U S S R S T A T E S T A N D A R D

HOT-ROLLED STEEL FOR REINFORCEMENT OF FERROCONCRETE STRUCTURES

SPECIFICATIONS

GOST 5781-82

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U S S R S T A T E S T A N D A R D

HOT-ROLLED STEEL FOR REINFORCEMENT OF FERROCONCRETE STRUCTURES

Specifications

GOST 5781-82

OKP (All-Union Product Classification Code) 093004; 093005; 093006; 093007; 093008

This Standard applies to hot-rolled round steel with smooth and die-rolled section, designed for reinforcement of ordinary and prestressed ferroconcrete structures (reinforcing-bar steel).

This Standard also applies to ingots, blooms and billets regarding the norms of chemical composition for low-alloyed steels.

(Amended Wording. Amendment No. 4)

1. CLASSIFICATION AND ASSORTMENT

1.1. Reinforcing-bar steel is subdivided into classes depending on its mechanical properties: A-I (A240), A-II (A300), A-III (A400); A-IV (A600), A-V (A800), A-VI (A1000).

1.2. Reinforcing-bar steel is manufactured in bars and hanks. Reinforcing-bar steel of class A-1 (A240) shall be manufactured with smooth section. Steel of classes A-II (A300), A-III (A400), A-IV (A600), A-V (A800) and A-VI (A1000) shall be manufactured with die-rolled section. At the customer’s request steel of classes A-II (A300), A-III (A400), A-IV (A600) and A-V (A800) may be manufactured with smooth section.

1.1 and 1.2. **(Amended Wording. Amendment No. 5)**.

1.3. Section numbers, cross-section areas, linear (per 1 m) masses of reinforcing-bar steel with smooth and die-rolled section, and also maximum mass deviations for die-rolled sections shall be in compliance with those specified in table 1 of this Standard.

1.4. Nominal diameters of die-rolled sections shall correspond to nominal diameters of smooth sections equal by their cross-section area.

Table 1

Section number (bar nominal diameter d_n)	Bar cross section area, cm^2	Section linear mass (per 1 m)	
		Theoretical, kg	Maximum deviations, %
6	0.283	0.222	+9.0
8	0.503	0.395	-7.0
10	0.785	0.617	+5.0
12	1.131	0.888	-6.0
14	1.540	1.210	
16	2.010	1.580	
18	2.540	2.000	
20	3.140	2.470	+3.0
22	3.800	2.980	-5.0
25	4.910	3.850	
28	6.160	4.830	
32	8.040	6.310	
36	10.180	7.990	+3.0
40	12.570	9.870	-4.0
45	15.000	12.480	
50	19.630	15.410	
55	23.760	18.650	
60	28.270	22.190	+2.0
70	38.480	30.210	-4.0
80	50.270	39.460	

(Amended Wording. Amendment No. 3).

1.5. Linear mass (per 1 m) shall be calculated using the nominal dimensions and steel density of $7.85 \cdot 10^3$ kg/m^3. The probability of linear mass provision shall be of no less than 0.9.

(Amended Wording. Amendment No. 3).

1.6. Maximum deviations of smooth section diameters shall be in compliance with GOST 2590-88 for ordinary accuracy of rolling.

1.7. Reinforcing-bar steel with die-rolled section is the round section with two longitudinal ribs and transversal projections lengthwise triple-thread helical line. The projections lengthwise single-thread helical line are allowed for sections of 6 mm in diameter. The projections lengthwise double-thread helical line are allowed for sections of 8 mm in diameter.

1.8. Reinforcing-bar steel of class A-II (A300) of general assignment with a section, specified in figure 1*a*, and reinforcing-bar steel of special assignment of class Ac-II (Ac300) with a section, specified in figure 2*a*, shall have the projections lengthwise helical lines with similar thread direction on both sides of the section.

