STEEL STAMPING FORGINGS

Tolerances, allowances and forging laps

GOST 7505-89

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Группа В03

GOVERNMENT STANDARD OF USSR

ПОКОВКИ STEELНЫЕ ШТАМПОВАННЫЕ
Допуски, припуски и кузнечные напуски
STEEL STAMPING FORGINGS.
Tolerances, allowances and forging laps

GOST
7505—89

ОКП О8 9300

Date of introduction 01.07.90

Non-observance of the standard will be pursued under the law

This standard covers steel stamping forgings of 250 kg maximum and (or) with linear overall dimension not more than 2500 mm made by hot die forging.

The standard sets the maximum values of tolerance on dimensions, deviations of the shape, allowances, forging laps and the minimum rounding off radii of external corners.

For forgings with weight more than 250 kg or with the linear dimensions more than 2500 mm; for forgings made from high temperature heat resistant, and corrosion-proof steels and alloys, and also for additional special elements of forgings (test specimens for mechanical tests, clamps for suspension of forgings during heat treatment and for other technological purposes), the specified set values as agreed between the manufacturer and the customer. It is permitted to manufacture the forgings as per the drawings developed before the introduction of this standard before 01.07.92

APPENDIX 1 TERMINOLOGY AND DEFINITIONS

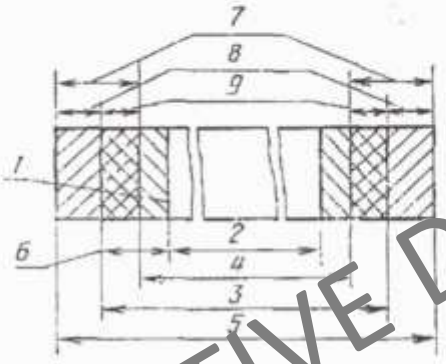
In the section, the terminology and the definitions used for this standard are given.

1.1. Steel stamping forgings (further referred to as forgings) – is a product received by die forging according to technical requirements of GOST 8479.

1.2. The forging shape —spatial figure determined by the nominal linear and angular dimensions.

1.3. Weight of forging — weight parameter of forging is to be determined based on its shape and density of steel.

1.4. Nominal linear dimension of forge – geometrical parameter measured in units of length and to be determined based on the nominal linear dimension of the part, set allowance (fig. 1) and forge laps.



1 — Part; *2* — part dimension; *3* — nominal dimension of the forging; *4* — minimum limit of forge dimension; *5* — maximum limit of forge dimension; *6* — allowance; *7* — tolerance (tolerance field); *8* — plus tolerance(value of deviation); *9* — minus tolerance(value of tolerance).

Figure 4

1.5. The nominal angular dimension of forging — geometrical parameter, measured in angular units and determined from the nominal angular dimension of the part.

1.6. Actual dimension of the forge — the actual dimension obtained by measurement with permissible error.

1.7. The limiting/maximum dimensions of forging — two permissible dimensions, among them, one of them should be actual or nominal dimension.

1.8. Permissible deviation of the dimension of forging—algebraic dimension between the limiting and the corresponding nominal dimensions.

1.9. Tolerance (tolerance field) on forge dimension — absolute value of difference between the maximum and minimum the limiting dimensions.

1.10. Geometrical parameters of forgings (fig. 2 and 3).

1.10.1. Length (L, *l*), width (B, *b*), diameter (D, *d*), height and depth (H, *h*) – dimensions of forge elements in one part of die.

1.10.2. Thickness (T, t) — height of the geometric element of forge in both the parts of the die.

1.10.3. Inter axial distance:

A_1—Dimension of section of straight line connecting two centers and not intersecting the external contour of the forging (See fig 2);

A_2 — Same as above, but intersecting the external contour of the forging (See fig. 3).

1.10.4. Rounding off radius of internal corners ($R_в$)— Rounding of radius in the concave section of the forging surface (See fig. 2).

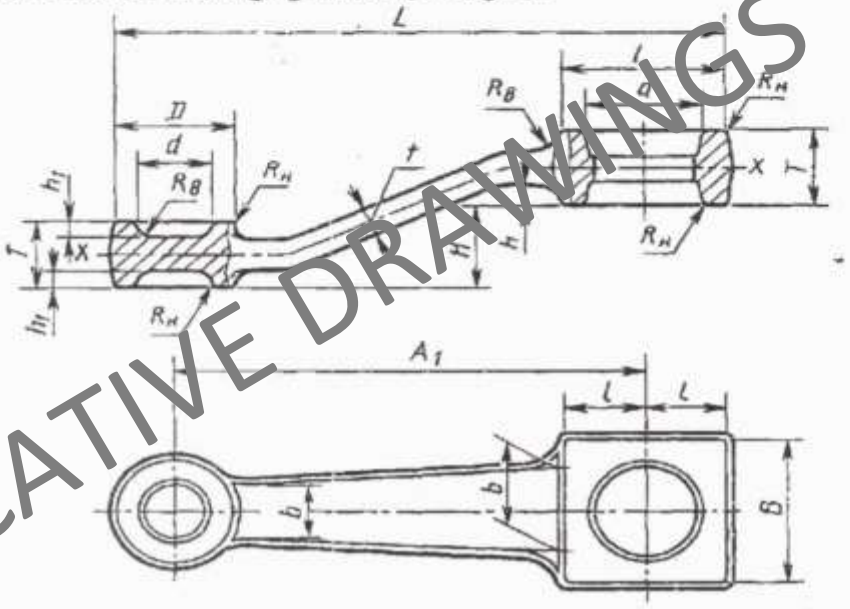


Fig. 2

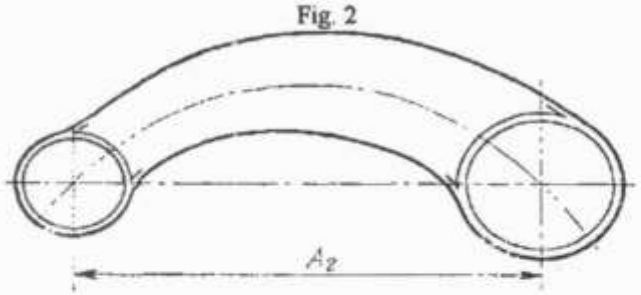


Fig 3

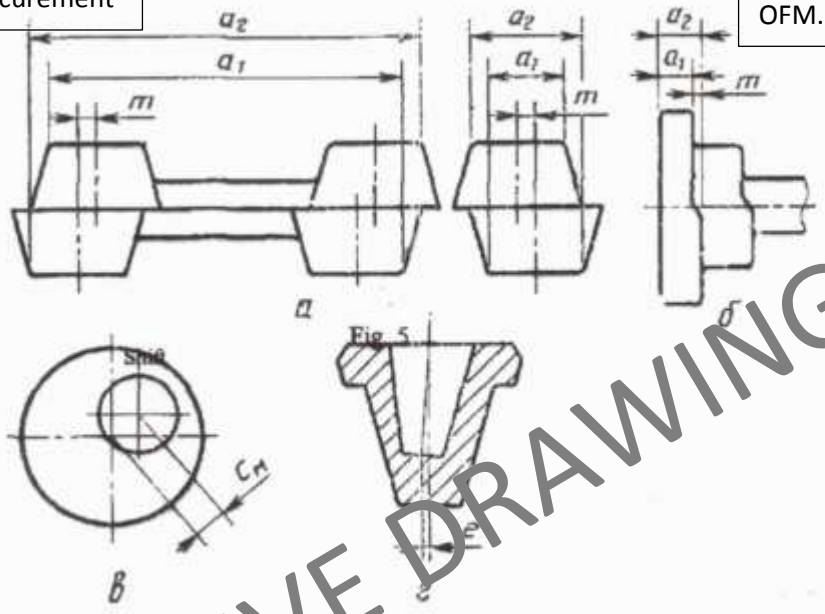


Fig. 4

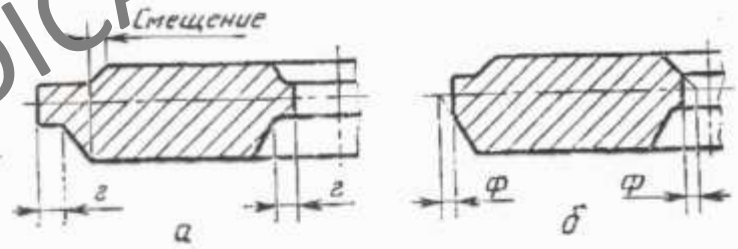


Fig. 5

1.10.5. Rounding off radius of external corners ($R_н$)— Rounding off radius in the convex section of the forging surface (See fig 2).

1.11. Tolerance on shape of forging— Permissible value of forging shape deviation.

1.12. Forging shape error (deviation)

1.12.1. Shifting of parting surface (m) - Forging shape deviation in the form of

maximum linear shift on one of the forging plane with respect to the other, calculated as per formula:

for dies with single parting surface (fig 4a)

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

for dies with two or multiple parting surface (Fig 4б)

$$m = a_2 - a_1$$

Where m — value of shift;

a_1 — Minimum forging dimension in the linear shift direction;

a_2 — maximum forging dimension in the linear shift direction.

1.12.2. Deviation from concentricity (Γ_m) – distance from the center of blind or forged hole till the given coordinates of this hole as per the drawing (figure 4в).

1.12.3. Deviation from alignment (e) — Angular deviation of the hole axis from the forging axis (fig. 4г) measured in unit of length.

1.12.4. Residual flash/ spew (r) — projections, which are in the forgings after sprueing or forging of holes (Fig 5a).

1.12.5. Trimmed edges (ф)—forging edges, formed during sprueing or forging of holes (fig 5б).

1.12.6. Burrs. (к)—Projections, formed on the forging surface in the unforeseen places of joint of die parts for the flash/spew, and also during sprueing and forging of hole and measured in height (fig. 6: а — during flash free stamping, б – during stamping in split dies, в— during sprueing and forging of holes).

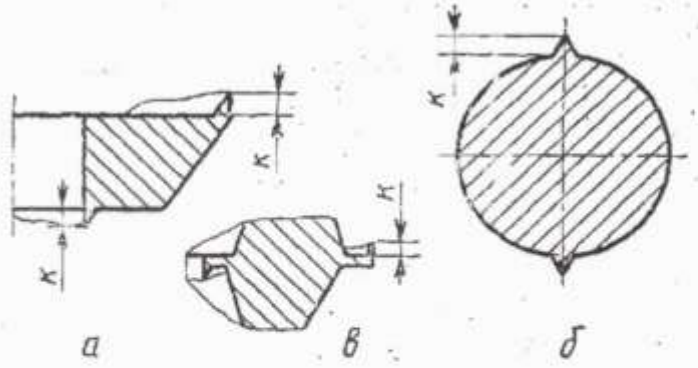


Fig 5

1.12.7. Traces of die knock out/ejector — Local positional deviation of the forging surface because of the die knock out

1.12.8. Camber (P_a)—Deviation of the axial line of the forging from the nominal position in the direction of maximum length or width of the forging (Fig 7a).

1.12.9. Deviation from flatness — deviation from flatness, evaluated by the maximum distance from the point of actual surface till the abutting plane surface (See fig. 7a).

1.12.10. Flatness tolerance (P_a)—maximum permissible deviation from flatness (see fig. 7a).

1.12.11. Deviation from straightness — Deviation from straightness in planes, evaluated by the maximum distance from the point of actual profile/form till the abutting straight surface (Fig 7б).

Fig 7

1.12.12. Straightness tolerance ($P_б$) — Maximum permissible value of variation in straightness.

1.12.13. Radial run out — Difference of maximum & minimum distance from the profile of forging section till its axis.

1.12.14. Tolerance on radial run out—Maximum permissible value of radial run out

1.13. Allowance— Metal layer on the machining surface, removed during maching.

1.14. Forging lap — Additional metal (layer) on the machining or non-machining surfaces, necessary for shaping operations.

1.15. Design weight of the forging — The set value, used while assigning the allowance & tolerance.

1.16. Initial index—Conventional parameter, taking into account the sum of design characteristics in the generalized form (accuracy class/quality, steel group, degree of complexity, die parting surface type/pattern) and forging weight.

2. GENERAL REQUIREMENTS

2.1. The linear dimensions on the forging drawing should be taken from the specified initial datum of machining, as agreed by the manufacturer and the customer (fig. 8).

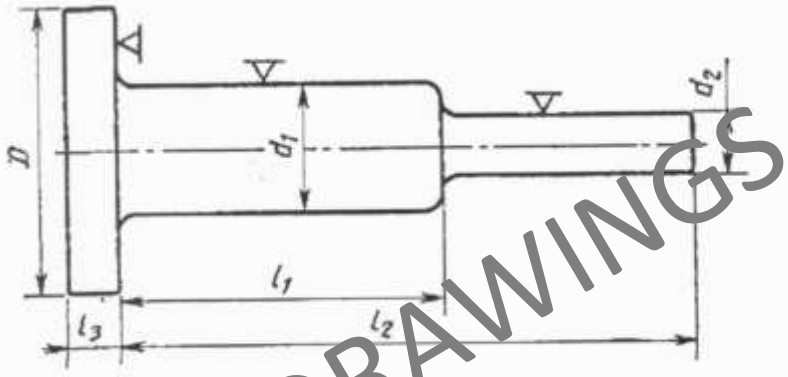


Fig 8

2.2. The tolerance set by this standard covers all the nominal forging dimensions.

2.3. The allowance established by this standard covers the machining surfaces of forgings.

2.4. Tolerance, allowance and forge lap are set depending on the design characteristics of forgings as given in tab. 1 and determined depending on the surface roughness (surface finish) of the machined surface of the forged part, and also depending on dimensions and weight. For 1-st class of accuracy T1, tolerance is set on those functional surfaces, which are not subjected to final machining

Table 1

Design characteristics of forgings	Designation & determination of design characteristics	Remarks
1. Accuracy class	T1 — 1st class T2 — 2nd class T3 — 3rd class T4 — 4th class T5 — 5th class	Determined as per appendix 1 (Table. 19)

Continuation of table 1

Design characteristics	Designation & determination of design characteristics	Remarks
2. Steel group	M1— steel with fraction of total mass of carbon up to 0.35 % inclusive and total mass fraction of alloying elements upto 2.0 % inclusive.; M2 — steel with fraction of total mass of carbon above 0.35 to 0.65 % inclusive and fraction of total mass of alloying elements above 2.0 to 5.0 % inclusive. M3 — steel with fraction of total mass of carbon above 0.65 % or fraction of total mass of alloying elements above 5.0%	For selecting the steel group, average mass content of carbon and alloying elements (Si, Mn, Cr, Ni, Mo, W, V) are the determining factors.
3. Degree of complexity	C1 — 1st degree C2 — 2nd degree C3 — 3rd degree C4 — 4th degree	Set as per appendix 2
4. Configuration of die parting surface	$П_п$ — Flat; $П_с$ — Symmetrically bent/curved; $П_н$ — asymmetrically bent/curved	

2.5. The design weight of forging is determined as the weight of deformation of forgings (forgings), or its parts. Weight of flash and crosspieces of the forged hole are not taken into account.

While upsetting the forging on upsetting machine or on local die-forging hammer or forging press, forging weight includes weight of the rod, pressed by the die.

