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## Steel die forgings – Tolerances on dimensions – Part 1: Drop and vertical press forgings

The European Standard EN 10243-1:1999 has the status of a Swedish Standard. This document contains the official English version of EN 10243-1:1999.

This standard supersedes the Swedish Standard, SMS 738, ed. 1.

Swedish Standards corresponding to documents referred to in this Standard are listed in "Catalogue of Swedish Standards", issued by SIS. The Catalogue lists, with reference number and year of Swedish approval, International and European Standards approved as Swedish Standards as well as other Swedish Standards.

## Sänksmide av stål – Dimensions-toleranser – Del 1: Varmsmide i hejare och press

Europastandarden EN 10243-1:1999 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 10243-1:1999.

Standarden ersätter SMS 738, utg. 1.

Motsvarigheten och aktualiteten i svensk standard till de publikationer som omnämns i denna standard framgår av "Katalog över svensk standard", som ges ut av SIS. I katalogen redovisas internationella och europeiska standarder som fastställts som svenska standarder och övriga gällande svenska standarder.

ICS 17.040.10; 77.140.80; 77.140.85



EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 10243-1**

September 1999

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ICS 77.140.85

English version

## Steel die forgings - Tolerances on dimensions - Part 1: Drop and vertical press forgings

Pièces forgées par estampage en acier - Tolérances dimensionnelles - Partie 1: Pièces exécutées à chaud sur marteaux-pilons ou presses verticales

Gesenkschmiedeteile aus Stahl - Maßtoleranzen - Teil 1: Warm hergestellt in Hämmern und Senkrecht-Pressen

This European Standard was approved by CEN on 22 August 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



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COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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**Contents**

<b>Foreword</b> .....	<b>3</b>
<b>1 Scope</b> .....	<b>4</b>
<b>2 Normative references</b> .....	<b>5</b>
<b>3 Symbols</b> .....	<b>5</b>
<b>4 Information required in determining tolerances</b> .....	<b>5</b>
4.1 Mass of forging.....	6
4.2 Shape of die line.....	6
4.3 Category of steel used .....	6
4.4 Shape complexity factor .....	7
4.5 Types of dimension .....	9
<b>5 Categories of tolerances</b> .....	<b>9</b>
5.1 Scope of categories.....	9
5.2 Definition of categories.....	11
5.3 Deviations of form .....	20
<b>6 Use of tables</b> .....	<b>21</b>
6.1 Tables 1 and 2 : Tolerances for length, width and height, residual flash (and trimmed flat), and mismatch .....	21
6.2 Tables 3 and 4 : Tolerances for thickness and ejector marks.....	23
6.3 Table 5 : Tolerances for straightness, flatness and tolerances for centre-to-centre dimensions .....	23
6.4 Table 6 : Tolerances for fillet and edge radii ; tolerances for burrs ; tolerances for sheared ends.....	23
<b>7 Design procedure</b> .....	<b>23</b>
7.1 Information required by the forger .....	23
7.2 Preparation of forging drawing .....	24
7.3 Indication of dimensions on forging drawing.....	24
7.4 Indication of tolerances on forging drawings.....	24
7.5 Importance of forging drawing .....	24
<b>Annex A (informative) Examples of application</b> .....	<b>30</b>

## Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 28 "Steel forgings", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2000, and conflicting national standards shall be withdrawn at the latest by March 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. This European Standard is considered to be a supporting standard to those application and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make reference to this European Standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

## 1 Scope

**1.1** This European Standard specifies the dimensional tolerances for steel drop and vertical press forgings made under hammers and presses.

The first part of this European Standard applies to hot forgings in the delivery condition, made in carbon and alloy steels. The tolerances specified apply to forgings not exceeding 250 kg in mass or 2 500 mm maximum dimension. Tolerances for heavier or larger forgings shall be agreed at the time of enquiry and order.

This European Standard does not apply to upset forgings made on horizontal forging machine (see prEN 10243-2).

**1.2** The tolerances shown in this European Standard cover both forgings to normal requirements and forgings to a closer range of tolerances. These two grades of tolerances are identified as follows :

- forging grade F with tolerances providing an adequate standard of accuracy for the majority of applications and capable of being complied with by commonly used forging equipment and production methods ;
- forging grade E providing closer tolerances to assist in accommodating those instances in which the normal manufacturing standards are inadequate.