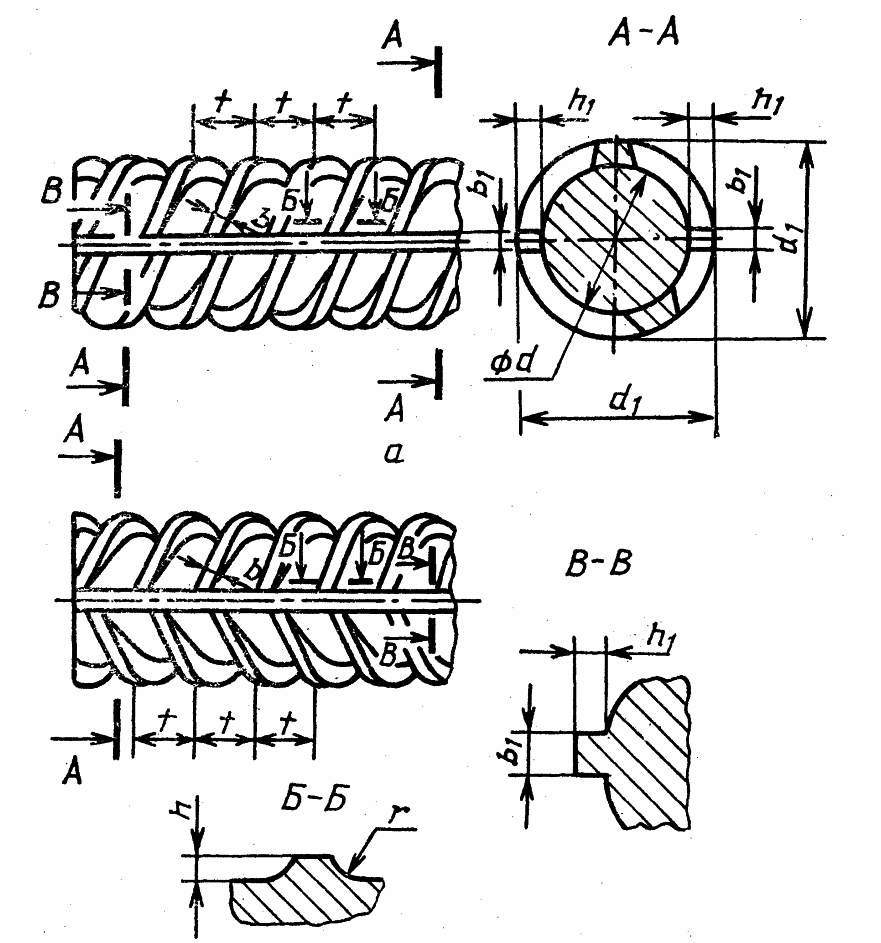

Fig. 1

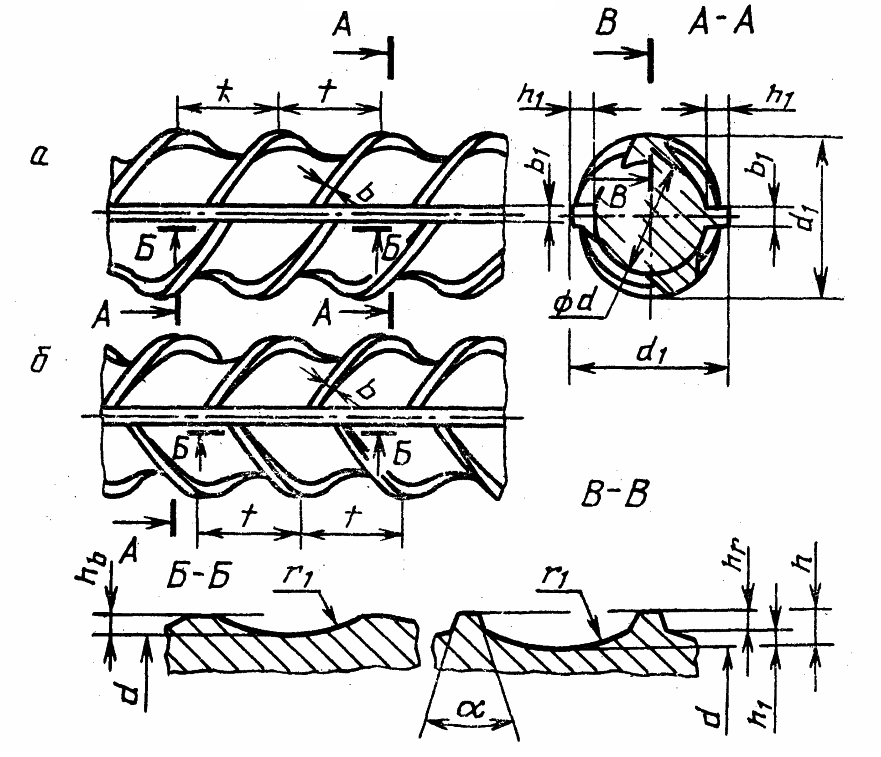

Fig. 2

Steel of class A-III (A400) with a section, specified in figure 1*б*, and steel of classes A-IV (A600), A-V (A800) and A-VI (A1000) with a section, specified in figures 1*б* and 2*б*, shall have projections lengthwise helical lines with right-hand thread direction on one side of the section and with left-hand thread direction on another side of the section.

Reinforcing-bar steel of special assignment of class AcII (Ac3OO) shall be manufactured with sections, specified in figures 1*а* or 2*а*.

The section of special assignment, specified in figure 2*а*, is manufactured by agreement between the customer and the manufacturer. The shapes and dimensions of sections, given in figures 2*а* and 2*б*, may be additionally specified.

1.9. Dimensions and their maximum deviations for reinforcing-bar steel with die-rolled section, manufactured in accordance with figures 1*а* and 1*б*, shall be in compliance with those specified in table 2. Dimensions and their maximum deviations for reinforcing-bar steel with die-rolled section, manufactured in accordance with figures 2*а* and 2*б*, shall be in compliance with those specified in table 3.

1.10. Relative displacements of helical projections, located on both sides of a section and separated by longitudinal ribs, are not standardized.

The dimensions without specified maximum deviations are given for construction of a gauge and shall not be checked on finished section.

1.11. Ovality of smooth sections (difference between maximum and minimum diameters in the same cross section) shall not exceed the sum of positive and negative maximum deviations of the diameter.

1.9 to 1.11. **(Amended Wording. Amendment No. 3).**

1.12. Reinforcing-bar steel of classes A-I (A240) and A-II (A300) up to 12 mm in diameter and class A-III (A400) steel up to 10 mm in diameter inclusive may be manufactured both in bars and hanks, and reinforcing-bar steel of greater diameters shall be manufactured in bars. Reinforcing-bar steel of classes A-IV (A600), A-V (A800) and A-VI (A1000) of all dimensions shall be manufactured in bars, and steel of 6 and 8 mm in diameter may be manufactured in hanks by agreement between the customer and the manufacturer.

