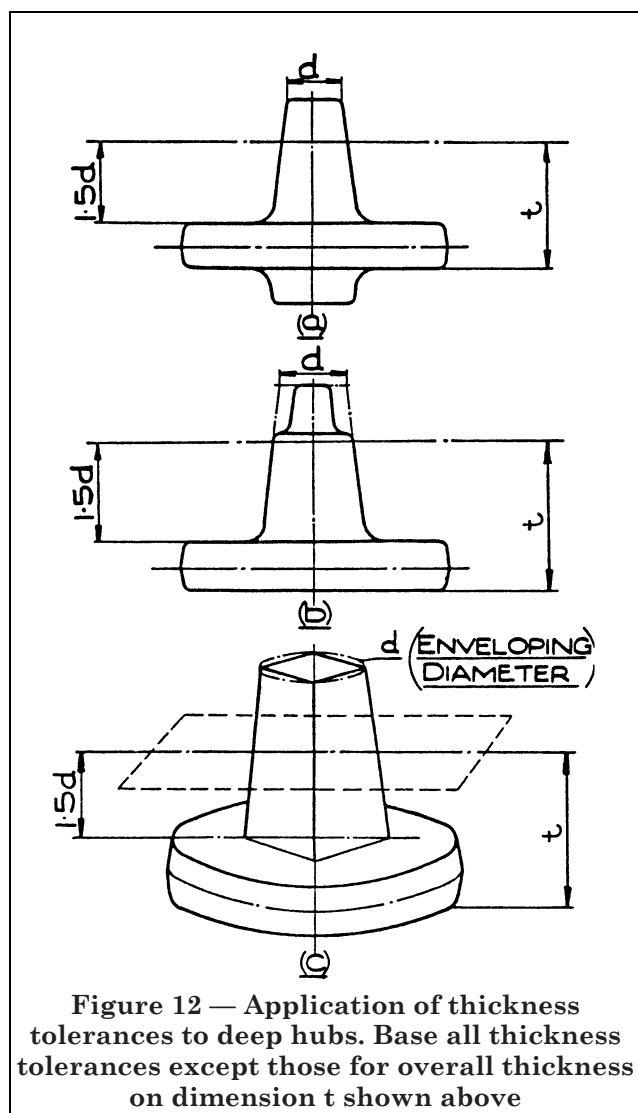
In the case of forgings having a flange from which projects either a) a deep hub the height of which is more than 1.5 times its diameter or b) a non-circular projection, the height of which is more than 1.5 times its enveloping diameter, all thickness tolerances other than that of the overall thickness will be calculated as if the height of the hub or projection had been equal only to 1.5 times its diameter (or enveloping diameter) and *not* to the greatest thickness dimension (see Figure 12).

3.2.2.2 Ejector mark tolerances. When forging dies incorporate ejectors, an allowance is required for the marks made on the forgings; these marks may be either sunken or raised. The total tolerances permitted are shown in Table 3 and Table 4 or Table 9 and Table 10.

The height or the depth of an ejector mark, relative to the surrounding surface, shall not exceed one-half of the total tolerance permitted, unless stated otherwise on the agreed forging drawing.

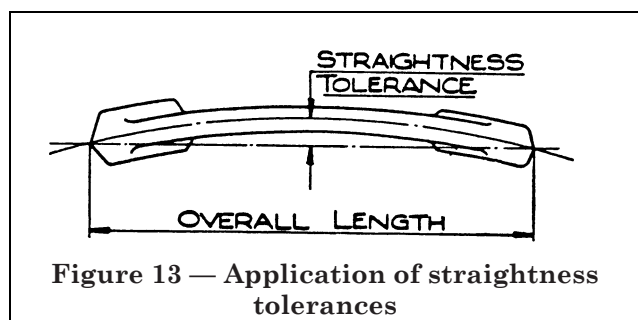
The nominal diameter and the location of ejector marks will be indicated to the purchaser on the forging drawing before the commencement of production.

Ejector mark tolerances are applied independently of, and in addition to, any other tolerances.



3.2.3 Third group of tolerances (Table 5 or Table 11)

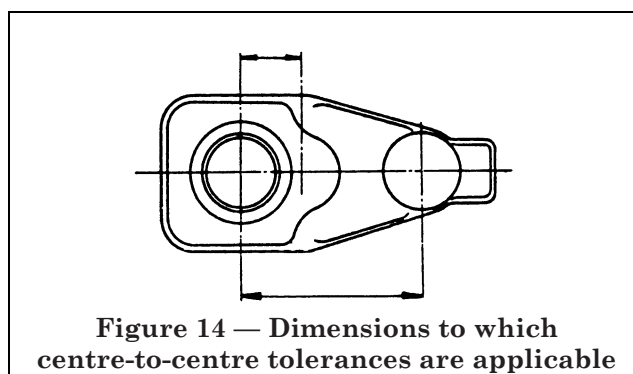
3.2.3.1 Straightness and flatness tolerances. Straightness tolerances relate to deviations of centre lines from the specified contour (see Figure 13). Flatness tolerances relate to deviations of surfaces from the specified contour.



When straightness tolerances or flatness tolerances are required, this shall be indicated on the agreed forging drawing.

Straightness and flatness tolerances are applied independently of, and in addition to, any other tolerances.

3.2.3.2 Tolerances for centre-to-centre dimensions. The tolerances for centre-to-centre dimensions, up to and including 1 250 mm (50 in), shall be taken from Table 5 or Table 11 and shall be indicated against the appropriate dimension on the agreed forging drawing. When no tolerance is indicated against the dimension concerned, the tolerance for the *maximum* length (or width) of the forging shall be applied (from Table 1 or Table 2, or Table 7 or Table 8), but the dispersion will be plus and minus one-half of the total tolerance, and *not* as shown in the tables. For centre-to-centre dimensions greater than 1 250 mm (50 in) length, tolerances from Table 1 or Table 2, or Table 7 or Table 8, with equal plus and minus dispersions, shall be applied. The centre-to-centre tolerances provided in this standard apply only when a straight line joining the two centres falls within the profile of the forging (see Figure 14).



In other instances (see Figure 15) centre-to-centre tolerances, if required either by the purchaser or the supplier, shall be negotiated before the commencement of production.