2.6. Design weight of the forging is determined based on its nominal dimensions.

Approximate design weight of the forging ($M_{п-р}$) can be calculated as per formula:

$$M_{П.Р.} = M_{Д} \cdot K_{Р}$$

Where $M_{п-р}$—Design weight of the forging, in kg;
$M_д$ — Part weight, kg;
$K_р$ — Design factor, set in compliance with appendix 3 (Table 20).

2.7. Accuracy class/quality of forgings is established depending on the technological process and the equipment for its manufacturing (see the appendix 1, tab. 19), and also depending on the requirements for dimensional accuracy of forgings.

Various classes of accuracy for different dimensions of one & the same forgings are permitted. During this the accuracy class/quality is determined based on the prevailing number of the dimension of one accuracy class/quality, stipulated in the forging drawing, and agreed between the manufacturer and the customer.

2.8. The class of accuracy, steel group, and degree of complexity should be specified in the drawing.

2.9. Rules for forge drawing — as GOST 3.1126.

2.10. Permissible deviations of the form/shape and arrangement of surfaces should be shown on the drawing according to requirements of GOST 2.308. Permissible deviations of rounding off radius and draft angle can be specified in the drawing if required by the customer.

2.11. Technical requirements for forgings are established as per GOST 8479,

3. DETERMINATION OF INITIAL INDEX

3.1. The initial index for subsequent assignment of the basic allowances, tolerance and permissible deviations is determined depending on the weight, steel grade, degree of complexity and accuracy class/quality of forging (tab. 2).

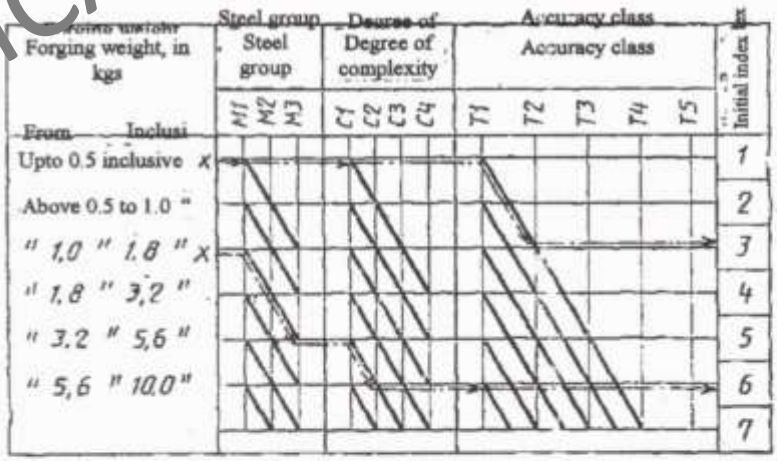
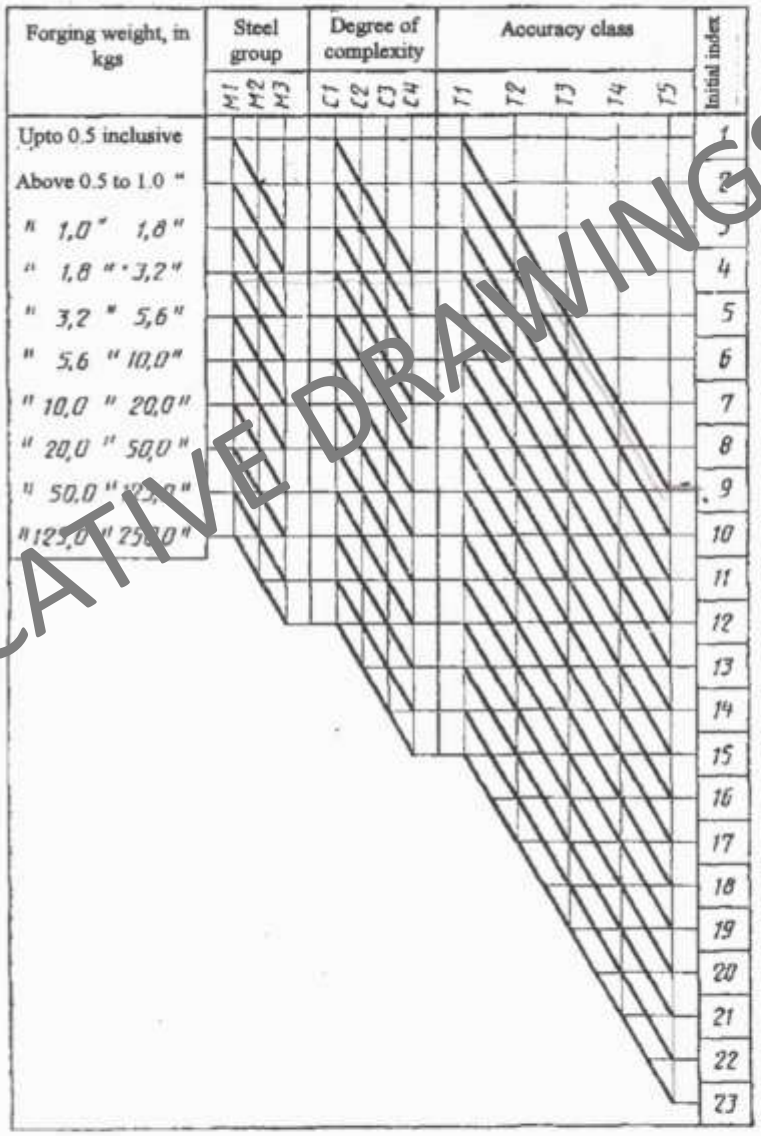


fig. 9

Table 2

Determination of initial index



3.2. For determining the initial index as per tab. 2, in the column «Weight of forgings» find the line corresponding to the given weight and, by moving across to the right or along the thickened inclined lines to the right down till intersecting with the vertical line, corresponding to the preset values of steel groups M, degree of complexity C, accuracy class T, the initial index is set (from 1 to 23).

Examples (fig. 9):

APPENDIX 1 Forgings of weight 0,5 kg, group of steel M1, degree of complexity C1, accuracy class T2.

Initial index — 3.

APPENDIX 1 Forgings of weight 1,5 kg, group of steel M3, degree of complexity C2, accuracy class T1.

Initial index — 6,

3.3. The Initial index should be specified in the forging drawing.

4. ALLOWANCE FOR MACHINING

4.1. The allowance for machining includes the basic and also the additional allowance, which takes into account the deviations of the forging shape. Value of allowances should be assigned for one side of the nominal forging dimension.

4.2. The basic allowances on machining depending on the initial index, determined according to point 3.2, the linear dimension and surface roughness of the part as per GOST 2789 are set as per tab. 3.

Allowances on thickness, subjected to cold or hot calibration, are set as per appendix 4.

4.3. The Additional allowances which takes into account the displacement of forging, curvature, deviations from flatness and straightness, centre to centre distance and interaxial distances, and angular dimensions are determined based on the forging shape/form and technologies of its manufacturing,

Depending on the accuracy class T, additional allowances on machining are set.

Basic allowance for mm

Initial index	Thickness of part: up to 25			25—40			40—63			63—100		
	Length, width, diameter, depth and height of the part: up to 40			40—100			100—160			160—250		
	100 12,5 ✓	10 1,6 ✓	1,25 ✓	100 12,5 ✓	10 1,6 ✓	1,25 ✓	100 12,5 ✓	10 1,6 ✓	1,25 ✓	100 12,5 ✓	10 1,6 ✓	1,25 ✓
1	0,4	0,6	0,7	0,4	0,6	0,7	0,5	0,6	0,7	0,6	0,8	0,9
2	0,4	0,6	0,7	0,5	0,6	0,7	0,6	0,8	0,9	0,8	0,9	0,9
3	0,5	0,6	0,7	0,6	0,8	0,9	0,6	0,8	0,9	0,7	0,9	1,0
4	0,6	0,8	0,9	0,6	0,8	0,9	0,7	0,9	1,0	0,8	1,0	1,1
5	0,6	0,8	0,9	0,7	0,9	1,0	0,8	1,0	1,1	0,9	1,1	1,2
6	0,7	0,9	1,0	0,8	1,0	1,1	0,9	1,1	1,2	1,0	1,3	1,4
7	0,8	1,0	1,1	0,9	1,2	1,2	1,0	1,3	1,4	1,1	1,4	1,5
8	0,9	1,1	1,2	1,0	1,3	1,4	1,1	1,4	1,5	1,2	1,5	1,6
9	1,0	1,3	1,4	1,1	1,4	1,5	1,2	1,5	1,6	1,3	1,6	1,8
10	1,1	1,4	1,5	1,2	1,5	1,6	1,3	1,6	1,8	1,4	1,7	1,9
11	1,2	1,5	1,6	1,3	1,6	1,8	1,4	1,7	1,9	1,5	1,8	2,0
12	1,3	1,6	1,8	1,4	1,7	1,9	1,5	1,8	2,0	1,7	2,0	2,2
13	1,4	1,7	1,9	1,5	1,8	2,0	1,7	2,0	2,2	1,9	2,3	2,5
14	1,5	1,8	2,0	1,7	2,0	2,2	1,9	2,3	2,5	2,0	2,5	2,7
15	1,7	2,0	2,2	1,9	2,3	2,5	2,0	2,5	2,7	2,2	2,7	3,0
16	1,9	2,3	2,5	2,0	2,5	2,7	2,2	2,7	3,0	2,4	3,0	3,3
17	2,0	2,5	2,7	2,2	2,7	3,0	2,4	3,0	3,3	2,6	3,2	3,5
18	2,2	2,7	3,0	2,4	3,0	3,3	2,6	3,2	3,5	2,8	3,5	3,8
19	2,4	3,0	3,3	2,6	3,2	3,5	2,8	3,5	3,8	3,0	3,8	4,1
20	2,6	3,2	3,5	2,8	3,5	3,8	3,0	3,8	4,1	3,4	4,3	4,7
21	2,8	3,5	3,8	3,0	3,8	4,1	3,4	4,3	4,7	3,7	4,7	5,1
22	3,0	3,8	4,1	3,4	4,3	4,7	3,7	4,7	5,1	4,1	5,1	5,6
23	3,4	4,3	4,7	3,7	4,7	5,1	4,1	5,1	5,6	4,5	5,7	6,2

machining (in a side)

Table 3

100—160			160—250			250								
250—400			400—630			630—1000			1000—1600			1600—2500		
100 12,5 ∨	10 1,6 ∨	1,25 ∨	100 12,5 ∨	10 1,6 ∨	1,25 ∨	100 12,5 ∨	10 1,6 ∨	1,25 ∨	100 12,5 ∨	10 1,6 ∨	1,25 ∨	100 12,5 ∨	10 1,6 ∨	1,25 ∨
0,6	0,8	0,9	—	—	—	—	—	—	—	—	—	—	—	—
0,7	0,9	1,0	0,8	1,0	1,1	—	—	—	—	—	—	—	—	—
0,8	1,0	1,1	0,9	1,1	1,2	1,0	1,3	1,4	—	—	—	—	—	—
0,9	1,1	1,2	1,0	1,3	1,4	1,1	1,4	1,5	—	—	—	—	—	—
1,0	1,3	1,4	1,1	1,4	1,5	1,2	1,5	1,6	1,3	1,6	1,8	—	—	—
1,1	1,4	1,5	1,2	1,5	1,7	1,3	1,6	1,8	1,4	1,7	1,9	1,5	1,8	2,0
1,2	1,5	1,6	1,3	1,6	1,8	1,4	1,7	1,9	1,5	1,8	2,0	1,7	2,0	2,2
1,3	1,6	1,8	1,4	1,7	1,9	1,5	1,8	2,0	1,7	2,0	2,2	1,9	2,3	2,5
1,4	1,7	1,9	1,5	1,8	2,0	1,7	2,0	2,2	1,9	2,3	2,5	2,0	2,5	2,7
1,5	1,8	2,0	1,7	2,0	2,2	1,9	2,3	2,5	2,0	2,5	2,7	2,2	2,7	3,0
1,7	2,0	2,0	1,9	2,3	2,5	2,0	2,5	2,7	2,2	2,7	3,0	2,4	3,0	3,3
1,9	2,3	2,5	2,0	2,5	2,7	2,2	2,7	3,0	2,4	3,0	3,3	2,6	3,2	3,5
2,0	2,5	2,7	2,2	2,7	3,0	2,4	3,0	3,3	2,6	3,2	3,5	2,8	3,5	3,8
2,2	2,7	3,0	2,4	3,0	3,3	2,6	3,2	3,5	2,8	3,5	3,8	3,0	3,8	4,1
2,4	3,0	3,3	2,6	3,2	3,5	2,8	3,5	3,8	3,0	3,8	4,1	3,4	4,3	4,7
2,6	3,2	3,5	2,8	3,5	3,8	3,0	3,8	4,1	3,4	4,3	4,7	3,7	4,7	5,1
2,8	3,5	3,8	3,0	3,8	4,1	3,4	4,3	4,7	3,7	4,7	5,1	4,1	5,1	5,6
3,0	3,8	4,1	3,4	4,3	4,7	3,7	4,7	5,1	4,1	5,1	5,6	4,5	5,7	6,2
3,4	4,3	4,7	3,7	4,7	5,1	4,1	5,1	5,6	4,5	5,7	6,2	4,9	6,2	6,8
3,7	4,7	5,1	4,1	5,1	5,6	4,5	5,7	6,2	4,9	6,2	6,8	5,4	6,8	7,5
4,1	5,1	5,6	4,5	5,7	6,2	4,9	6,2	6,8	5,4	6,8	7,5	5,8	7,4	8,1
4,5	5,7	6,2	4,9	6,2	6,8	5,4	6,8	7,5	5,8	7,4	8,1	6,2	7,9	8,7
4,9	6,2	6,8	5,4	6,8	7,5	5,8	7,4	8,1	6,2	7,9	8,7	7,1	9,1	10,0

4.3.1. Displacement along the die-parting surface — as per table 4.

Table 4

Weight, in kg	Allowance for accuracy class, мм									
	Flat parting surface (П)									
	T1	T2	T3	T4	T5					
			Symmetrically bent parting surface ($И_с$)							
			T1	T2	T3	T4	T5			
			Asymmetrically bent/curved parting surface ($И_а$)							
			T1	T2	T3	T4	T5			
Upto 0.5 inclusive	0,1	0,1	0,1	0,1	0,2	0,2	0,3	0,3		
Above 0.5 to 1.0 »				0,2		0,3		0,4		
» 1,0 » 1,8 »		0,2	0,2		0,3		0,4	0,5		
» 1,8 » 3,2 »				0,3		0,4	0,5	0,6		
» 3,2 » 5,6 »	0,2	0,3	0,3		0,4	0,5	0,6	0,7		
» 5,6 » 10,0 »				0,4	0,5	0,6	0,7	0,9		
» 10,0 » 20,0 »	0,3		0,4	0,5	0,6	0,7	0,9	1,2		
» 20,0 » 50,0 »		0,4	0,5	0,6	0,7	0,9	1,2	1,6		
» 50,0 » 125,0 »	0,4	0,5	0,6	0,7	0,9	1,2	1,6	2,0		
» 125,0 » 250,0 »										

4.3.2. Camber & deviation from flatness & straightness — as per table. 5.

Table 5

мм

Maximum dimension of the forging	Allowance for accuracy class				
	T1	T2	T3	T4	T5
Up to 100 inclusive.	APPEI	0.2	0.2	0.3	0.4
Above 100 » 160 »		0.2	0.3	0.4	0.5
» 160 » 250 »	0.2	0.3	0.4	0.5	0.6
» 250 » 400 »	0.2	0.4	0.5	0.6	0.8
» 400 » 630 »	0.3	0.5	0.6	0.8	APPE
» 630 » 1000 »	0.4	0.6	0.8	APPE	
» 1000 » 1600 »	0.5	0.8	APPE		1.2
» 1600 » 2500 »	0.6	1.0		1.2	1.6
	0.8		1.2	1.6	2.0

4.3.3. Deviations of interaxial distance — as table 6.

Table 6

мм

Distance between the centers, axis	Allowance for accuracy class				
	TI	T2	T3	T4	T5
Upto 60 inclusive.	APPEI	APPEI	0.2	0.2	
Above 60 to 100 »			0.2	0.3	APPI
» 100 » 160 »	APPEI	0.2	0.3	0.5	APPI
» 160 » 250 »		0.2	0.5	0.8	APPI
» 250 » 400 »	0.2	0.3	0.8	1.2	APPI
» 400 » 630 »	0.2	0.5	1.2	APPE	1.6
» 630 » 1000 »	0.3	0.8	1.6	2.0	2.0
» 1000 » 1600 »	0.5	1.2	2.0	2.5	2.5
» 1600 » 2500 »	0.8	1.6	2.5	4.0	4.0
	1.2	2.0			6.0
	1.6				

4.3.4. The value of the additional allowance, which takes into account the deviations of the angular dimension, is set as agreed by the manufacturer and the customer.