1.13. The bars shall be manufactured from 6 to 12 m long:

- of sized length;
- of sized length with unsized segments of no less than 2 m long and no more than 15 % of the batch mass;
- of unsized length.

A batch of unsized bars may contain the bars from 3 to 6 m long in amount of no more than 7 % of the batch mass.

Table 2

Dimensions, mm

Section number (nominal diameter d_n)	d		h		d_1	h_1	t	b	b_1	r
	Nominal	Maximum deviations	Nominal	Maximum deviations						
6	5.75	+0.3 -0.5	0.5	±0.25	6.75	0.5	5	0.5	1.0	0.75
8	7.5		0.75		9.0	0.75	5	0.75	1.25	1.1
10	9.3		1.0	±0.5	11.3	1.0	7	1.0	1.5	1.5
12	11.0		1.25		13.5	1.25	7	1.0	2.0	1.9
14	13.0		1.25		15.5	1.25	7	1.0	2.0	1.9
16	15.0		1.5		18.0	1.5	8	1.5	2.0	2.2
18	17.0		1.5		20.0	1.5	8	1.5	2.0	2.2
20	19.0		1.5		22.0	1.5	8	1.5	2.0	2.2
22	21.0	+0.4 -0.5	1.5		24.0	1.5	8	1.5	2.0	2.2
25	24.0		1.5		27.0	1.5	8	1.5	2.0	2.2
28	26.5	+0.4 -0.7	2.0	±0.7	30.5	2.0	9	1.5	2.5	3.0
32	30.5		2.0		34.5	2.0	10	2.0	3.0	3.0
36	34.5		2.5		39.5	2.5	12	2.0	3.0	3.5
40	38.5		2.5		43.5	2.5	12	2.0	3.0	3.5
45	43.0		3.0		49.0	3.0	15	2.5	3.5	4.5
50	48.0		3.0		54.0	3.0	15	2.5	3.5	4.5
55	53.0	+0.4 -1.0	3.0	±1.0	59.0	3.0	15	2.5	4.0	4.5
60	58.0		3.0		64.0	3.0	15	2.5	4.0	5.0
70	68.0	+0.5 -1.1	3.0		74.0	3.0	15	2.5	4.5	5.5
80	77.5		3.0		83.5	3.0	15	2.5	4.5	5.5

N o t e : At the customer’s request the maximum deviations for d_1 shall not exceed the maximum deviations for d plus doubled maximum deviations for h.

It is allowed to manufacture bars from 5 to 25 m long by agreement between the customer and the manufacturer.

1.14. The length maximum deviations for sized bars shall be in compliance with those specified in table 4.

Table 3

Dimensions, mm

Section number (nominal diameter d_n)	d		h		d_1	h_1	h_r	h_B	t	B	b_1	r_1	α, degrees
	Nominal	Maximum deviations	Nominal	Maximum deviations									
10	8.7	+0.3 -0.5	1.6	±0.5	11.9	1.6	0.6	1.0	10	0.7	1.5	11	50
12	10.6		1.6		13.8	1.6	0.6	1.0	10	0.7	2.0	11	
14	12.5		2.0	+0.65 -0.85	16.5	2.0	0.8	1.2	12	1.0	2.0	12	
16	14.2		2.5		19.2	2.5	1.0	1.5	12	1.0	2.0	12	
18	16.2		2.5		21.2	2.5	1.0	1.5	12	1.0	2.0	12	
20	18.2		2.5		23.2	2.5	1.0	1.5	12	1.0	2.0	12	
22	20.3	+0.4 -0.5	2.5		25.3	2.5	1.0	1.5	12	1.0	2.0	12	
26	23.3		2.5		28.3	2.5	1.0	1.5	14	1.2	2.0	14	
28	25.9	+0.4 -0.7	3.0	+1.0 -1.2	31.9	3.0	1.2	1.8	14	1.2	2.5	14	
32	29.8		3.2		36.2	3.2	1.2	2.0	16	1.5	3.0	14	
36	33.7		3.5		40.7	3.5	1.5	2.0	18	1.5	3.0	19	
40	37.6		3.5		44.6	3.5	1.5	2.0	18	1.5	3.0	19	

Table 4

Bar length, m	Maximum deviations of length for cutting accuracy, mm	
	ordinary accuracy	heightened accuracy
Up to 6 inclusive	+50	+25
Over 6	+70	+35

The bars of heightened accuracy are manufactured at the customer's request.

1.15. The curvature of bars shall not exceed 0.6 % of the measurable length.

Examples of conventional designations

Reinforcing-bar steel of 20 mm in diameter, class A-II (A300):

20-A-II ГОСТ 5781-82

Reinforcing-bar steel of 18 mm in diameter, class A-I (A240):

18-A-I ГОСТ 5781-82

Index «c» shall be added to conventional designation of bars of special assignment of class A-II (A300): Ac-II (Ac300).

(Amended Wording. Amendment No. 4)

TECHNICAL REQUIREMENTS

2.1. Reinforcing-bar steel shall be manufactured in compliance with the requirements of this Standard and production schedule approved in accordance with the established procedure.