While grade 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 grade should not be specified unless the additional forging cost entailed can be justified by a consequent saving in overall cost.

The tables showing dimensional tolerances are based on the R20 series of preferred numbers (see ISO 3).

The annex A gives for information some examples of application of these tolerances for different types of closed die forgings.

**1.3** Any occasional instances may 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 agreed modifications appropriate to the particular circumstances.

**1.4** This European Standard does not include ranges of special tolerances closer than grade E. Such requirements usually necessitate supplementary operations, e. g. hot or cold coining or special processes such as warm or cold forging.

Consideration of this nature, whilst frequently encountered, are highly individual, and vary widely. They are best dealt with by consultation at 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 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 3	Preferred numbers - Series of preferred numbers
ISO 8015	Technical drawings - Fundamental tolerancing principle

## 3 Symbols

The symbols used along this European Standard are as follows :

$l$	= length dimension ;
$b$	= width dimension ;
$h$	= height dimension ;
$a$	= thickness dimension ;
$d$	= diameter ;
$r$	= radius ;
$p$	= step dimension ;
$u$	= height of burr ;
$v$	= width of burr ;
$t$	= theoretical length ;
$e$	= special thickness across die line ;
$m$	= mass (weight) ;
$\pi$	= circle factor ;
$\rho$	= density ;
$S$	= shape complexity factor (see 4.4) ;
$M$	= category of steel (see 4.3) ;
$x$ and $y$	= shearing deformation.

## 4 Information required in determining tolerances

To determine the tolerances applicable to a given forging in accordance with tables 1 to 6, the following information is required in addition to the dimensions of the forging :

- mass of forging ;
- shape of die line ;
- category of steel used ;
- shape complexity factor ;
- types of dimension.

#### 4.1 Mass of forging

The forging mass is calculated.

#### 4.2 Shape of die line

The shape of die line is determined as being within one of the following categories :

- either straight or symmetrically cranked ;
- or asymmetrically cranked (see figure 1 for example).

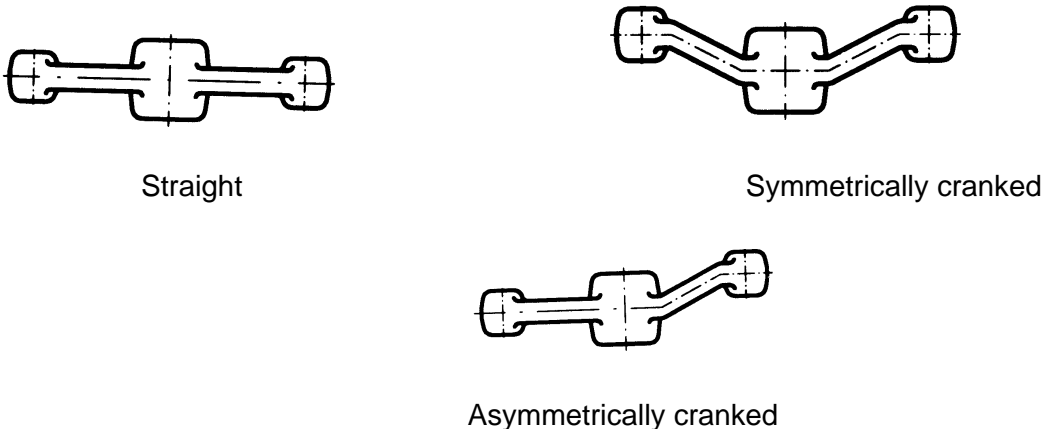


Figure 1 : Die lines

#### 4.3 Category of steel used

The type of steel symbol used takes account of the fact that steels of high carbon and high alloy content are more difficult to deform and cause higher die wear than do steels with lower carbon content and lower alloying elements.

The category of steel used is determined as being within one of the following :

- group M 1 : 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 % by mass ;
- group M 2 : Steel with carbon content above 0,65 % **or** total of specified alloying elements (Mn, Ni, Cr, Mo, V, W) above 5 % by mass.