4.4. It is permitted to round off the linear dimensions of the forgings with accuracy up to 0,5 mm.

4.5. While assigning value of allowance on surface, position of which is determined by two and more dimensions of the forgings, higher value of the allowance for the given surface will be taken.

4.6. While manufacturing core forgings with two sided upsetting or forgings for which the core is not subjected to deformations, allowances on machining should be set taking into account the tolerance on rod length as given in point 5.6.

4.7. The minimum value of rounding off the radius of external corners of the forgings depending on the depth of the die impression pocket/cavity is set as per table. 7.

Table 7

Forging weight, in kg	Minimum rounding off radius, in мм, for depth of die impression pocket, in мм			
	Upto 10 Inclusive.	10—25	25-50	Above 50
Upto 1,0 inclusive.	1.0	1.6	2.0	3.0
Above 1.0 to 6.3 »	1.6	2.0	2.5	3.6
» 6.3 » 16.0 »	2.0	2.5	3.0	4.0
» 16.0 » 40.0 »	2.5	3.0	4.0	5.0
» 40.0 » 100.0 »	3.0	4.0	5.0	7.0
» 100.0 » 250.0 »	4.0	5.0	6.0	8.0

4.3. While manufacturing the forgings of accuracy class T5 by flame heating of the blank, it permitted to increase the allowance for forging with weight, as given below:

Upto 3.2 kg	—upto 0.5 мм;
3.2 to 10.0 »	— » 0.8 » ;
Above 10.0 »	— » 1.0 » .

5. TOLERANCES

5.1. Tolerances and permissible deviations of the linear dimensions of the forging are fixed depending on the initial index and the dimension of the forgings as per tab. 8.

5.2. Permissible deviations of the internal dimensions of the forgings should be fixed with opposite signs.

Tolerances and permissible deviations of the dimensions (see fig. 2), reflecting one sided wear & tear of the dies are equal to 0.5 the dimension given in tab. 8.

5.3. Tolerances and permissible deviations of the thickness, taking into account underforgings are set on the higher forging thickness and covers for all thickness.

5.4. Tolerance on thickness of forgings subjected to cold or hot sizing are set as per the appendix 4.

5.5. The tolerance on dimensions, which are not specified in the forging drawing, is taken as equal to 1,5 times the tolerance of corresponding forging dimension with equal permissible deviations.

5.6. For forgings, for which the core/rod projects beyond the die limit and does not undergo deformation, tolerance on core length is taken, in mm:

Upto 2 — For forgings of 1st accuracy class
» 3 For forgings of 2nd accuracy class
» 4 For forgings of 3rd accuracy class
» 5 For forgings of 4th accuracy class
» 6 For forgings of 5th accuracy class

The value of the tolerance on length of the undeformed core for forgings, obtained by two sided upsetting is doubled. For forgings, obtained by upsetting with subsequent stamping/forging & upsetting of the rolled stock of standard length, tolerance on length of the core/rod is set as agreed by the manufacturer and the customer.

Tolerance does not include deviations on pressing and non-perpendicularity of the core/rod end face.

For the section of the core, pressed in the die or in clamp from the back support during forgings, it is permitted to increase the diameter of the core by a value of double the positive permissible deviation as per table 8 for a distance of upto two diameters from the head of the forging and one and a half the diameters from the end face of the core.

Table 8

Tolerance and permissible deviations of the linear dimensions

In мм

Index	Maximum thickness of forgings																	
	Upto 40		40—63		63—100		100—160		160—250		ca. 250							
	Length, width, diameter, depth & height of forging																	
	Upto 40		40—100		100—160		160—250		250—400		[illegible]—630		630—1099		1000—1600		1600—2500	
1	0,3	+0,2 −0,1	0,4	+0,3 −0,1	0,5	+0,3 −0,2	0,6	+0,4 −0,2	0,7	+0,5 −0,2	—	—	—	—	—	—	—	—
2	0,4	+0,3 −0,1	0,5	+0,3 −0,2	0,5	+0,4 −0,2	0,7	+0,5 −0,2	0,8	+0,5 −0,3	0,9	+0,6 −0,3	—	—	—	—	—	—
3	0,5	+0,3 −0,2	0,6	+0,4 −0,2	0,7	+0,5 −0,2	0,8	+0,5 −0,3	0,9	+0,6 −0,3	1,0	+0,7 −0,3	1,2	+0,8 −0,4	—	—	—	—
4	0,6	+0,4 −0,2	0,7	+0,5 −0,3	0,8	+0,5 −0,3	0,9	+0,6 −0,3	1,0	+0,7 −0,3	1,2	+0,8 −0,4	1,4	+0,9 −0,5	—	—	—	—
5	0,7	+0,5 −0,2	0,8	+0,5 −0,3	0,8	+0,6 −0,3	1,0	+0,7 −0,3	1,2	+0,8 −0,4	1,4	+0,9 −0,5	1,6	+1,1 −0,5	2,0	+1,3 −0,7	—	—
6	0,8	+0,5 −0,3	0,9	+0,6 −0,3	1,0	+0,7 −0,3	1,2	+0,8 −0,4	1,4	+0,9 −0,5	1,6	+1,1 −0,5	2,0	+1,3 −0,7	2,2	+1,4 −0,8	2,5	+1,6 −0,9
7	0,9	+0,6 −0,3	1,0	+0,7 −0,3	1,2	+0,8 −0,4	1,4	+0,9 −0,5	1,6	+1,1 −0,5	2,0	+1,3 −0,7	2,2	+1,4 −0,8	2,5	+1,6 −0,9	2,8	+1,8 −1,0
8	1,0	+0,7 −0,3	1,2	+0,8 −0,4	1,4	+0,9 −0,5	1,6	+1,1 −0,5	2,0	+1,3 −0,7	2,2	+1,4 −0,8	2,5	+1,6 −0,9	2,8	+1,8 −1,0	3,2	+2,1 −1,1

Continuation

Index	Maximum thickness of forgings															
	Upto 40		40—63		63—100		100—160		160—250		ca. 250					
	Length, width, diameter, depth & height of forging															
	Upto 40		40—100		100—160		160—250		250—400		400—630		630—1000		1000—1600		1600—2500	
9	1,2	+0,8 −0,4	1,4	+0,9 −0,5	1,6	+1,1 −0,5	2,0	+1,3 −0,7	2,2	+1,4 −0,8	2,5	+1,6 −0,9	2,8	+1,8 −1,0	3,2	+2,1 −1,1	3,6	+2,4 −1,2
10	1,4	+0,9 −0,5	1,6	+1,1 −0,5	2,0	+1,3 −0,7	2,2	+1,4 −0,8	2,5	+1,6 −0,9	2,8	+1,8 −1,0	3,2	+2,1 −1,1	3,6	+2,4 −1,2	4,0	+2,7 −1,3
11	1,6	+1,1 −0,5	2,0	+1,3 −0,7	2,2	+1,4 −0,8	2,5	+1,6 −0,9	2,8	+1,8 −1,0	3,2	+2,1 −1,1	3,6	+2,4 −1,2	4,0	+2,7 −1,3	4,5	+3,0 −1,5
12	2,0	+1,3 −0,7	2,2	+1,4 −0,8	2,5	+1,6 −0,9	2,8	+1,8 −1,0	3,2	+2,1 −1,1	3,6	+2,4 −1,2	4,0	+2,7 −1,3	4,5	+3,0 −1,5	5,0	+3,3 −1,7
13	2,2	+1,4 −0,8	2,5	+1,6 −0,9	2,8	+1,8 −1,0	3,2	+2,1 −1,1	3,6	+2,4 −1,2	4,0	+2,7 −1,3	4,5	+3,0 −1,5	5,0	+3,3 −1,7	5,6	+3,7 −1,9
14	2,5	+1,6 −0,9	2,8	+1,8 −1,0	3,2	+2,1 −1,1	3,6	+2,4 −1,2	4,0	+2,7 −1,3	4,5	+3,0 −1,5	5,0	+3,3 −1,7	5,6	+3,7 −1,9	6,3	+4,2 −2,1
15	2,8	+1,8 −1,0	3,2	+2,1 −1,1	3,6	+2,4 −1,2	4,0	+2,7 −1,3	4,5	+3,0 −1,5	5,0	+3,3 −1,7	5,6	+3,7 −1,9	6,3	+4,2 −2,1	7,1	+4,7 −2,4
16	3,2	+2,1 −1,1	3,6	+2,4 −1,2	4,0	+2,7 −1,3	4,5	+3,0 −1,5	5,0	+3,3 −1,7	5,6	+3,7 −1,9	6,3	+4,2 −2,1	7,1	+4,7 −2,4	8,0	+5,3 −2,7

Continuation

In mm

Index	Maximum thickness of forging															
	Upto 40		40—63		63—100		100—160		160—250		over 250					
	Length, width, diameter, depth & height of forging															
	Upto 40		40—100		100—160		160—250		250—400		400—630		630—1000		1000—1600		1600—2500	
17	3,6	+2,4 −1,2	4,0	+2,7 −1,3	4,5	+3,0 −1,5	5,0	+3,3 −1,7	5,6	+3,7 −1,9	6,3	+4,2 −2,1	7,1	+4,7 −2,4	8,0	+5,3 −2,7	9,0	+6,0 −3,0
18	4,0	+2,7 −1,3	4,5	+3,0 −1,5	5,0	+3,3 −1,7	5,6	+3,7 −1,9	6,3	+4,2 −2,1	7,1	+4,7 −2,4	8,0	+5,3 −2,7	9,0	+6,0 −3,0	10,0	+6,7 −3,3
19	4,5	+3,0 −1,5	5,0	+3,3 −1,7	5,6	+3,7 −1,9	6,3	+4,2 −2,1	7,1	+4,7 −2,4	8,0	+5,3 −2,7	9,0	+6,0 −3,0	10,0	+6,7 −3,3	11,0	+7,4 −3,6
20	5,0	+3,3 −1,7	5,6	+3,7 −1,9	6,3	+4,2 −2,1	7,1	+4,7 −2,4	8,0	+5,3 −2,7	9,0	+6,0 −3,0	10,0	+6,7 −3,3	11,0	+7,4 −3,6	12,0	+8,0 −4,0
21	5,6	+3,7 −1,9	6,3	+4,2 −2,1	7,1	+4,7 −2,4	8,0	+5,3 −2,7	9,0	+6,0 −3,0	10,0	+6,7 −3,3	11,0	+7,4 −3,6	12,0	+8,0 −4,0	13,0	+8,6 −4,4
22	6,3	+4,2 −2,1	7,1	+4,7 −2,4	8,0	+5,3 −2,7	9,0	+6,0 −3,0	10,0	+6,7 −3,3	11,0	+7,4 −3,6	12,0	+8,0 −4,0	13,0	+8,6 −4,4	14,0	+9,2 −4,8
23	7,1	+4,7 −2,4	8,0	+5,3 −2,7	9,0	+6,0 −3,0	10,0	+6,7 −3,3	11,0	+7,4 −3,6	12,0	+8,0 −4,0	13,0	+8,6 −4,4	14,0	+9,2 −4,8	16,0	+10,0 −6,0

Permissible deviations of the core section dimension of the undeformed sections are determined by the corresponding standards on the rolled stock by increasing the negative permissible deviation by not more than 0,5 mm.

5.7. The tolerance on parting surface shift value is determined depending on the weight of the forging, configuration of parting surface and accuracy class and should not exceed the values given in tab. 9.

Table 9

Weight of the forging, in kg	Permissible shift value of parting surface, in mm						
	Flat surface of parting plane (H)						
	T1	T2	T3	T4	T5		
	Symmetrically bent surface of parting plane (H_s)						
	T1	T2	T3	T4	T5		
	Asymmetrically bent surface of parting plane (H_a)						
	T1	T2	T3	T4	T5		
Up to 0,5 Inclusive	0,1	0,2	0,2	0,3	0,4	0,5	0,6
Above 0,5 » 1,0 »	0,2	0,2	0,3	0,4	0,5	0,6	0,7
» 1,0 » 1,8 »	0,2	0,3	0,4	0,5	0,6	0,7	0,8
» 1,8 » 3,2 »	0,3	0,4	0,5	0,6	0,7	0,8	1,0
» 3,2 » 5,6 »	0,4	0,5	0,6	0,7	0,8	1,0	1,2
» 5,6 » 10,0 »	0,5	0,6	0,7	0,8	1,0	1,2	1,4
» 10,0 » 20,0 »	0,6	0,7	0,8	1,0	1,2	1,4	1,8
» 20,0 » 50,0 »	0,7	0,8	1,0	1,2	1,4	1,8	2,5
» 50,0 » 125,0 »	0,8	1,0	1,2	1,4	1,8	2,5	3,2
» 125,0 » 250,0 »	1,0	1,2	1,4	1,8	2,5	3,2	4,0

5.8. The permissible value of residual flash is determined depending on the weight of the forging, configurations of die parting surface and accuracy class and is fixed as per tab. 10.