2.2. Reinforcing-bar steel shall be manufactured from carbon steel and low-alloyed steel of grades specified in table 5. Steel of grade shall be specified by the customer in the order. In case of absence of steel of grade specification it shall be stipulated by the manufacturer. Steel of grade for bars of class A-IV (A600) shall be stipulated by agreement between the customer and the manufacturer.

Table 5

Class of reinforcing-bar steel	Section diameter, mm	Steel of grade
A-I (A240)	6 to 40	Ст3кп, Ст3пс, Ст3сп
A-II (A3OO)	10 to 40 40 to 80	Ст5сп, Ст5пс 18Г2С
Ac-II (Ac300)	10 to 32 (36 to 40)	10ГТ
A-III (A400)	6 to 40 6 to 22	35ГС, 25Г2С 32Г2Рпс
A-IV (A600)	10 to 18 (6 to 8) 10 to 32 (36 to 40)	80С 20ХГ2Ц
A-V (A800)	(6 to 8) 10 to 32 (36 to 40)	23Х2Г2Т
A-VI (A1000)	10 to 22	22Х2Г2АЮ, 22Х2Г2Р, 20Х2Г2СР

Notes:

1. It is allowed to manufacture reinforcing-bar steel of class A-V (A800) from steel of grades 22Х2Г2АЮ, 22Х2Г2Р and 20Х2Г2СР.

2. The sections with dimensions specified in brackets are manufactured by agreement between the customer and the manufacturer.

(Amended Wording. Amendment Nos. 3 and 4).

2.3. Chemical composition of reinforcing-bar carbon steel shall be in compliance with GOST 380-88. Chemical composition of low-alloyed steel shall be in compliance with the norms specified in table 6.

Table 6

Steel of grade	Mass fraction of elements, %			
	Carbon	Manganese	Silicon	Chromium
10ГТ	No more than 0.13	1.00 to 1.40	0.45 to 0.65	No more than 0.30
18Г2С	0.14 to 0.23	1.20 to 1.60	0.60 to 0.90	No more than 0.30
32Г2Рпс	0.28 to 0.37	1.30 to 1.75	No more than 0.17	No more than 0.30
35ГС	0.30 to 0.37	0.80 to 1.20	0.60 to 0.90	No more than 0.30
25Г2С	0.20 to 0.29	1.20 to 1.60	0.60 to 0.90	No more than 0.30
20ХГ2Ц	0.19 to 0.26	1.50 to 1.90	0.40 to 0.70	0.90 to 1.20
80С	0.74 to 0.82	0.50 to 0.90	0.60 to 1.10	No more than 0.30
23Х2Г2Т	0.19 to 0.26	1.40 to 1.70	0.40 to 0.70	1.35 to 1.70
22Х2Г2АЮ	0.19 to 0.26	1.40 to 1.70	0.40 to 0.70	1.50 to 2.10
22Х2Г2Р	0.19 to 0.26	1.50 to 1.90	0.40 to 0.70	1.50 to 1.90
20Х2Г2СР	0.16 to 0.26	1.40 to 1.80	0.75 to 1.55	1.40 to 1.80

Table 6 (cont.)

Steel of grade	Mass fraction of elements, %						
	Titan	Zirconium	Aluminum	Nickel	Sulfur	Phosphorus	Copper
				no more than			
10ГТ	0.015 to 0.035	-	0.02 to 0.05		0.040	0.030	0.30
18Г2С	-	-	-	0.30	0.045	0.040	0.30
32Г2Рпс	-	-	0.001 to 0.015	0.30	0.050	0.045	0.30
35ГС	-	-	-	0.30	0.045	0.040	0.30
25Г2С	-	-	-	0.30	0.045	0.040	0.30
20ХГ2Ц	-	0.05 to 0.14	-	0.30	0.045	0.045	0.30
80С	0.015 to 0.040	-	-	0.30	0.045	0.040	0.30
23Х2Г2Т	0.02 to 0.08	-	0.015 to 0.050	0.30	0.045	0.045	0.30
22Х2Г2АЮ	0.005 to 0.030	-	0.02 to 0.07	0.30	0.040	0.040	0.30
22Х2Г2Р	0.02 to 0.08	-	0.915 to 0.050	0.30	0.040	0.040	0.30
20Х2Г2СР	0.02 to 0.08	-	0.0l5 to 0.050	0.30	0.040	0.040	0.30

2.3.1. For steel of grade 20ХГ2Ц it is allowed to increase zirconium mass fraction up to 1.7 % and to replace zirconium with 0.02 % to 0.08 % of titanium. For steel of grade 23Х2Г2Т it is allowed to replace titanium with 0.05 to 0.10 % of zirconium. In this case letter “Ц” in designation of steel of grade 20ХГ2Ц shall be replaced with letter “Т” and letter “Т” in designation of steel of grade 23Х2Г2Т shall be replaced with letter “Ц”.

For steel of grade 32Г2Рпс It is allowed to replace aluminum with titanium or with zirconium in equal amounts.

2.3.2. Nitrogen mass fraction in steel of grade 22Х2Г2АЮ shall be 0.015 to 0.030% and residual nitrogen mass fraction in steel of grade 10ГТ shall be of no more than 0.008 %.