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



#### 4.4 Shape complexity factor

The shape complexity factor takes account of the fact that in forging thin sections and branched components, as compared to components having simple compact shapes, larger dimensional variations occur which are attributable to different rates of shrinkage, higher shaping forces and higher rates of die wear. Examples are shown of circular and non-circular forgings (see figures 2 and 3).

The shape complexity factor of a forging is the ratio of the mass <sup>1)</sup> of the forging to the mass <sup>1)</sup> of the enveloping shape necessary to accommodate the maximum dimensions of the forging.

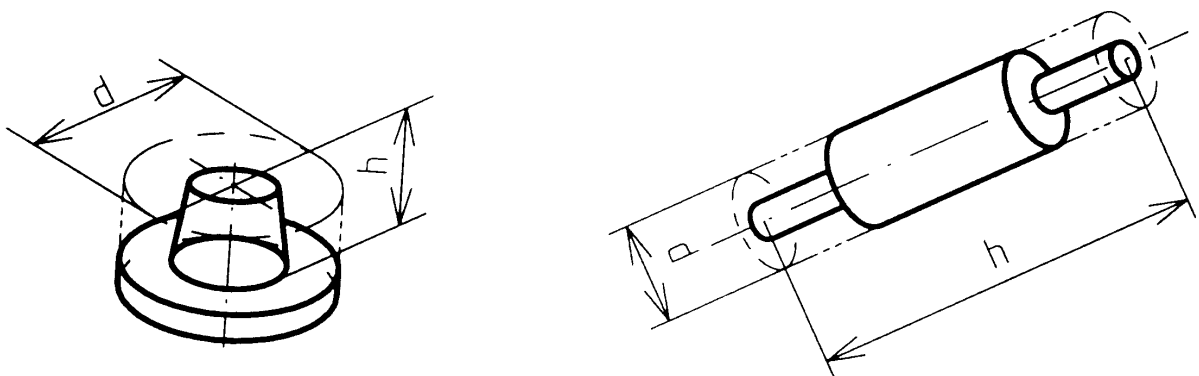
$$S = \frac{m_{\text{forging}}}{m_{\text{enveloping shape}}}$$

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

$$m_{\text{enveloping shape}} = \frac{\pi \times d^2}{4} \times h \times \rho$$

where

- $d$  = diameter ;
- $\rho$  = density (7,85 g/cm<sup>3</sup>) ;
- $h$  = height, or length of cylinder.

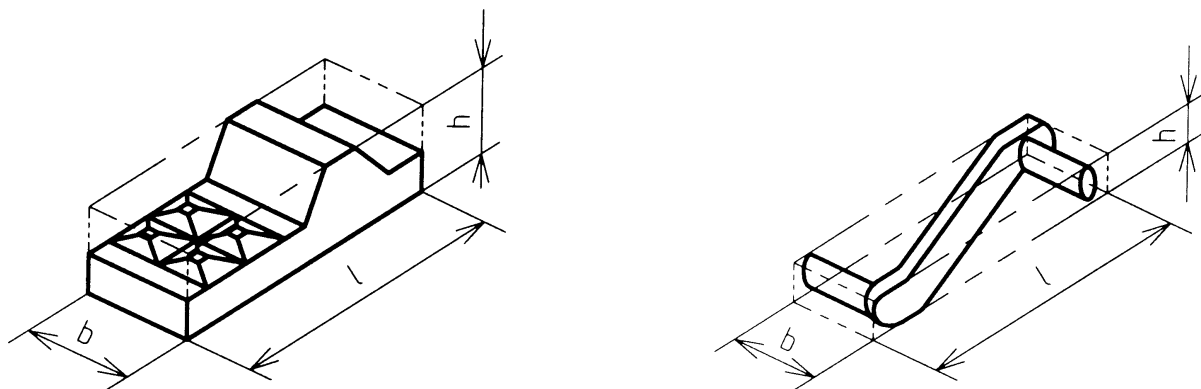


**Figure 2 : Enveloping shapes of circular forgings**

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

$$m_{\text{enveloping shape}} = l \times b \times h \times \rho$$

<sup>1)</sup> If desired, the shape complexity factor may be calculated as the ratio of the volume of the forging to the volume of the enveloping shape.