Table 10

Weight of the forging, in kg	Permissible value of residual flash							
	Flat surface of parting plane (II)							
	T1	T2	T3	T4	T5			
		Symmetrically bent surface of parting plane (H_s)						
				T2	T3	T4	T5	
				Asymmetrical bent surface of parting plane (H_a)				
				T1	T2	T3	T4	T5
Up to 0,5 inclusive	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9
Above 0,5 » 1,0 »	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0
» 1,0 » 1,8 »	0,4	0,5	0,6	0,7	0,8	0,9	1,0	1,2
» 1,8 » 3,2 »	0,5	0,6	0,7	0,8	0,9	1,0	1,2	1,4
» 3,2 » 5,6 »	0,6	0,7	0,8	0,9	1,0	1,2	1,4	1,6
» 5,6 » 10,0 »	0,7	0,8	0,9	1,0	1,2	1,4	1,6	1,8
» 10,0 » 20,0 »	0,8	0,9	1,0	1,2	1,4	1,6	1,8	2,2
» 20,0 » 50,0 »	0,9	1,0	1,2	1,4	1,6	1,8	2,2	2,8
» 50,0 » 125,0 »	1,0	1,2	1,4	1,6	1,8	2,2	2,8	3,5
» 125,0 » 250,0 »	1,2	1,4	1,6	1,8	2,2	2,8	3,5	4,0

In places of transition for radii upto 10 mm, it is permitted to fix double the value of residual flash.

5.9. Value of the trimmed edge should not reduce the set allowance.

5.10. The permissible value of burr height in the forgings along the profile of deflashing should not exceed the values given below:

2 мм — For forgings of weight up to 1.0 kg included.;
3 мм » » » above 1.0 kg to 5.6 kg inclusive.;
5 мм » » » » 5.6 kg » 50.0 kg » ;
6 мм » » » » 50.0 kg

and while forging a whole this value can be increased by 1,3 time.

5.11. The permissible value of burrs formed along the punch profile while forging in closed dies (flash free) is determined as per tab. 11.

Table 11

Weight of forging, in kg	Degree of complexity of the forging	Permissible value of burrs for maximum dimension of the forge cross section in the parting plane of the die, in мм				
		upto 40	40-100	100—160	160—250	св. 250
Upto 0.5 inclusive	Cl, C2	1.0	2.0	—	—	—
	C3	2.0	3.0	—	—	—
	C4	3.0	4.0	—	—	—
Above 0.5 to 3.2 »	Cl, C2	2.0	3.0	4.0	—	—
	C3	3.0	4.0	5.0	—	
	C4	4.0	5.0	6.0	—	—
» 3.2 » 5.6 »	Cl, C2	3.0	4.0	5.0	—	—
	C3	4.0	5.0	6.0	—	—
	C4	5.0	6.0	7.0	—	
» 5.6 » 20.0 »	Cl, C2	4.0	5.0	6.0	7.0	8.0
	C3	5.0	6.0	7.0	8.0	9.0
	C4	6.0	7.0	8.0	9.0	10.0
» 20.0 » 50.0 »	Cl, C2	5.0	6.0	7.0	8.0	9.0
	C3	6.0	7.0	8.0	9.0	10.0
	C4	7.0	8.0	9.0	10.0	11.0
» 50.0	Cl, C2	6.0	7.0	8.0	9.0	10.0
	C3	7.0	8.0	9.0	10.0	11.0
	C4	8.0	9.0	10.0	11.0	12.0

5.12. For forgings, manufactured on up-setting machines, the permissible height of the burrs in the parting plane of the matrixes should not exceed the double the value of residual flash as per tab. 10.

5.13. Burrs on the non-machining surfaces of the forge should be deburred at customer's request, if the forging form/shape in technically justified cases allows deburring on deburring machine tools.

5.14. The permissible deviation from concentricity (misalignment) of non-forged holes (markings) in forgings (see fig. 4r) is taken 1,0 % maximum of the hole depth (marking).

5.15. The permissible maximum deviation from concentricity of forged holes in the forgings (see fig. *4в)* is established in tab. 12.

Table 12

in MM

Maximum dimension of the forging	Permissible maximum deviation from concentricity of forged holes for accuracy class				
	T1	T2	T3	T4	T5
Up to 100 inclusive.	0.4	0.5	0.6	0.8	1,0
Above 100 to 160 »	0 5	0.6	0.8	1.0	1,5
» 160 » 250 »	0.6	0.8	1.0	1.5	2.0
» 250 » 400 »	0.8	1.0	1.5	2.0	2.5
» 400 » 630 »	1.0	1.5	2.0	2.5	3.0
» 630 » 1000 »	1.5	2.0	2.5	3.0	4.0

The given permissible deviations from concentricity of holes (misalignment) correspond to the beginning/starting of hole punching (from the side of entry of punch into forging). At the end of the punching hole (from the side of exit of punch) these deviations can be increased by 25%.

5.16. Permissible deviations/variation on camber, from flatness and from straightness for flat surfaces (see fig. 7) are set as per tab. 13. In the given values, drop in height, thickness or width of forgings are not taken into account.

Table 13

in MM

Maximum dimension of the forging	Permissible deviation on camber for accuracy class				
	T1	T2	T3	T4	T5
Up to 100 inclusive.	0.3	0.4	0.5	5.6	0.8
Above 100 » 160 »	0.4	0.5	0.6	0.8	1.0
» 160 » 250 »	0.5	0.6	0.8	1.0	1.2
» 250 » 400 »	0.6	0.8	1.0	1.2	1.6
» 400 » 630 »	0.8	1.0	1.2	1.6	2.0
» 630 » 1000 »	1.0	1.2	1.6	2.0	2.5
» 1000 » 1600 »	1.2	1.6	2.0	2.5	3.2
» 1600 » 2500 »	1.6	2.0	2.5	3.2	4.0

Long forgings of dimension/size over 1000 mm are straightened before machining.

5.17. Tolerance on radial run-out of cylindrical surfaces should not exceed double the value specified in tab. 13 (Assigned as agreed between the manufacturer and the customer).

5.18. Permissible deviations of interaxal distance (A_1) in forgings (see fig. 2) should not exceed the values specified in tab. 14.

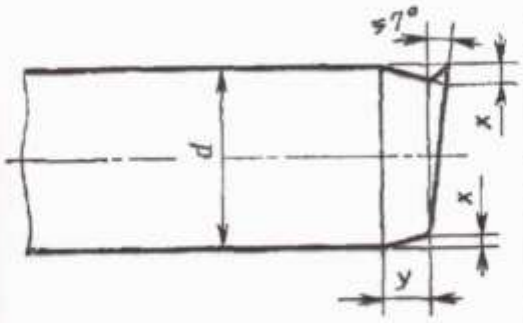
Table 14

Interaxal distance	Permissible deviations of interaxal distance for accuracy class				
	T1	T2	T3	T4	T5
Upto 60 inclusive	±0.10	±0.15	±0.20	±0.25	±0.50
Above 60 » 100 »	±0.15	±0.20	±0.25	±0.30	±0.50
Above 100 » 160 »	±0.20	±0.25	±0.30	±0.50	±0.80
Above 160 » 250 »	±0.25	±0.30	±0.50	±0.80	±1.20
Above 250 » 400 »	±0.30	±0.50	±0.80	±1.20	±1.60
Above 400 » 630 »	±0.50	±0.80	±1.20	±1.60	±2.00
Above 630 » 1000 »	±0.80	±1.20	±1.60	±2.00	±3.00
Above 1000 » 1600 »	±1.20	±1.60	±2.00	±3.00	±4.50
Above 1600 » 2500 »	±1.60	±2.00	±3.00	±4.50	±7.00

5.19. The permissible deviation of interaxal distance (A_2) in forgings (see fig. 3) is set as agreed by the customer and the manufacturer.

5.20. The permissible deviation of the end face of forging core/rod after parting the rod from the blank, which is not subjected to deformation during forging (fig. 10) is determined as per table 15 depending on the diameter of the rod. Non-perpendicularity of the parted surface to the axis of blank up to 7° is permitted.

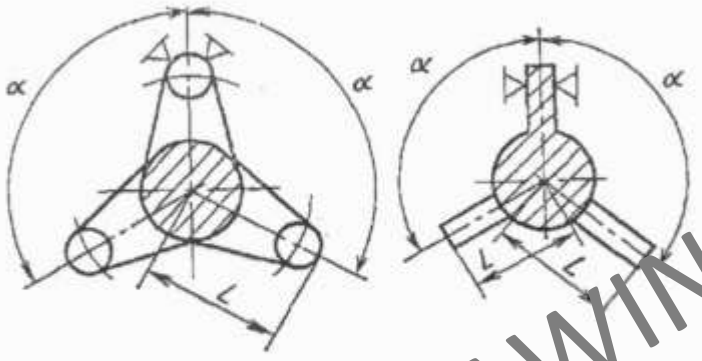
mm Table 15



Rod diameter (d)	Permissible deviation	
	x	y
Upto 40 inclusive	0.08 d	1 d
Above. 40	0.07 d	0.8 d

Fig 10

5.21. Permissible deviations of angular (α) dimension of forging elements (Fig. 11) are set as per table 16.



L — Element length (distance from the forge axis to face of the element)

Fig. 11

Table 16

Element length (*L*), mm	Permissible deviations of angular (α) dimension of forging elements for accuracy class				
	T1	T2	T3	T4	T5
Upto 25 inclusive	±0°45'	±1°00'	±1°30'	±2°00'	±2°30'
Above 25 » 60 »	±0°30'	±0°45'	±1°00'	±1°30'	±2°00'
» 60 » 100 »	±0°15'	±0°30'	±0°45'	±1°00'	±1°30'
» 100 » 160 »	±0°10'	±0°15'	±0°30'	±0°45'	±1°00'
» 160	±0°05'	±0°10'	±0°15'	±0°30'	±0°45'

Permissible deviations of the angular dimensions for forging are increased by 50 % for which twisting or bending of elements is carried out on separate equipment.

5.22. Traces in the form of depression or projections formed because of the pusher/knock out or clamping elements of the die are permitted.

Depth of depression should not be more than 0.5 times the actual allowance value. Permissible height of projection should be upto 3.0 mm on machining surface, and on non-machining surface - it should be agreed between the manufacturer and the customer.

5.23. Tolerance on rounding off radius of internal and external corners of forging is set as per table 17.

Table 17

MM

Rounding off radius	Tolerance on rounding off radius for accuracy class				
	T1	T2	T3	T4	T5
Upto 4 inclusive	0.5	0.5	0.5	1.0	2.0
Above 4 » 6 »	0.5	0.5	1.0	2.0	3.0
» 6 » 10 »	1.0	1.0	2.0	3.0	5.0
» 10 » 16 »	1.0	2.0	3.0	5.0	8.0
» 16 » 25 »	2.0	3.0	5.0	8.0	12.0
» 25 » 40 »	3.0	5.0	8.0	12.0	20.0
» 40 » 60 »	5.0	8.0	12.0	20.0	30.0
» 60 » 100 »	8.0	12.0	20.0	30.0	50.0

5.24. Permissible deviations of draft angle on forgings are fixed within the limits of ±0,25 of their nominal dimension.

5.25 Tolerance on height (length) of the core, bush and tag of forgings manufactured by extrusion is fixed as agreed by the manufacturer and the customer.

5.26 Permissible deviations of the form and position of surfaces (points 5.7-5.17, 5.20, 5.22—5.24) are independent and does not depend on tolerance and permissible deviations of forging dimension.

6. FORGING LAP

6.1. Forge lap can be formed on forgings by draft, rounding off radius of internal corners, impenetrable crosspiece in the holes and undercuts and cavities, which cannot be carried out in forging operations.

6.2. Draft should not exceed the values given in table 18.

Table 18

Equipment	Draft, rad	
	On external surface	On internal surface
Forging hammers, die without knock out	7	10
Die/press with knock out, up-setting forging	5	7
Hot (die)-Forging machines	1	2

Draft surface of hole in the forgings, manufactured on up-setting forging machines, the draft should not exceed 3°.

For forgings manufactured on forging hammers and presses without pushers/knock out, having elements in the form of edge, projection, flanges with ratio of their height to width more than 2.5, draft can be upto 10° on the external surface and upto 12° on the internal surface.

6.3. Value of rounding off radius of internal corners is set as agreed by the manufacturer and customer.

6.4. Dents and depression in the forgings, when their axes are parallel to the direction of movement of one of the moving parts of the die, and diameter or the least cross sectional area is not les than 30 mm, are made with depth up to 0.8 of their diameters or the least cross sectional area— while manufacturing on hammers and presses and up to three times the diameters — during manufacturing on horizontal – forging machines/ up-setting forging machines.

6.5. Through holes are made in the forgings during double sided depression, if during its manufacturing their axis is parallel to the direction of movement of one of the moving parts of the stamp /die. Diameter of the through hole is not less than 30mm, and forging thickness at places of hole punching — not more than the diameter of forging / punching holes.

APPENDIX
Recommended

Table 19

SELECTION OF FORGING ACCURACY CLASS

Basic deforming equipment, Technological process	Accuracy class				
	T1	T2	T3	T4	T5
Crank operated hot forging press;					
Open (with flash) forging				+	+
Closed forging		+	+		
Extrusion			+		
Horizontal forging machine (up-setting)				+	+
Hydraulic screw press				+	+
Hot forging automats		+	+		
Forging hammer				+	+
Three dimensional calibration (hot & cold)	+	+		+	
Precision forging	+				

Note:

1. Precision forging — Method of forging, ensuring the required accuracy & surface finish roughness) of one or many functional surfaces of the forging, which are not subjected to machining.

2. During flame heating of blanks, it is permitted to reduce the accuracy for classes T2—T4 by one class

3. During cold or hot plane calibration/shaping, accuracy is taken on one class above.

APPENDIX 2
Compulsory

DEGREES OF COMPLEXITY OF FORGINGS

1. The degree of complexity is one of the design characteristics of forgings, qualitatively evaluating it and is used for fixing allowances and tolerance.

2. Degree of complexity is determined by calculation of the ratio of weight (volume) $G_п$ of the forging to weight (volume) $G_ф$ of the geometrical figure, in which the forging mould is entered. The geometrical figure can be a sphere, a parallel piped, cylinder with perpendicular faces to its axis or rectangular regular prism (fig. 12).

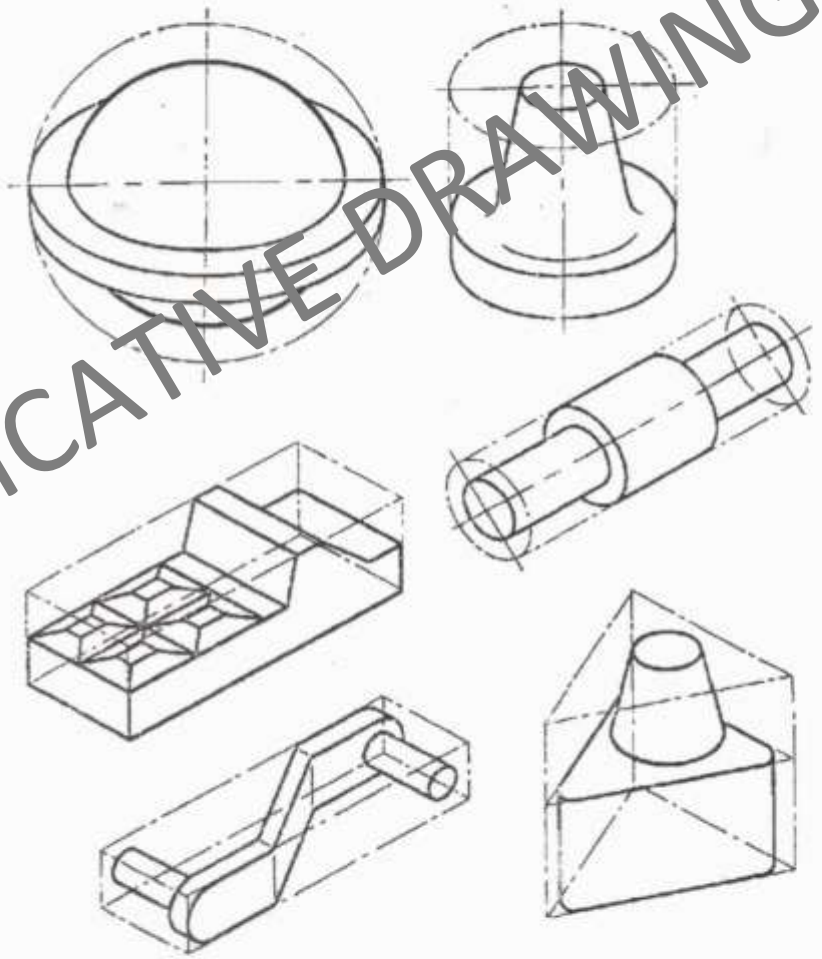


Figure 12

While calculating the ratio $G_п$ / $G_ф$, those geometrical figures are taken, weight of which (volume) is least.