2.3.3. Boron mass fraction in steel of grades 22Х2Г2Р, 20Х2Г2СР and 32Г2Рпс shall be from 0.001 to 0.007 %. It is allowed to add 0.001 to 0.008 % of boron into steel of grade 22Х2Г2АЮ.

2.3.4. It is allowed to add titanium into steel of grades 18Г2С, 25Г2С and 35ГС on the basis of its calculated mass fraction of 0.01 to 0.03 % in finished rolled metal, and to add titanium into steel of grade 35ГС on the basis of its calculated mass fraction of 0.01 to 0.06 % in finished rolled metal manufactured in hanks.

2.4. Chemical composition deviations in finished rolled metal made of carbon steel shall be in compliance with GOST 380-88. Chemical composition deviations in finished rolled metal made of low-alloyed steels shall be in compliance with table 7, provided that the norms for mechanical properties are observed. The negative deviations in chemical composition of elements (except for titanium and zirconium for all steel grades, and except for silicon for steel of grade 20Х2Г2СР) are not limited.

Table 7

Element	Maximum deviations, %	Element	Maximum deviations, %
Carbon	+0.020	Sulfur	+0.005
Silicon	+0.050	Phosphorus	+0.005
Manganese	+0.100	Zirconium	+0.010
Chromium	+0.050		-0.020
Copper	+0.050	Titanium	±0.010

Note: By agreement between the customer and the manufacturer steel may be manufactured with other deviations of chromium, silicon and manganese contents.

(Amended Wording. Amendment No. 3).

2.5. Reinforcing-bar steel of classes A-I (A240), A-II (A300), A-III (A400) and A-IV (A600) shall be manufactured as hot-rolled steel. Reinforcing-bar steel of class A-V (A800) shall be manufactured with backing. Reinforcing-bar steel of class A-VI (A1000) shall be manufactured with backing or with thermomechanical treatment in the stream of a rolling mill.

It is allowed to omit the backing for steel of classes A-V (A800) and A-VI (A1000) under conditions that 1) the aspect ratio is not lower than 9 % and 2) uniform elongation is not lower than 2 % in process of testing during 12 hours after the rolling.

2.6. Mechanical properties of reinforcing-bar steel shall be in compliance with the norms specified in table 8.

For steel of class A-II (A300) more than 40 mm in diameter it is allowed to reduce the aspect ratio by 0.25 % per each millimeter of diameter increase, but totally no more than by 3 %.

For steel of class A-II (Ac300) it is allowed to reduce maximum load point to 426 MPa (43.5 кgf/mm^2) for aspect ratio δ_5 of no less than 30 %.

For steel of grade 25Г2С of class A-III (A400) it is allowed to reduce maximum load point to 560 MPa (57 кgf/mm^2) for yield point of no less than 405 MPa (41 kgf/mm^2) and aspect ratio δ_5 of no less than 20 %.

2.7. Statistic characteristics of mechanical properties of reinforcing steel bars with die-rolled section shall be in compliance with Appendix 1 of this Standard. The same shall be in compliance with Appendix 1 and table 9 if steel possesses heightened homogeneity of mechanical properties.

Confidence probability for mechanical properties specified in table 8 shall be of no less than 0.95.

(Amended Wording. Amendment No. 3).

2.8. Rolled cracks, stress cracks, fissure cavities, rolled skins and rolled-in scale shall not be observed on the section surface including the surface of ribs and projections.

Small defects of ribs and projections (no more than three defects per each meter of length), insignificant rust, separate expanded contamination, rolled marks, accumulations, traces of rolled blisters, cratering and scaliness are allowed within maximum deviations of dimensions.

(Amended Wording. Amendment No. 2).

2.9. Weldability of reinforcing-bar steel of all grades, except for grade 80C, shall be ensured by chemical composition and manufacturing technique.

2.10. Carbon equivalent $C_{equ} \le C + \frac{Mn}{6} + \frac{Si}{10}$ for welded reinforcing bars made of low-alloyed steel of class A-III (A400) shall be of no more than 0.62.

(Subsequently Inserted, Amendment No. 5)

Table 8

Class of reinforcing-bar steel	Yield point, σ_T		Point of maximum load, σ_B		Aspect ratio, δ_5 %	Uniform elongation, δ_p %	Impact elasticity at a temperature of 60 °C		Bending test in cold state (c – mandrel thickness, d – bar diameter)
	N/mm^2	kgf/mm^2	N/mm^2	kgf/mm^2			MJ/m^2	$kgf \cdot m/cm^2$	
	no less than								
A-I (A240)	235	24	373	38	25	—	—	—	180 °; $c=d$
A-II (A300)	295	30	490	50	19	—	—	—	180 °; $c=3d$
Ac-II (A300)	295	30	441	45	25	—	0.5	5	180 °; $c=d$
A-III(A400)	390	40	590	60	14	—	—	—	90 °; $c=3d$
A-IV (A600)	590	60	883	90	6	2	—	—	45 °; $c=5d$
A-V (A800)	785	80	1 030	105	7	2	—	—	45 °; $c=5d$
A-VI (A1000)	980	100	1 230	125	6	2	—	—	45 °; $c=5d$

Notes:

1. It is allowed not to carry out impact elasticity test for reinforcing-bar steel of class Ac-II by agreement between the customer and the manufacturer..