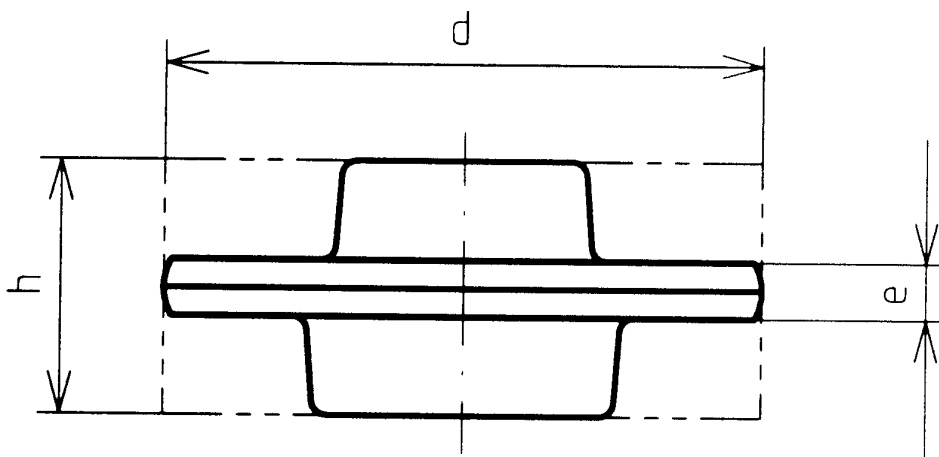
**Figure 3 : Enveloping shapes of non-circular forgings**

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

- S 4 : Up to and including 0,16 ;
- S 3 : Above 0,16 up to and including 0,32 ;
- S 2 : Above 0,32 up to and including 0,63 ;
- S 1 : Above 0,63 up to and including 1.

EXCEPTION : In determining the shape 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 (see figure 4).

In such cases the factor S 4 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 4.4.



**Figure 4 : Exception in determining shape complexity factor**

#### 4.5 Types of dimension

Four major types of dimension are identified (see figure 5) and the relationship to the forging direction and die line is as follows :

Dimension	Forging direction	Die line
Length	⊥	one side
Width	⊥	
Height	//	across
Thickness	//	

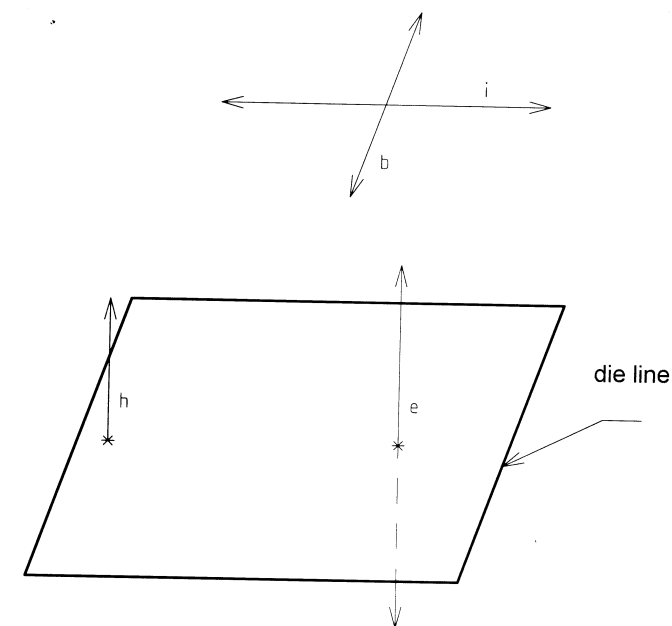


Figure 5 : Relationship between types of dimensions and die line

### 5 Categories of tolerances

#### 5.1 Scope of categories

The tolerances are related to the different kinds of dimension. They are classified into four groups, accordingly each of them is displayed in the table.

##### 5.1.1 First group of tolerances (tables 1 and 2)

Tolerances for :

- length, width and height ;
- mismatch ;
- residual flash (and trimmed flat) ;
- pierced hole.