3. While determining the dimensions describing the forging, the geometrical figure can be started with increase by 1,05 times of the overall linear dimension of the part, determining the position of its machined surfaces.

4. The following numerical values of the ratio $G_п$ / $G_ф$ corresponds to the degrees of complexity of forgings:

C1	— above 0.63				
C2	»	0.32	to	0.63	»
C3	»	0.16	»	0.32	»
C4			»	0.16	

5. The Degree of complexity C4 is set for forgings with thin elements, for example, in the form of disk, flange, ring (fig. 13), including with forging crosspieces, and also for forgings with thin rod elements if ratio t/D; t/L; t/(D-d) does not exceed 0.20 and t should not be more than 25 mm (where D - the maximum dimension of thin element, t - thickness of thin element, L - length of thin element, d - diameter of forging element thickness of which exceeds the value t).

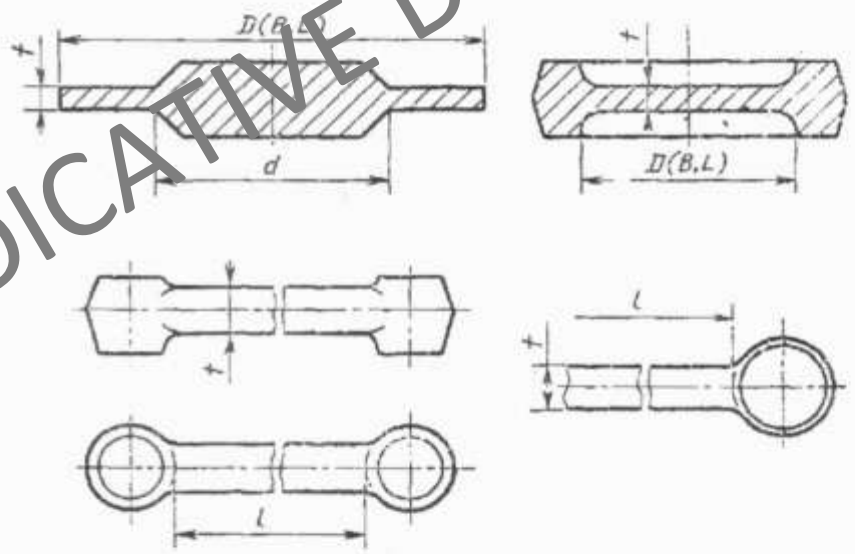


Figure. 13

6. For forgings, made on horizontal - forging machines, it is permitted to determine the degree of complexity of the form/mould depending on number of transitions:

C1 —not more than two transitions ;

C2 — during three transitions;

C3 — during four transitions;

C4 — more than four transitions or while manufacturing in two forging machines.

FACTOR (K_P) FOR DETERMINING THE APPROXIMATE DESIGN WEIGHT OF FORGING

Table 20

Group	Characteristics of parts	Standard specimen	K_P
1	Stretched form		
1.1	With straight axis	Shafts, axles, journals, cranks	1.3—1.6
1.2	With curved axis	Levers, crop arm	1.1-1.4
2	Round & multiple sided in horizontal projection		
2.1	Round	Wheel, hub, Flange	1.5—1.8
2.2	Square, rectangular, many sided	Flange, hub, nuts	1.3-1.7
2.3	With branch piece (extensions)	Cross piece, fork/socket	1.4—1.6
3	combined (combined elements of group 1 & 2) configuration	Rotating cam, crank shaft	1.3—1.8
4	With too many unmachined surfaces	Front-axle beam, transmission gear box clutch, pulling hook	1.1—1.3
5	With holes, recess, undercuts, which cannot be forged	Hollow shaft, flange, gear block	1.8—2.2

APPENDIX 1
Compulsory

TOLERANCE AND ALLOWANCE ON FORGING THICKNESS, SUBJECTED TO COLD AND HOT CALIBRATION

1. During cold shaping, allowance on machining and tolerances on thickness between the calibrated/shaped planes are determined as per tab. 21.

Permissible deviations is taken as equal to half of tolerance field.

Table 21

Surface area subjected to calibration, in $см^2$	Allowance, in мм	Tolerance field at K*, in мм	
		Upto 0.5 Inclusive	Above 0.5
Upto 2.5 inclusive	0.30	0.32	0.26
Above 2.5 » 6.3 »	0.30	0.36	0.32
» 6.3 » 10.0 »	0.36	0.40	0.36
» 10.0 » 16.0 »	0.40	0.44	0.40
» 16.0 » 25.0 »	0.50	0.50	0.44
» 25.0 » 40.0 »	0.60	0.60	0.50
» 40.0 » 80.0 »	0.70	0.80	0.60

* The ratio of thickness (distance between the calibrated/shaped planes) to width of forging, subjected to calibration/shaping, or its element.

1.1. During simultaneous calibration/shaping of several planes of forgings, the area of the surface subjected to calibration/shaping is determined as their sum. Tolerances and permissible deviations are set for all calibrating/shaping elements as per the least/minimum value K*.

1.2. During hot calibration/shaping, allowances and tolerances on forging thickness can be increased by 1.5 times.

2. The width, length and diameter of forgings or it elements, which changes during calibration/shaping, are set as agreed by the manufacturer and the customer. During this the value of single sided increase of the dimensions should not exceed double the positive side deviation, and the decrease —double the negative deviation value on the dimension before shaping/calibration.

3. Deviation from parallelism, flatness and straightness of the calibrated/shaped planes are permitted within the limits of the tolerance on the dimension after calibration/shaping.

APPENDIX 5
Reference

EXAMPLES OF CALCULATION (ASSIGNMENT)) OF TOLERANCES AND PERMISSIBLE DEVIATIONS AND ALLOWANCES ON FORGINGS

Example 1

Drive gear (figure 14).

Forging machine — Automatic hot forging,

Heating of blank — Induction.

1. Basic data for the part

1.1. Material— Steel 30XMA (as per GOST 4543): 0.17—0.37% Si; 0.26—0.33% C; 0.4—0.7% Mn; 0.8—1.1% Cr; 0.15—0.25% M

1.2. Part weight — 0.390 kg.

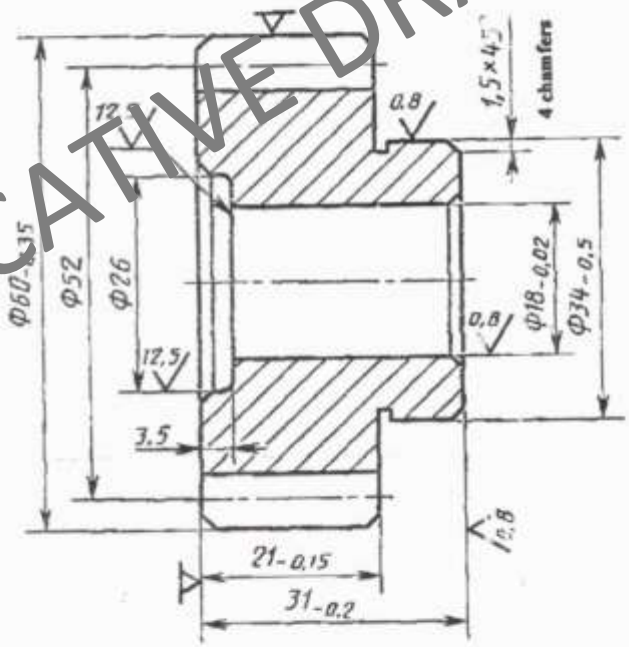


Figure 14

2. Initial data for calculation

2.1. Forge weight (Design) —0.620 kg:

Design coefficient K_p (see appendix 3) — 1.6;

0.390 x 1.6=0.620 kg.

2.2. Accuracy class — T3 (see reference 1).

2.3. Steel group — M1 (see table.1).

Average fraction of total mass of carbon in steel 30XMA 0.3% C, and fraction of total mass of alloying elements—1.9% (0.27% Si; 0.55% Mn; 0.95% Cr; 0.25% Mo).

2.4. Degree of complexity — C1 (see appendix 2).

Dimensions describing the shape of the forging (cylinder), in мм:

Diameter — 63 (60 x 1.05);

Length—32.5 (31 x 1.05) (where 1.05—coefficient).

Weight of the describing shape (design)—0.780 kg;

$$G_n : G_\phi = 0.620 : 0.780 = 0.79.$$

2.5. Configuration/type of the parting plane II (flat) — (see table. 1).

2.6. Initial index — 6 (see table. 2).

3. Allowance and forging lap

3.1. Basic allowance on dimension (see table. 3), in мм:

1,0 — Diameter 60 мм and surface condition/surface roughness 6.3;

1.0 — Hub diameter 34 мм and surface condition/surface roughness 0.8;

1.0 — Thickness 31 мм and surface condition/surface roughness 6.3;

1.1 — Thickness 31 мм and surface condition/surface roughness 0.8;

0.9 — Thickness 21 мм and surface condition/surface roughness 6.3.

3.2. Additional allowance, which takes into account the deviation from flatness — 0.2 мм (see table. 14).

4. The dimensions of forging and their permissible deviations (see fig. 15)

4.1. The dimensions of forging, in мм:

Diameter 60+1.0x2 = 62	Taken as 62;
Diameter 34+1.0x2 = 36	» 36;
Thickness 21 + (0.9 + 0.2) x 2=23,2	» 23;
Thickness 31 + 1.0+1.1+0.2x2 = 33,5	Taken as 33.5.

4.2. Rounding off radius of external corners—2,0 мм (minimum) taken as 3.0 мм (see table 7).

4.3. Permissible deviation on dimension (see table. 8), мм:

Diameter $62^{+0.6}_{-0.3}$;

Hub diameter $36^{+0.5}_{-0.3}$;

Thickness $23^{+0.5}_{-0.3}$;

Thickness $33.5^{+0.5}_{-0.3}$;

4.4. Unspecified maximum deviation on dimensions — as per point 5.5.

4.5. Unspecified tolerance on rounding off radius — as per point 5.23.

4.6. Permissible height of face burrs — 3.0 мм (see table 11).

4.7. Permissible deviation from flatness — 0.5 мм (See table 13).

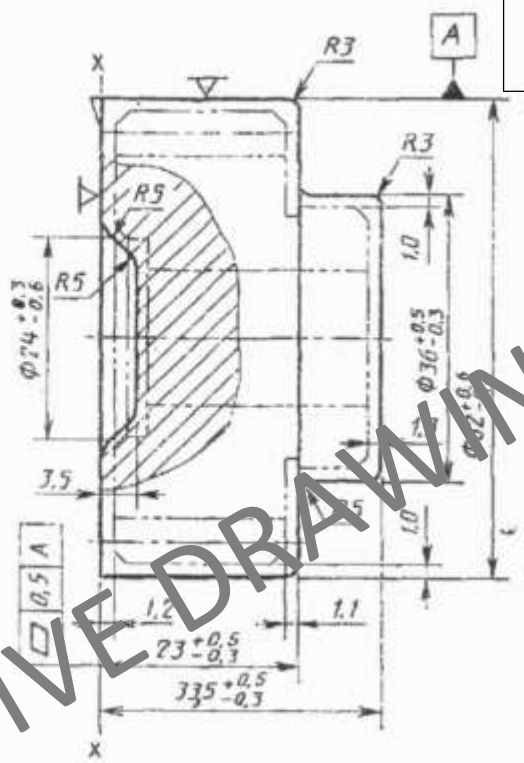


Figure. 15

Example 2

Gear wheel (Figure. 16).

Forging machine— КГШПП.

Blank heating: Induction

1. Initial data for the part

1.1. Material — Steel 45ХН2МФА (as per GOST 4543): 0.42—0.50% C; 0.17—0.37% Si; 0.5—0.8% Mn; 0.8—1.1% Cr; 1.3—1.8% Ni; 0.2—0.3% Mo; 0.10—0.18% V.

1.2. Part weight — 1.83 kg.

2. Initial data for calculation

2.1. Forging weight — 3.3 kg (design):

Design coefficient Kp = 1.8 (See appendix 3);

1.83 X 1.8 = 3.3 kg.

2.2. Accuracy class — Т3 (See appendix 1).

2.3.Steel group — М2 (See table. 1).

Average fraction of total mass of carbon in steel 45ХН2МФА 0.46% C; fraction of total mass of alloying elements — 3.81% (0.27% Si; 0.65% Mn; 0.95% Cr; 1.55% Ni; 0.25% Mo; 0.14% V).

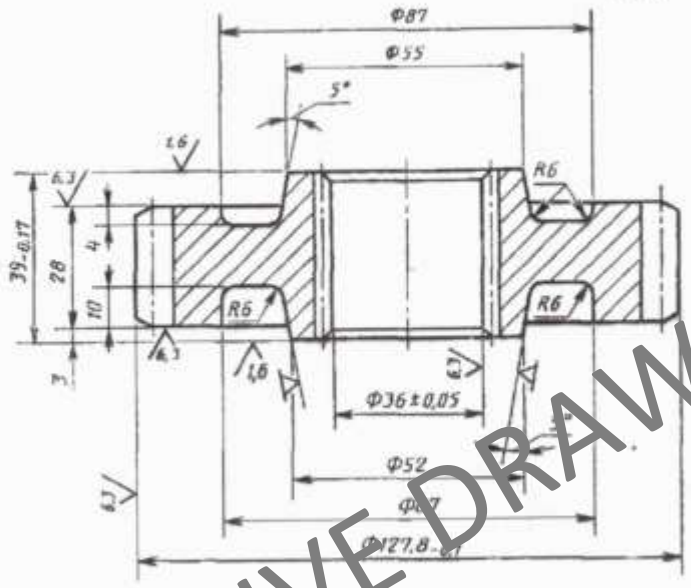


Figure 16

2.4.Degree of complexity—C1 (See appendix 2).
Dimensions describing the forging shape (Cylinder), in мм:
Diameter 134.2 (127.8 x 1.05):
Height 41 (39 x 1.05) (where 1.05 — coefficient).
Weight of the describing shape (Design)—4.55kg;

$$G_n : G_\phi = 3.3 : 4.56 = 0.72.$$

2.5. Configuration/type of parting plane П (flat) — (See table. 1).
2.6. Initial index— 10 (See table. 2).
3. Allowance and forging lap
3.1. Basic allowance on dimensions (See table. 3), in мм
1.6 — Diameter 127.8 мм and surface smoothness/surface condition 6.3;
1.4 — Diameter 36 мм and surface smoothness/surface condition 6.3;
1.5 — Thickness 39 мм and surface smoothness/surface condition 1.6;
1.5 — Thickness 28 мм and surface smoothness/surface condition 6.3;
3.2.Additional allowance taking into account:
Shift on parting plane — 0.3 мм (See table. 4);
Deviation from flatness— 0.3 мм (See table. 5).
3.3.Draft:
On external surface— not more than 5° taken as 5°;
On internal surface— not more than 7° taken as 7°.