2. **(Removed, Amendment No. 3).**

3. The bending test angle in cold state shall be of no less than 30° for reinforcing-bar steel of class A-IV, of grade 80C and 18 mm in diameter.

4. The mandrel thickness shall be taken equal to doubled bar diameter ($c=2d$) and bending angle equal to 180º during the test in cold state for reinforcing-bar steel of class A-I (A240) more than 20 mm in diameter. The mandrel thickness shall be taken equal to four bar diameters ($c=4d$) and bending angle equal to 180º during the test in cold state for reinforcing-bar steel of class A-II (A300) more than 20 mm in diameter.

5. The conventional designations of reinforcing-bar steel class by its yield point are specified in brackets.

(Amended Wording, Amendment Nos. 1, 3 and 5).

Table 9

Class of reinforcing-bar steel	Section number	S		S_0		$S/\bar{x}$		$S_0/\tilde{x}$	
		For σ_T ($\sigma_{0.2}$)	For σ_B	For σ_T ($\sigma_{0.2}$)	For σ_B	For σ_T ($\sigma_{0.2}$)	For σ_B	For σ_T ($\sigma_{0.2}$)	For σ_B
		MPa (kgf/mm^2)		MPa (kgf/mm^2)					
		no more than							
A-II (A300)	10 to 40	29 (3)	29 (3)	15 (1.5)	15 (1.5)	0.08	0.06	0.05	0.03
A-III (A400)	6 to 40	39 (4)	39 (4)	20 (2.0)	20 (2.0)	0.08	0.07	0.05	0.03
A-IV (A600)	10 to 32	69 (7)	69 (7)	39 (4)	39 (4)	0.09	0.07	0.06	0.05
A-V (A800)	10 to 32	78 (8)	78 (8)	49 (5)	49 (5)	0.09	0.07	0.06	0.05
A-VI (A1000)	10 to 32	88 (9)	88 (9)	49 (5)	49 (5)	0.08	0.07	0.05	0.04

Notes:

1. S is the root-mean-square deviation in general totality of tests;
S_0 is the root-mean-square deviation in a batch-tap;
$\bar{x}$ is the mean value in general totality of tests;
$\tilde{x}$ is the minimum mean value in a batch-tap.

2. It is allowed to exceed S and S_0 standardized values by 4.9 MPa (0.5 kgf/mm^2) for reinforcing-bar steel of 6 mm and 8 mm in diameter manufactured in hanks.

3. **(Removed, Amendment No. 5).**

3. ACCEPTANCE

3.1. Reinforcing-bar steel shall be accepted in batches consisting of sections one diameter, one class, one tap-ladle and accompanied by one quality certificate.

The batch mass shall not exceed 70 tons.

It is allowed to increase the batch mass up to the mass of a tap-ladle.

3.2. Every batch shall be accompanied by quality certificate in compliance with GOST 7566-81 with additional data:

- section number;
- class;
- minimum mean value $\tilde{x}$ and root-mean-square deviation S_0 of parameters σ_T ($\sigma_{0.2}$) and σ_B in the batch;
- bending test results obtained in cold state;

- uniform elongation values for steel of classes A-IV (A600), A-V (800) and A-VI (A1000).

3.3. The following quantity of samples shall be selected for check of dimensions and surface quality:

- no less than 5 % of a batch for reinforcing-bar steel manufactured as bars;
- two hanks from each batch for reinforcing-bar steel manufactured as hanks.

(Amended Wording, Amendment No. 3).

3.4. The samples shall be selected in compliance with GOST 7565-81 for check of chemical composition.

Aluminum mass fraction shall be checked periodically by the manufacturer but no less than once per three months.

3.5. Two bars shall be selected from a batch for tensile test, bending test and impact elasticity test.

The selection time interval shall be of no less than half the time necessary to roll one batch of bars with the same dimensions and same section.

(Amended Wording, Amendment No. 3).

3.6. The retest shall be carried out in compliance with GOST 7566-81 if unsatisfactory results are obtained for at least one parameter.

4. TEST METHODS

4.1. The chemical analysis of steel shall be carried out in compliance with GOST 12344-88, GOST 12348-78, GOST 12350-78, GOST 12352-81, GOST 12355-78, GOST 12356-81, GOST 18895-81 or using other methods that provide the required accuracy.

4.2. The diameter and ovality of sections shall be measured at a distance of no less than 150 mm from a bar end, at a distance of no less than 1 500 mm from a hank end if the hank mass is less than 250 kg, and at a distance of no less than 3 000 mm from the hank end if the hank mass is more than 250 kg.

4.3. The dimensions shall be checked with aid of measuring tools of necessary accuracy.

4.4. One sample shall be cut off from each selected bar for tensile test, bending test and impact elasticity test.

4.5. The sampling for tensile test, bending test and impact elasticity test shall be carried out in compliance with GOST 7564-73.

4.6. The tensile test is carried out in compliance with GOST 12004-81.

4.7. The bending test shall be carried out in compliance with GOST 14019-80 using the samples with cross-section equal to cross-section of a bar.

For the bars more than 40 mm diameter it is allowed to test the samples cut lengthwise the bar axis using the mandrel with diameter twice smaller than the value specified in table 4. The bending load shall be applied on the side of the cut.