4. Forging dimension and their permissible deviation (Figure17)

4.1. Forge dimensions, in мм;

Diameter 127.8+(1.6+0.3) x 2= 131.6 taken as 132;

Diameter 36-(1.4+0.3) x 2 = 32.6 taken as 32;

Thickness 39+(1.5+0.3) x 2 = 42.6 taken as 42.5;

Thickness 28+(1.5+0.3) x 2 = 31.6 taken as 31.5.

4.2. Rounding off radius of external corners — 2.0 мм (Minimum) taken as 3.0 мм (See table. 7).

4.3. Permissible deviation of dimensions (See table. 8), мм:

Diameter $132^{+1.3}_{-0.7}$

Diameter $32^{+0.5}_{-0.9}$

Thickness $42.5^{+1.1}_{-0.5}$

Thickness $31.5^{+1.1}_{-0.5}$

4.4. Unspecified maximum deviation of dimensions (Example, Diameter (86,5±1,1) мм) — as per point 5.5.

4.5. Unspecified tolerance on rounding off radius — as per point 5.23.

4.6. Permissible value/size of residual flash 0.7 мм — as per point 5.8.

4.7. Permissible deviation from flatness 0.6 мм — as per point 5.16.

4.8. Permissible deviation from concentricity of forged holes with respect to external profile of the forging 0.8 мм (See table. 12).

4.9. Permissible shift of parting plane 0.6 мм (See table. 9).

4.10. Permissible size of burr height 3.0 мм as per point 5.10.

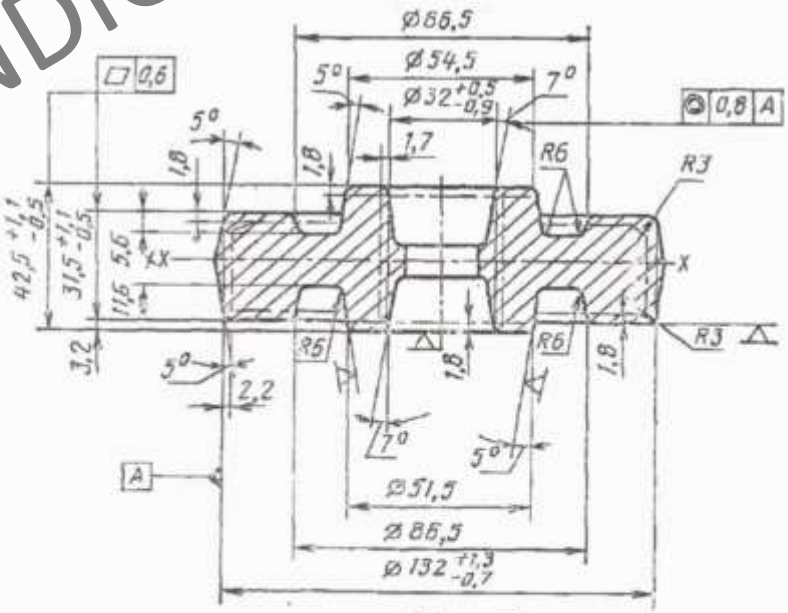


Figure 17

Example 3

Drive shaft cross piece (Figure 18).

Forging machine — К Г Ш П .

Blank heating — Induction.

1.Initial data for part

1.1. Material — Steel 45 (as per GOST 1050): 0.42—0.50% C; 0.17—0.37% Si; 0.50—0.80% Mn; not more than 0.25% Cr.

1.2. Part weight — 0.845 kg.

2.Initial data for calculation

2.1.Forge weight (Design) — 1.27 kg:

Design coefficient K_p—1.5 (See appendix 3);

0.845 x 1.5=1.27kg.

2.2. Accuracy class— Т3 (See appendix 1).

2.3. Steel group—М2 (See table. 1).

Average fraction of total mass of carbon in steel 45 — 0.46%.

2.4. Degree of complexity—С2 (See appendix 2).

Dimensions describing the forging shape (parallel piped), мм:

100 x 100 — Sides (determined graphically);

36—Height (Determined as per drawing).

Weight of the describing shape (Design) —2.56 kg;

Gn: Gp = 1.27: 2.80=0.454.

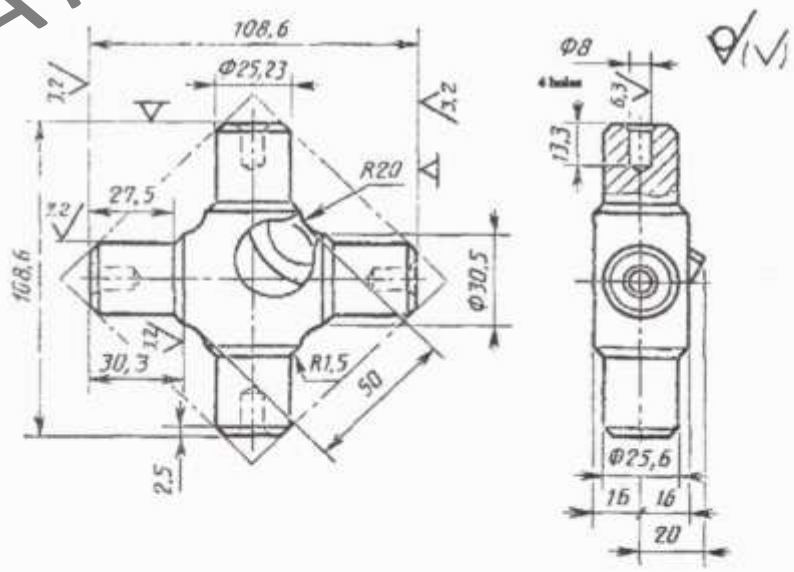


Figure 18

2.5. Configuration of parting plane—П (flat) (See table. 1),

2.6. Initial index — 9 (See table. 2).

3.Allowance and forging lap

3.1. Basic allowance on dimensions (see table. 3), мм:

1,5 — width 108.6 мм and surface smoothness/surface condition 3.2;

1,3 — Thickness 25.6 мм and surface smoothness/surface condition 3.2;

1,3 — Length 30.3 мм and surface smoothness/surface condition 3.2.

3.2. Additional allowance taking into account:

Shift of parting plane — 0.2 мм (See table 4);

Deviation from flatness — 0,3 мм (See table. 5).

3.3. Draft on external surface, not more than 5° taken as 3° (See table. 17).

4.Forging dimensions and their permissible deviations (Figure 19)

4.1. Forge dimensions, мм:

Width 108.6+(1.5+0.2+0.3) x 2= 112.6 taken as 112.5;

Thickness 25.6+(1.3+0.2) x 2=28.6 taken as 28.5;

Length 30.3+1.3+0.3 = 31.9 taken as 32.0

4.2. Rounding off radius of external corners — 2.0 мм (Minimum) taken as 3.0 мм (See table. 7).

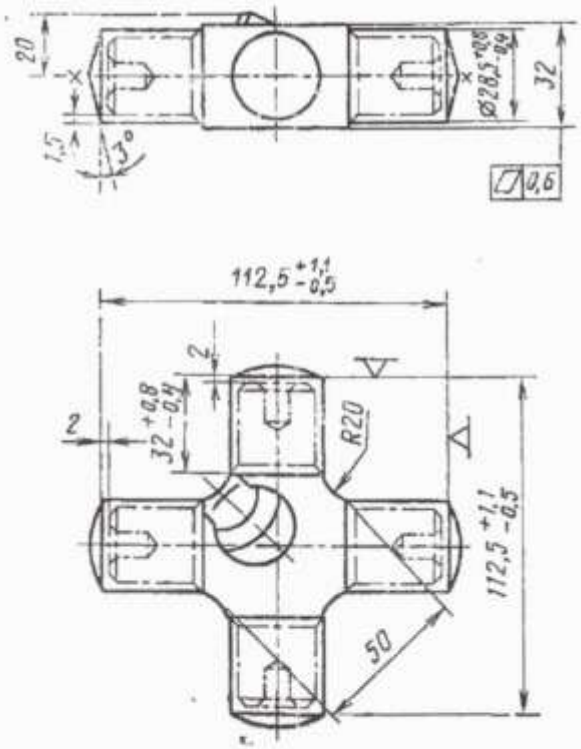


Figure 19

4.3. Permissible deviation of dimensions (See table. 8), мм:

Width $112.5^{+1.1}_{-0.5}$;

Thickness $28.5^{+0.8}_{-0.4}$;

Length $32.0^{+0.8}_{-0.4}$;

4.4. Unspecified maximum deviation of dimensions — as per point 5.5.

4.5. Unspecified tolerance on rounding off radius — as per point 5.23.

4.6. Permissible value/size of residual flash 0.5 мм — as per point 5.8.

4.7. Permissible deviation from flatness 0.6 мм — as per point 5.16.

4.8. Permissible draft of tag axis ±1° — as per point. 6.2.

4.9. Permissible shift value of parting plane 0,4 мм — as per point 5.7.

4.10. Permissible value/size of burr 2,0 мм — as per point 5.10;

Example 4

Bush (Figure 20),

Forging machine — КГШП.

Blank heating — Induction.

1. Initial data for part

1.1. Material—Steel 65 (As per GOST 1050): 0.62—0.7% C; 0.5—0.8% Mn; 0.17—0.37% Si; upto 0.25% Cr.

1.2. Part weight — 5.4 kg.

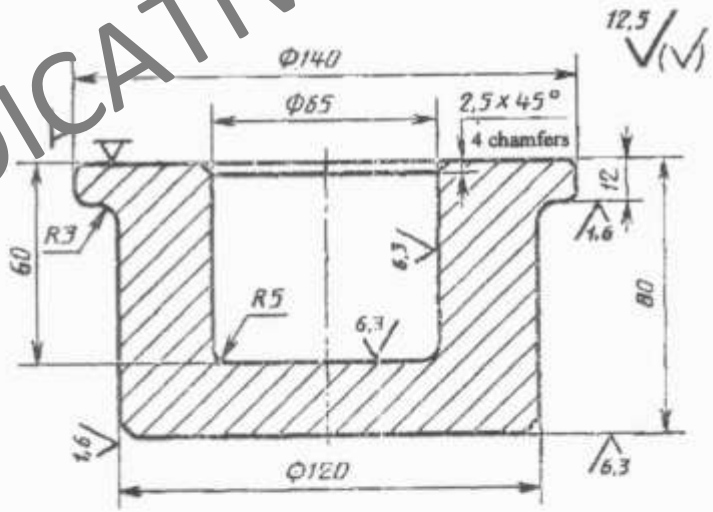


Figure20

2. Initial data for calculation

2.1. Forge weight (Design) —8.6 kg:

Design coefficient K_o—1,6 (See appendix 3); 5.4 x 1.6 =8.6 kg.

2.2. Accuracy class—T3 (See appendix 1).

2.3. Steel group — M3 (See table. 1).

Average fraction of total mass of carbon in steel 65: 0,68% C; fraction of total mass of alloying elements — 1.04% (0.27% Si; 0.65% Mn; 0.12% Cr).

2.4. Degree of complexity — G1 (See appendix 2).
Dimensions describing the forging shape (Cylinder), мм:
147 (140 x 1.05) — Diameter;
84 (80 x 1.05) — Length (where 1.05— coefficient).
Weight of the describing shape (Design) — 11.2 kg;
Gп : Gф =8.6 : 11.2 = 0.78.
2.5. Configuration/type of parting plane—П (flat) (See table. 1).
2.6. Initial index— 12 (See table. 2).
3. Allowance and forge lap
3.1. Basic allowance on dimensions (See table. 3), мм:
1.5 — Diameter 140 мм and surface smoothness/surface condition 12.5;
1.8 — Diameter 120 мм and surface smoothness/surface condition 1.6;
2.0 — Thickness 80 мм and surface smoothness/surface condition 6.3;
1.7 — Thickness 80 мм and surface smoothness/surface condition 12.5;
1.6 — Thickness 12 мм and surface smoothness/surface condition 12.5;
1.6 — Thickness 12 мм and surface smoothness/surface condition 1.6;
1.7 — Diameter 65 мм and surface smoothness/surface condition 6.3;
1.7 — Depth 60 мм and surface smoothness/surface condition 12.5.
3.2. Additional allowance taking into account:
Deviation from flatness — 0.3 мм (See table. 5);
Shift of parting plane—0.3 мм (See table. 4)
3.3. Draft angle (See table. 8):
On external surface — not more than 5° taken as — 3°;
On internal surface — not more than 7° taken as — 7°.
4. Forge dimensions and their permissible deviations (Figure 21)
4.1. Forge dimensions, мм:
Diameter 140+(1.5 + 0.3) x 2= 143.6 taken as 144;
Diameter 120+(1.8+0.3) x 2 = 124.2 taken as 124;
Diameter 65-(1.7+0.3) x 2 = 61 taken as 61;
Thickness 80+1.7+2+0.3x2 = 84 taken as 84;
Thickness 12+1.7+1.6+0.3x2=15.9 taken as 16;
Depth (Point 6.4) 60 x 0.8 = 48.8 taken as 50.
4.2. Rounding off radius of external corners (See table. 7) for die impression cavity depth, in мм:
Upto 50 — not less than 3 taken as 5;
Above 50 » » 3 » 4.
4.3. Permissible deviation of dimensions (See table. 8), in мм:
Diameter $144^{+1.3}_{-0.7}$;
Diameter $124^{+1.3}_{-0.7}$;
Diameter $61^{+0.6}_{-1.2}$;
Depth $50^{+0.7}_{-1.3}$;
Thickness $84^{+1.6}_{-0.9}$;
Thickness $16^{+1.6}_{-0.9}$;
4.4. Unspecified tolerance on rounding off radius— as per point 5.23.
4.5. Permissible deviation from flatness 0.6 мм —as per point 5.16.
4.6. Permissible value/size of residual flash 0.8 мм— as per point 5.23.

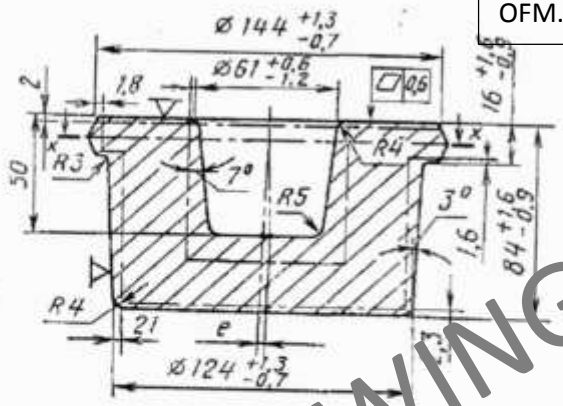


Figure 21

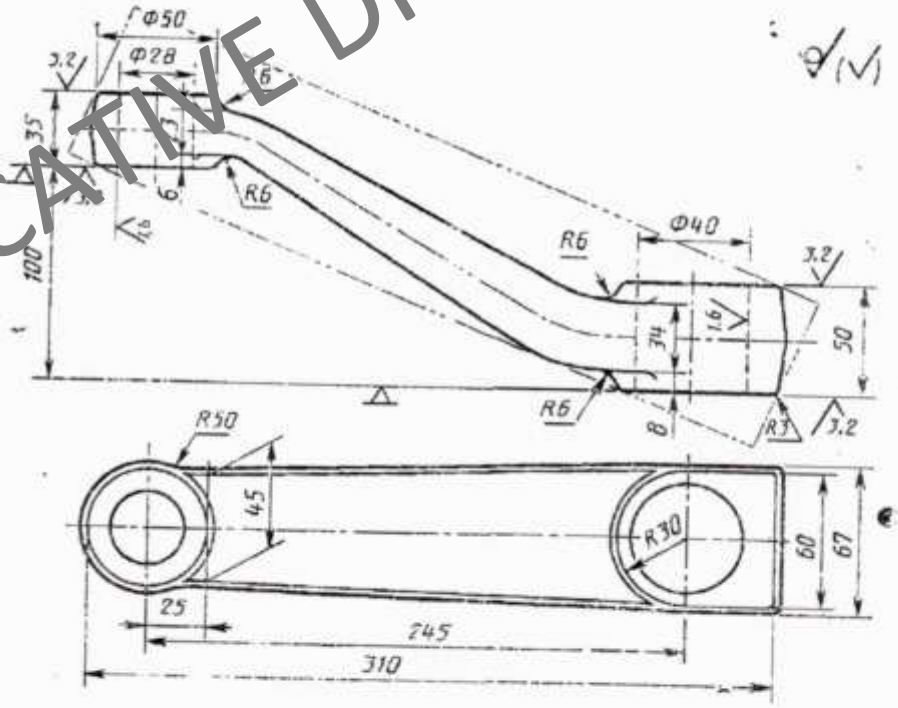


Figure 22

4.7. Permissible deviation from alignment of grooves 50 x 0.01 = 0.5 мм taken as 0.5 мм as per point 5.14.

4.8. Permissible value for parting plane shift 0.7 мм — as per point 5.7.

Example 5

Lever (Figure 22).

Forging machine — Air and steam hammer.

Blank heating — Gas flame.

1. Initial data for part

1.1. Material —Steel 12X2H4A (as per GOST 4543): 0.09—0.15% C; 0.17—0.3% Si; 0.30-0.60 % Mn; 1.25—1.65 % Cr; 3.25—3.65% Ni;

1.2. Part weight —3.30 kg.

2. Initial data for calculation

2.1. Forge weight (Design) —4.25 kg;

Design coefficient K_p=1.3 (See appendix 3);

3.30 x 1.3 = 4.25 kg.

2.2. Accuracy class—T5 (See appendix 1).

2.3. Steel group — M3 (See table. 1).

Average fraction of total mass of carbon in steel 12X2H4A: 0.12% C; fraction of total mass of alloying elements — 5.62% (0.2[illegible]% Si; 0.45% Mn; 1.45% Cr; 3.45% Ni).

2.4. Degree of complexity— C2 (See appendix 2).

Dimensions describing the forge shape (parallelepiped), in мм:

Length 340 (Determined graphically);

Height 67 (Determined graphically);

Width 67 (Determined as per drawing).

Weight of the describing shape (Design):

[illegible]3 x 34 cм x 6.7 см x 6.7 см x 7.85 g/см^3= 12420 g =12.42 kg;

[illegible] G_ϕ = 4.25 : 13.06 = 0.325.

2.5. Configuration/shape of parting plane surface — $И_Н$ (offset asymmetric) (See table. 1).

2.6. Initial index — 16 (See table. 2).

3. Allowance & forging lap

3.1. Basic allowance on dimensions (See table. 3), мм:

2.7 — Thickness 50 мм and surface smoothness/surface condition 2.2;

2.5 —Thickness 35 мм and surface smoothness/surface condition 3.2;

2.5—Diameter 40 мм and surface smoothness/surface condition 1.6;

2.3 — Diameter 28 мм and surface smoothness/surface condition 1.6.

3.2. Additional allowance which takes into account:

Shift of parting plane (See table. 13), мм:

0.6 —Diameter 40;

0.6 » 28;

Deviation from straightness (See table. 5), мм:

0.8 — Thickness 50;

0.8 » 35;

Deviation of center distance for dimension 245 мм —1.2 мм (see table. 6).

3.3. Draft angle (See table. 18):

On external surface— not more than 7° taken as 7°;

On internal surface — not more than 10° taken as 10°.

4. Forging dimensions & their permissible deviation (Figure 23)

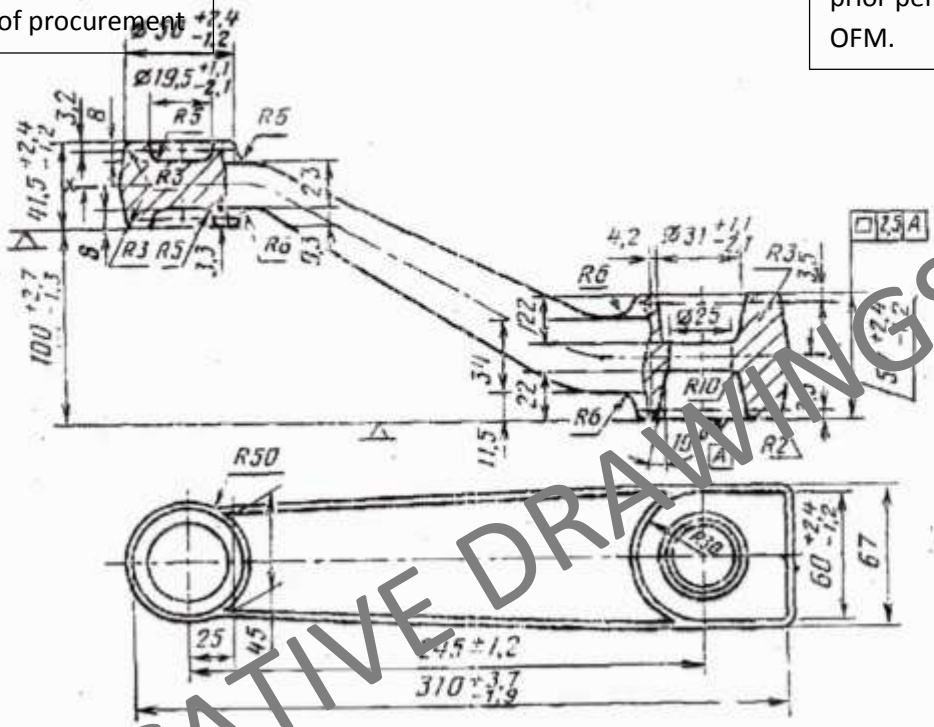


Figure 23

4.1. Forge dimensions, мм:
Thickness 50+(2.7+0.8) x 2 = 57 taken as 57;
Thickness 35+ (2.5 + 0.8) x 2 = 41.6 taken as 41.5;
Diameter 40-(2.5+0.6+1.2) x 2=31.4 taken as 31;
Diameter 28-(2.3 + 0.6+ 1.2) x 2=19.4 taken as 19.5;
Height 100+(2.7-2.5) = 100.2 taken as 100.

4.2. Rounding off radius of external corners for impression depth 10 - 25 мм — 2,0 мм (See table. 7).

4.3. Permissible deviation of dimensions (See table. 8), in мм:

Thickness $57^{+2.4}_{-1.2}$; Height $100^{+2.7}_{-1.3}$;
Thickness $41.5^{+2.4}_{-1.2}$; Length $310^{+3.7}_{-1.9}$;
Width $60^{+2.4}_{-1.2}$; Diameter $31.5^{+1.1}_{-2.1}$;
Width $50^{+2.4}_{-1.2}$; Diameter $19.5^{+1.1}_{-2.1}$

4.4. Unspecified maximum deviation of dimensions — as per point 5.5.
4.5. Unspecified tolerance on rounding off radius—as per point. 5.23.
4.6. Permitting value of parting plane shift 1,2 мм —as per point 5.7.

4.7. Permissible Deviation from flatness and straightness 1.6 мм — as per point. 5.16.
4.8. Permissible value/size of residual flash or trimmed edges1.6 мм — As per point 5.8.
4.9. Permissible deviation of interaxial distance ±1.2 мм (see table14).

Example 6

Drive sprocket (Figure24).
Forging machine — К Г III П .
Blank heating — Induction.
1 Initial data for part
1.1. Material —Steel 35 (as per GOST 1050): 0.32—0.40 % C; 0.17—0.37% Si; 0.50—0.80% Mn; not more than 0.25% Cr.
1.2. Part weight — 2.05 kg.

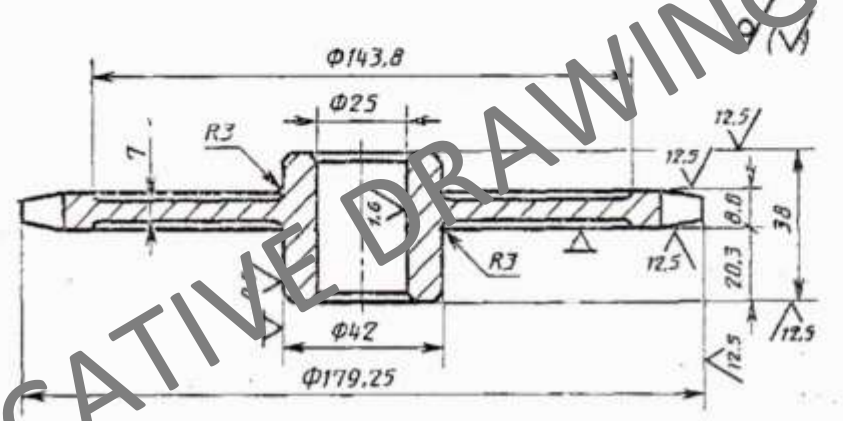


Figure 24

2 Initial data for calculation
2.1. Forge weight (Design) —3.28 kg;
Design coefficient K_P = 1.6 (See appendix 3);
2.05 x 1.6=3.28 kg.
2.2. Accuracy class—T4 (See appendix 1).
2.3. Steel group—Ml (See table. 1).
Average fraction of total mass of carbon in steel 35: 0.36% C.
2.4. Degree of complexity—C4 (See appendix 2).
Ratio of the flat surface thickness to the diameters:

$$\frac{7}{143.2-42} = 0.07$$

2.5. Parting plane configuration/type — П (flat) (see table. 1).
2.6. Initial index — 14 (See table. 14).
3. Allowance and forge lap
3.1. Basic allowance on dimensions (See table. 3), мм:
2.0 —Diameter 179.25 мм and surface smoothness/surface condition 12.5;
2.2 — Diameter 42 мм and surface smoothness/surface condition 0.8;
1.7—Thickness 38 мм and surface smoothness/surface condition 12.5;
1.5 — Thickness 8.8 мм and surface smoothness/surface condition 12.5.

3.2. Additional allowance taking into account:
Deviation from flatness — 0 3 мм (See table. 5);
Shift on parting plane — 0.3 мм (See table. 4).
4. Forge dimension and their permissible deviation (Figure25).
4.1.Forge dimensions, мм:
Diameter 179.25+(2.0+0.5+0.3) x 2= 184.85 taken as 185;
Diameter 42+(2.2+0.5+0.3) x 2 = 48.0 taken as 48;
Thickness 38+(1.7+0.5) x 2=42.4 taken as 42,5;
Thickness 8.8+(1.5+0.5) x 2=12.8 taken as 13.0.
4.2. Rounding off radius of external corners —2.0 мм (Minimum) taken as 3.0 мм (See table. 7).
4.3. Permissible deviation of dimensions (See table. 8), мм:

Diameter $185.0^{+2.4}_{-1.2}$;
Diameter $48.0^{+1.8}_{-1.0}$;
Thickness $42.5^{+1.8}_{-1.0}$;
Thickness $13.0^{+1.8}_{-1.0}$;

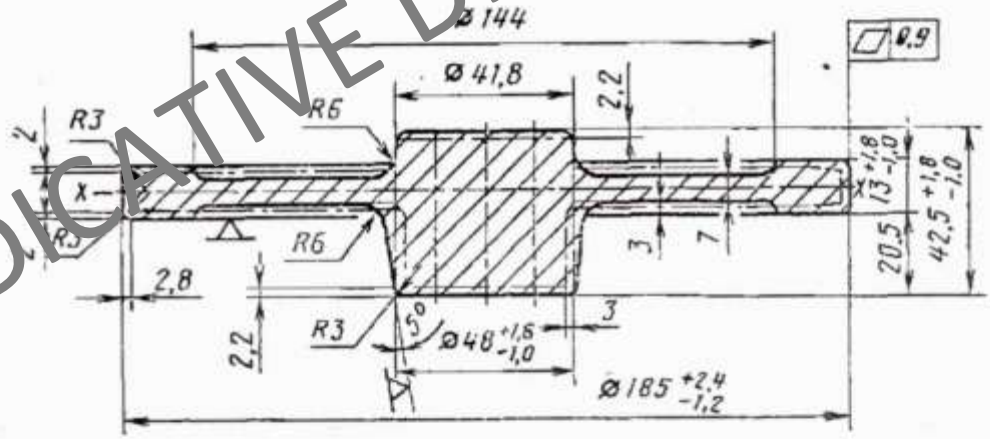


Figure 25

4.4. Unspecified maximum deviation of dimensions— as per point 5.5.
4.5. Unspecified tolerance on rounding off radius — as per point 5.23.
4.6. Permissible value/size of residual flash 1.0 мм—as per point 5.16.
4.7. Permissible Deviation from flatness and straightness 0.9 мм —as per point 5.8.
4.8. Permissible value of parting plane shift 0.7 мм — as per point 5.7.
4.9. Permissible value/size of burrs 2.0 мм — as per point 5.10.

Example 7

Half shaft (Figure 26).
Forging machine — Horizontal forging machine/up-setting press.
Number of transitions — 5.
Blank heating — Induction.

1. Initial data for part

1.1. Material - Steel 45Г (as per GOST 4543): 0.12—0.50% C; 0.7-1.0% Mn; 0.17-0.37% Si.

1.2. Part weight— 16.5 kg.

Flange weight with the clamp — 6.5 kg.