4.8. Determination of impact elasticity shall be carried out in compliance with GOST 9454-78 on samples with U-concentrator of type 3 for bars from 12 to 14 mm in diameter, and on samples of type 1 for the bars of no less than 16 mm in diameter. The samples shall be manufactured in compliance with GOST 9454-78.

4.9. It is allowed to use statistical nondestructive test methods to check mechanical properties and mass of sections.

4.10. Bar curvature shall be measured lengthwise the section. The bar shall be of no less than 1 m long.

4.11. Determination of statistical factors for mechanical properties shall be carried out in compliance with obligatory Appendix 2 of this Standard.

4.12. The surface quality shall be checked without magnifying tools.

4.10 to 4.12. **(Subsequently Inserted, Amendment No. 3).**

4.13. Measuring of a height of transversal projections of die-rolled section shall be carried out lengthwise the vertical axis of the reinforcing bar cross-section.

(Subsequently Inserted, Amendment No. 4).

5. PACKING, MARKING, TRANSPORTATION AND STORAGE

5.1. Packing, marking, transportation and storage shall be carried out in compliance with GOST 7566-81 with additions:

- the ends of bars made from low-alloyed steels of class A-IV (A600) shall be painted in red; the ends of bars made from low-alloyed steels of class A-V (A600) shall be painted in red and green; the ends of bars made from low-alloyed steels of class A-VI (A1000) shall be painted in red and blue. It is allowed to paint a bunch at a distance of 0.5 m from its ends.
- the bars shall be packed in bunches of no more than 15 tons in mass. They shall be banded with wire and rods. At the customer’s request the bars may be packed in bunches up to 3 and up to 5 tons in mass.
- The bunches shall be painted with stripes no less than 20 mm wide on the side surface along the circle (no less than half of the circle length) no more than 500 mm away from the edge.
- The hanks shall be painted by stripes no less than 20 mm wide across the coils on the hank outer side.
- Non-packed products shall be painted on the edge or side surface at a distance of no more than 500 mm from the edge.
- The conventional designation of reinforcing-bar steel class (for example, A-III) or steel yield point (for example, A400) shall be specified on a label attached to every bunch of bars.

(Amended Wording, Amendment Nos. 3 and 5)

APPENDIX 1
Obligatory

REQUIREMENTS FOR STATISTICAL FACTORS OF MECHANICAL PROPERTIES

1. The manufacturer shall guarantee to the customer the mean values of maximum load point σ_B, yield strength (physical σ_τ and conventional $\sigma_{0.2}$) in general totality $\tilde{x}_i$ and minimum mean values $\bar{x}_i$ of the same factors in every batch-tap. The values of these factors shall be stipulated under the following conditions:

$$\bar{x}_i \geq x_{i\text{бр}} + t \cdot S$$

$$\tilde{x}_i > 0.9x_{i\text{бр}} + 3S$$

$$\tilde{x}_i \geq x_{i\text{бр}}$$

where:

$x_{i\text{бр}}$ are the reject values of factors σ_B, $\sigma_{0.2}$ specified in table 8 of this Standard;

t is the fractile value. It shall be taken equal to 2 for steel bars of classes A-II and A-III and equal to 1.64 for steel bars of classes A-IV, A-V and A-VI.

2. Quality control performed by the manufacturer for mechanical properties of products

2.1. The required quality factors of sections are ensured by observance of production technology and are controlled by testing in compliance with the requirements of clause 3.5 and clauses 4.4 to 4.8 of this Standard.

2.2. Factors $\bar{x}_i, \tilde{x}_i$, S and S_0 are determined in compliance with test results and provisions of Appendix 2 of this Standard.

3. Quality control performed by the customer for mechanical properties of products

3.1. The customer may refuse to test the mechanical properties if there is the quality certificate that guarantees the highest quality of a product.

3.2. The test of six samples with different sections selected from different bunches or hanks shall be carried out to check the mechanical properties in case of necessity. The test results shall be checked under the following conditions:

$$x_{\min} \geq \tilde{x}_i - 1.64S_0$$

$$\bar{x}_6 \geq \tilde{x}_i \geq \tilde{x}_{i\text{бр}}$$

where:

$\bar{x}_6$ are the mean values of mechanical properties obtained using the tests results of six samples;

$x_{\min}$ are the minimum values of mechanical properties obtained using the test results of six samples.

3.3. The minimum values of aspect ratio δ_5 and uniform elongation δ_p shall be no less than the values specified in table 8.

(Amended Wording, Amendment Nos. 3 and 5).

APPENDIX 2
Obligatory

PROCEDURE
for determination of statistical factors for strength characteristics of mechanical properties of hot-rolled steel designed for reinforcement of ferroconcrete structures

This procedure applies to hot-rolled, cooled in accelerated way, thermomechanically and thermally strengthened rolled steel with die-rolled section manufactured in hanks or in bars.

The procedure is applied to estimate reliability of mechanical properties for every batch-tap and for steel as a whole and to check the stability of engineering procedure.

1. The control test results, named general totalities, are used to determine statistical factors of mechanical properties (yield strength, physical σ_τ and conventional $\sigma_{0.2}$, maximum load point σ_B).