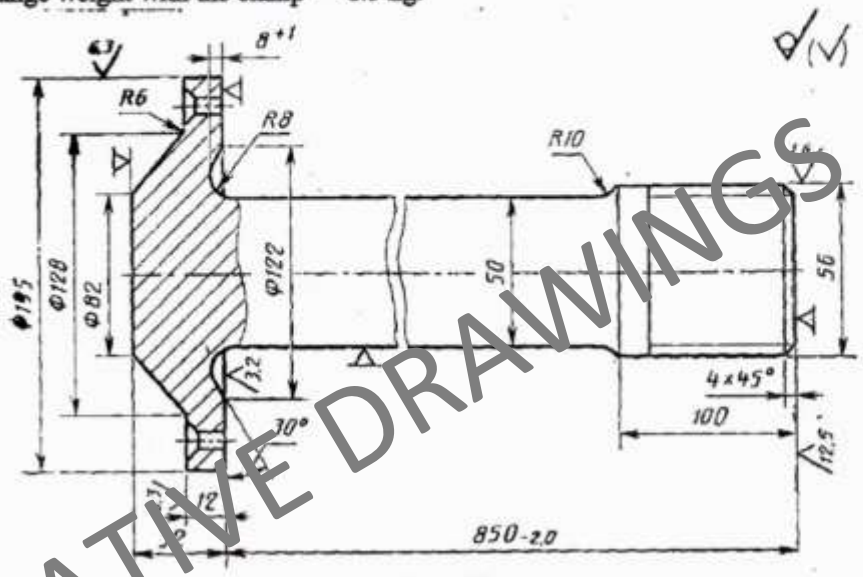


Figure26

2. Initial data for calculation:

2.1. Forge weight (Design) — 9.5/6.0 kg.

Design coefficient K_p (see appendix 3);

For flange — 1.5;

For split end —1.3.

Weight of the flange with clamp: 6.5 x 1.5 = 9.8 kg.

Weight of split end with clamp: 4.6 x 1.3 = 6.0 kg.

2.2. Accuracy class — T4 (see appendix 1).

2.3. Steel group — M2 (see table. 1).

Average fraction of total mass of carbon in steel 45Г: 0.46% C; fraction of total mass of alloying elements: 1.12% (0.27% Si; 0.85% Mn).

2.4. Degree of complexity—C4 (see appendix 2).

2.5. Configuration/type of parting plane — П (flat) (see table. 1).

2.6. Initial index —16 (see table. 2).

3. Allowance and forge lap

3.1. Basic allowance on dimensions (See table. 3), мм:

3.0 — Diameter 195 мм and surface smoothness/surface condition 6.3;

2.5 — Diameter 56 мм and surface smoothness/surface condition 1.6;

2.3 — Thickness 12 мм and surface smoothness/surface condition 6.3;

2.5 — Thickness 12 мм and surface smoothness/surface condition 3.2;

2.5 — Thickness 32 мм and surface smoothness/surface condition 3.2;

2.4 — Thickness 100 мм and surface smoothness/surface condition 12.5;

3.2. Additional allowance taking into account:
Shift on parting plane—0.3 мм (See table. 14);
Chamfer/curvature, deviation from flatness and straightness (see table 5)
0,5 — Diameter 195;
0,3 » 56.

4. Forge dimensions and their permissible deviation (Figure 27)

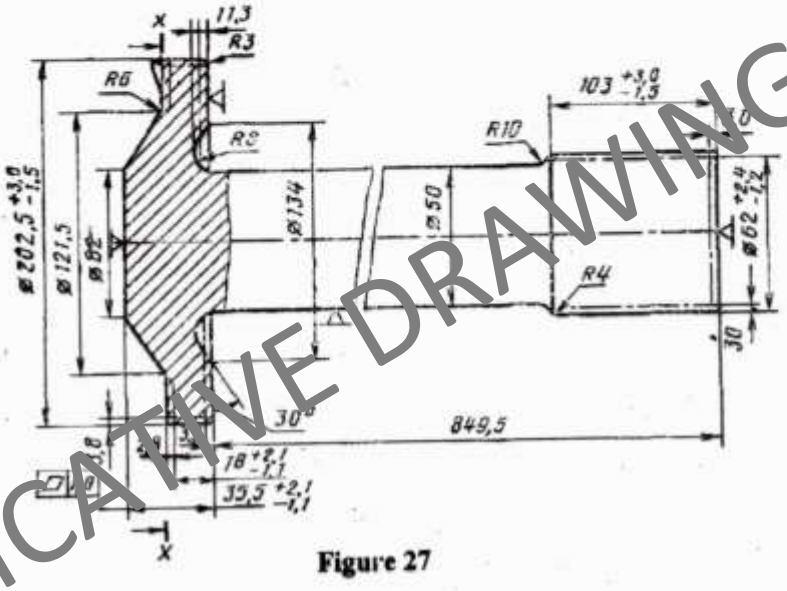


Figure 27

4.1. Forge dimensions, мм:
Diameter 195+(3.0+0.3+0.5) x 2 = 202.6 taken as 202.5;
Diameter 56+(2.5+0.3+0.3) x 2 = 62.2 taken as 62;
Thickness 12+(2.3+0.5)+(2.5+0.3+0.5) = 18.1 taken as 18;
Thickness 32+(2.5+0.3+0.5) =35.3 taken as 35.5;
Thickness 100+(2.4+0.3) = 102,7 taken as 103;
Length 850+(2.4+0.3) - (2.5+0.3+0.5) =849.4 taken as 849.5.
4.2. Rounding off radius of external corners (See table. 7), мм:
of flange — 3.0;
of slit end — 4.0;
4.3. Permissible deviation of dimensions (See table. 8), мм:
Diameter $202.5^{+3.0}_{-1.5}$;
Diameter $62^{+2.4}_{-1.2}$;
Thickness $18^{+2.1}_{-1.1}$
Thickness $35.5^{+2.1}_{-1.1}$
Thickness $103^{+3.0}_{-1.5}$
Diameter $50^{+0.4}_{-1.0}$ (as per GOST 2590)

4.4. Unspecified maximum deviation of dimensions— as per point 5.5.
4.5. Unspecified tolerance on rounding off radius— as per point. 5.23.
4.6. Permissible height of face burrs (See table. 11), in mm:
of flange— 9;
of slit end—7.
4.7. Permissible burr height in die/matrix parting plane 2.0 мм — as per point 5.12.
4.8. Permissible deviation for chamber/curvature, from flatness and straightness (see table. 13), in мм:
of flange — 1.0;
of slit end — 0.6;
of total forging — 2.0.
4.9. Permissible value of parting plane shift 0.8 мм (see table. 9).
4.10. Permissible increase of rod diameter for a distance of 100 мм from the flange and slit end- upto 54.8 мм — as per point 5.6.

Example 8

Main drive shaft (Figure 28).
Forging machine — Horizontal forging machine/up-setting press.
Number of transitions—4.
Blank heating— Flame.
1. Initial data for part
1.1. Material — Steel 15XГН2TA (as per GOST 4543): 0.13—0.18% C; 0.7—1.0% Mn; 0.17-0.37% Si; 0.7—1.0% Cr; 1.4-1.8% Ni; 0.03-0.09% Ti.
1.2. Part weight — 6.6 kg.
Weight of the deforming and clamping part — 5.2 kg.
2. Initial data for calculation
2.1. Forge weight (Design) — 7.8 kg;
Design coefficient K_p=1.5 (see appendix 3);
5.2 x 1.5 = 7.8 kg.
2.2. Accuracy class— T5 (see appendix 1).
2.3. Steel group — M2 (see table. 1)
Average fraction of total mass of carbon in steel 15XГН2TA: 0.15% C; fraction of total mass of alloying elements — 3.73% (0.9% Mn; 0.27% Si; 0.9% Cr; 1.6% Ni; 0.06% Ti).
2.4. Degree of complexity— C3 (see appendix 2),
2.5. Configuration/type of parting plane — II (flat) (see table 1).
2.6. Initial index—17 (See table. 12).
3. Allowance and forging lap
3.1. Basic allowance on dimensions (See table. 3), мм:
3.0 — Diameter 126 мм and surface smoothness/surface condition 6.3;
2.7 — Diameter 86 мм and surface smoothness/surface condition 6.3;
2.7 — Diameter 60 мм and surface smoothness/surface condition 1.6;
2.2 — Diameter 45 мм and surface smoothness/surface condition 12.5;
3.0 — Thickness 52 мм and surface smoothness/surface condition 6.3;
3.3 — Thickness 52 мм and surface smoothness/surface condition 0.8;
3.0 — Thickness 50 мм and surface smoothness/surface condition 6.3;
2.4 — Thickness 50 мм and surface smoothness/surface condition 12.5;
3.0 — Depth 40 мм and surface smoothness/surface condition 6.3;
2.0 — Depth 40 мм and surface smoothness/surface condition 12.5.
3.2. Additional allowance, which takes into account:
Shift on parting plane 0.4 мм (See table. 4); chamber/curvature, deviation from flatness and straightness (see table. 5), in мм:
of rod — 0.8;
of flange — 0.5.

Forging dimensions and their permissible deviations (Figure 29)

4.1. Forge dimensions, мм:

Diameter 126+(3.0+0.4+0.5) x 2 = 133.8 taken as 134;

Diameter 86-(2.7+0.4+0.5) x 2 = 78.8 taken as 78.5;

Diameter 60+(2.7+0.5+0.4) x 2 = 67.2 taken as 67;

Diameter 45+(2.2+0.8) x 2 = 51 taken as 52. (As per GOST 2590);

Depth 4.0+(3.0-2.0+0.5) = 41.5 taken as 41.5;

Thickness 52+(3.0+3.3+0.5+0.4) =59.1 taken as 59.0;

Thickness 50+(3.0+2.4+0.5 + 0.4) =56.2 taken as 56.0.

4.2. Rounding off radius of external corners 4.0 мм (see table. 7).

4.3. Draft angle—7° (see table. 18).

4.4. Permissible deviation of dimensions (see table. 8), мм:

Diameter $134^{+3.0}_{-1.5}$;

Diameter $78.5^{+1.3}_{-2.7}$;

Diameter $67^{+2.7}_{-1.3}$;

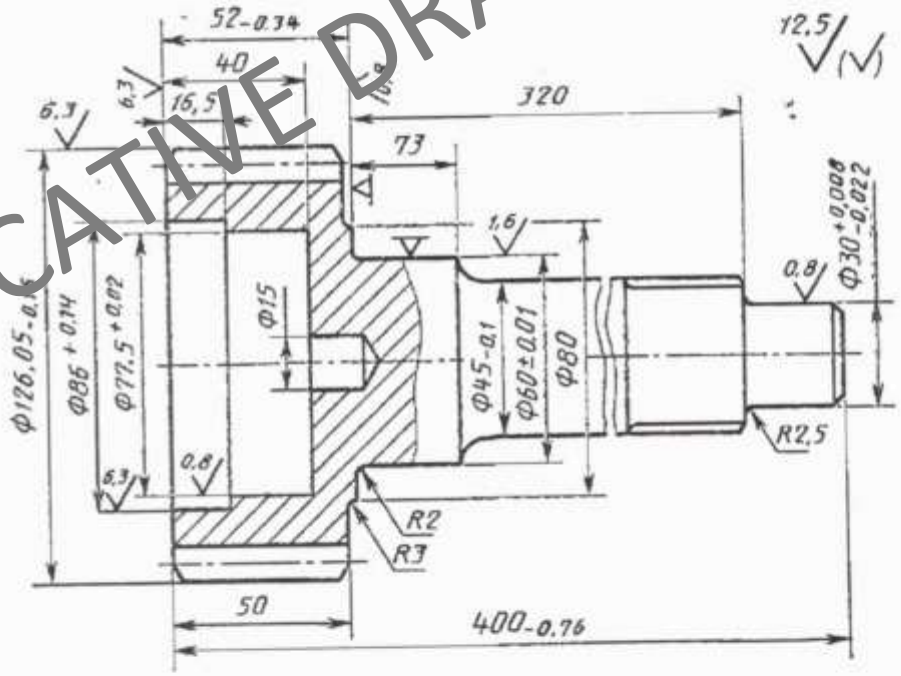


Figure 28

Diameter $52^{+0.4}_{-1.0}$ (as per GOST 2590);

Height $41.5^{+1.2}_{-2.4}$;

Thickness $59^{+2.7}_{-1.3}$;

Thickness $56^{+2.7}_{-1.3}$;

4.5. Tolerance on rod length 6.0 мм — as per point 5.6.

4.6. Unspecified maximum/limiting deviation of dimensions — as per point 5.5.

4.7. Unspecified tolerance on rounding off radius— as per point 5.23.

4.8. Permissible height of burrs in parting plane of the die 2.4 мм —as per point 5.12.

4.9. Permissible height of end face burrs 7.0 мм —as per point 5.11.

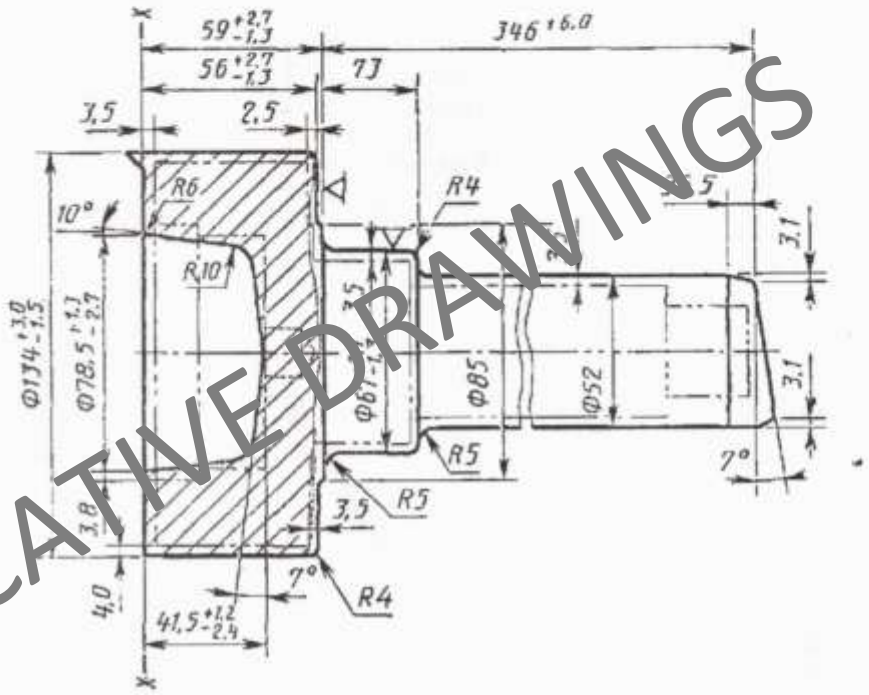


Figure 29

4.10. Permissible deviations:

From flatness and straightness 1.0 мм —as per point 5.16;

From camber 1.6 мм (See table. 13).

4.11 Permissible value of parting plane shift 1.0 мм (See table. 9).

4.12. Deviation of concentricity of diameter 78.5 (Point 5.14) - 0.4 мм.

4.13. Permissible deviation of draft angle — as per point 5.24 – (7±1.7)

4.14. Permissible increase in diameter of rod - upto 55.4 мм for a distance of 100 мм from the forging die (Point. 5.6).

4.15. Permissible deviation of rod face (Table 15), in мм:

x — 3.1;

y — 36.5.

Edge camber — 7°.

Replacement to GOST 7505—74

STANDARD REFERENCE DOCUMENTS

Designation of normative technical documents in which reference is given	Para no, appendix
GOST 2.303—79	2.10
GOST 3.1126—88	2.9
GOST 1050—88	1.1 Appendix 5
GOST 2590—88	4.3 Appendix 5
	4.1 Appendix 5
	4.4 Appendix 5
GOST 2789—73	4.2
GOST 4543—71	1.1 Appendix 5
GOST 8479—70	1.1; 2.11
GOST 14959—79	1.1 Appendix 5