2. The compliance of mechanical properties of rolled steel with the requirements of specifications and technical documentation is determined on the basis of statistical processing of test results that constitute a sample from general totality. All conclusions and test results on the basis of this sample are referred to the whole general totality.

3. The sample is a totality of control test results that constitute the information bulk subject to processing.

The sample includes the acceptance test results for rolled steel of one class, one grade and smelting method. It shall be rolled for one section dimension or for group of similar section dimensions.

4. The sample, that is used for determination of statistical factors, shall be representative and shall cover sufficiently long time interval to continue with the same engineering procedure but no longer than for three months. This time interval may be increased in case of necessity. The sample homogeneity test shall be carried out using specifications and technical documentation.

5. The number of batch-taps shall be of no less than 50 in each sample.

6. The condition of random sampling from a batch-tap shall be observed during forming of a sample. Estimation of abnormality of test results shall be carried out in compliance with specifications and technical documentation.

7. The following factors shall be determined during statistical processing:

- mean value $\bar{x}$;
- mean square deviation S for every sample (general totality);
- mean square deviation S_0 within every batch-tap;
- mean square deviation for mean tap values S_1.

Value S_1 shall be determined using the formula:

$$S_1 = \sqrt{S^2 - S_0^{\,2}}$$

Values $\bar{x}$, S shall be determined in compliance with specifications and technical documentation.

8 Factors $\bar{x}$ and S stability check shall be carried out in compliance with OST 14-34–78.

9. Value S_0 shall be determined using only experimental method for cooled in accelerated way, thermomechanically and thermally strengthened reinforcing-bar steel. This value can be determined by experimental method and «span» method for hot-rolled steel using the formula:

$$S_0^{\,2} = \frac{\overline{ш}^2 + S_ш^{\,2}}{2};$$

where:

$\overline{ш}$ is the mean value of the span distribution for two tests from the batch;

$S_ω$ is the root-mean-square deviation of the span distribution for two tests from the batch.

Minimum value of S_0 is equal to 1.

10. Determination of S_0 by experimental method shall be carried out using no less than two taps for every steel grade, every class and every section dimension of the rolled steel by random sampling of no less than 1 000 samples from each tap.

11. Minimum mean value $\widetilde{x}_2$ of mechanical characteristics (σ_τ, $\sigma_{0.2}$, σ_B) in each tap shall be determined using condition $\widetilde{x}_1 = \widetilde{x} - t \cdot S_1$, where t is the fractile value. This value shall be equal to 1.64 and confidence probability equal to 0.95.

12. Minimum value of tensile test results for two samples (n=2) for each batch under the test shall be of no less than $x_{\min}$ that is determined using the formula:

$$x_{\min} \geq \widetilde{x}_i - 1.64 S_0$$

13. The following conditions shall be satisfied to guarantee mechanical properties for the customer:

$$\overline{x}_i \geq x_{i\text{бр}} + 1.64 S$$

$$\widetilde{x}_i \geq x_{i\text{бр}}$$

$$\widetilde{x}_i > 0.9 x_{i\text{бр}} + 3 S_0$$

where:

$x_{i\text{бр}}$ is the rejection value of σ_τ ($\sigma_{0.2}$) and σ_B, specified in corresponding specifications and technical documentation.

(Subsequently Inserted, Amendment No. 3)

DETAILS

1. DEVELOPED AND SUBMITTED by USSR Ministry for Ferrous Metallurgy and by Gosstroy of the USSR

DEVELOPERS:
N.M. Vorontsov, Cand. Sci. (Tech.); **I.S. Grin,** Cand. Sci. (Tech.); **K.F. Peretyatko; G.I. Snimshchikova; A.G. Bolshova; E.D. Gavrilenko** Cand. Sci. (Tech.); **K.V. Mikhaylov,** Dr. Sci. (Tech.); **S.A. Madatyan,** Cand. Sci. (Tech.); **N.M. Mulin,** Cand. Sci. (Tech.); **V.Z. Meshkov,** Cand. Sci. (Tech.); **B.P. Goryachev,** Cand. Sci. (Tech.); **B.N. Fridlyanov; V.I. Petina**

2. APPROVED AND INTRODUCED be Decree No. 4800, dated 17.12.82, of USSR State Committee for Standards

3. IN PLACE OF GOST 5.1459-72 and GOST 5781-75

4. REFERENCE DOCUMENTATION:

Designation of the reference document	Clause number
GOST 380-88	2.3, 2.4
GOST 2590-88	1.6
GOST 7564-73	4.5
GOST 7565-81	3.4
GOST 7566-81	3.2, 3.6, 5.1
GOST 9454-78	4.8
GOST 12004-81	4.6
GOST 12344-88	4.1
GOST 12348-78	4.1
GOST 12350-78	4.1
GOST 12352-81	4.1
GOST 12355-78	4.1
GOST 12356-81	4.1
GOST 14019-80	4.7
GOST 18895-81	4.1
OST 14-34-78	Appendix 2

5. The limitation of validity period is removed by Decree of Interstate Council for Standardization, Metrology and Certification (protocol 3-93, dated 17.02.93).

6. Revised Edition (December, 1993) with Amendments Nos. 1, 2, 3, 4 and 5, approved in February 1984, June 1987, December 1987, October 1989 and December 1990 (5-84, 11-87, 3-88, 1-90, 3-91)