Structural alloy steel bars

Technical Specifications
GOST 4543 – 71

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Group B32

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

STRUCTURAL ALLOY STEEL BARS

Technical specifications

GOST 4543-71

OKII 09 5040

Effective period from : 01.01.73

Non – observance of standard is dealt as per rules

This standard pertains to hot rolled, forged bar of structural alloy steels with diameter or thickness upto 250 mm, calibrated and with special surface finish, to be used in heat treated conditions.

As far as norms of chemical composition, the standard pertains to all the other types of rolled stocks, ingots, forgings and stampings.
(Amended edition, Amendment No. 1, 2, 4, 5)

1. CLASSIFICATION

1.1 Depending upon the chemical composition and properties, structural steel is divided into following categories:

Quality;

High quality - A;

Very high quality - III.

Note:-

1. The steel of electro slag re-melting belongs to very high quality steel.

2. **(Deleted, Amendment No. 2)**

1.2 Depending upon the main alloying element, steel is divided into following groups:

Chromium, manganese, chromium-manganese, chromium-silicon, chromium-molybdenum, chromium-molybdenum-vanadium, chromium-vanadium, nickel-molybdenum, chromium-nickel and chromium-nickel with boron, chromium-silicon-manganese, and chromium-silicon-manganese-nickel, chromium-manganese nickel and chromium-manganese-nickel with titanium and boron, chromium-nickel-molybdenum,

Chromium-nickel-molybdenum-vanadium and chromium-nickel-vanadium, chromium-aluminium and chromium-aluminium with molybdenum, chromium-manganese-nickel with molybdenum, chromium-manganese-nickel with molybdenum and titanium.

(Amended addition, Amendment No. 3)

1.3 As per the types of processing, the rolled stock is divided as follows:

hot rolled and forged (including with turned or roughened surfaces):

calibrated;

with special surface finish.

1.4 Depending upon the surface quality, the hot rolled and forged stock is divided into following groups: 1, 2, 3

1.5 According to condition of materials, rolled stock is manufactured:

without heat treatment;

heat treatment - T;

cold worked - H (for calibrated and with special surface finish of rolled stock).

1.3 – 1.5. **(Amended edition, Amendment No. 5).**

2a. Assortment

2a.1. Assortment of rolled stock should correspond to the requirements of GOST 2591 – 88, GOST 2590 – 88, GOST 2879 – 88, GOST 103 – 76, GOST 1133 – 71, GOST 7417 – 75, GOST 8559 – 75; GOST 8560 – 78, GOST 14955 – 77 and other standard technical documents.

(Amended edition, Amendment No. 5).

Example of conventional designation:

Hot rolled stock, square, having side of square 46 mm, normal accuracy of rolling B as per GOST 2591 – 88, grade 18ХГТ, surface quality of group 2, heat treated T:

$$\text{Square}\ \frac{46 - \text{B GOST } 2591 - 88}{18\text{ХГТ} - 2 - \text{T GOST } 4543 - 71}$$

As well as, round having diameter 80 mm, normal accuracy of rolling B as per GOST 2590 – 88, grade 18X2H4MA, surface quality of group 1, mechanical properties of make 2, heat treated T:

$$\text{Round}\ \frac{80 - \text{B GOST } 2590 - 88}{18\text{X2H4MA} - 1 - 2 - \text{T GOST } 4543 - 71}$$

As well as, strip having thickness 20 mm, width 75 mm as per GOST 103 – 76, grade 25ХГТ, surface quality of group 3, mechanical properties of make 1, without heat treatment:

$$\text{Strip}\ \frac{20\text{X}75\ \text{GOST}\ 103-76}{25\text{ХГТ}-3-1\ \text{GOST}\ 4543-71}$$

Calibrated rolling stock, round having diameter 15 mm, with limit deviation as per h11 according to GOST 7417 – 75, grade 40ХН2МА, surface quality of group Б as per GOST 1051 – 73, with checking of mechanical properties М, cold worked Н:

$$\text{Round}\ \frac{15-\text{h}11\ \text{GOST}\ 7417-75}{40\text{XH}2\text{MA}-\text{Б}-\text{M}-\text{H}\ \text{GOST}\ 4543-71}$$

Rolling stock with special surface finish, round having diameter 8.5 mm with limit deviations as per h9 and surface quality of group В as per GOST 14955–77, Grade 12ХН3А with standardized hardenability П, heat treatment Т:

$$\text{Round}\ \frac{8.5-\text{h}9\ \text{GOST}\ 14955-77}{12\text{XH}3\text{A}-\text{B}-\text{П}-\text{T}\ \text{GOST}\ 4543-71}$$

(Amended edition, Amendment No. 5).

2. TECHNICAL REQUIREMENTS

2.1 Structural alloy steel rolled stocks are manufactured inconformity with requirement of present standard according to production schedules, approved in established order.

(Amended edition, Amendment No. 5)

2.2 Grade and chemical composition of steel should correspond to those specified in table.1.

2.3 Mass fraction of phosphorous, sulphur, residues of copper, nickel and chromium in steel of all grades should not exceed the norms, specified in table.2.

Table 1

Group of steel	Grade of steel	Mass fraction of elements, %								
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum	Aluminium	Titanium	Vanadium
Chromium	15X	0.12-0.18	0.17-0.37	0.40-0.70	0.70-1.00	–	–	–	–	–
	15XA	0.12-0.17	0.17-0.37	0.40-0.70	0.70-1.00	–	–	–	–	–
	20X	0.17-0.23	0.17-0.37	0.50-0.80	0.70-1.00	–	–	–	–	–
	30X	0.24-0.32	0.17-0.37	0.50-0.80	0.80-1.10	–	–	–	–	–
	30XPA	0.27-0.33	0.17-0.37	0.50-0.80	1.00-1.30	–	–	–	–	–
	35X	0.31-0.39	0.17-0.37	0.50-0.80	0.80-1.10	–	–	–	–	–
	38XA	0.35-0.42	0.17-0.37	0.50-0.80	0.80-1.10	–	–	–	–	–
	40X	0.36-0.44	0.17-0.37	0.50-0.80	0.80-1.10	–	–	–	–	–
	45X	0.41-0.49	0.17-0.37	0.50-0.80	0.80-1.10	–	–	–	–	–
	50X	0.46-0.54	0.17-0.37	0.50-0.80	0.80-1.10	–	–	–	–	–
Manganese	15Г	0.12-0.19	0.17-0.37	0.70-1.00	–	–	–	–	–	–
	20Г	0.17-0.24	0.17-0.37	0.70-1.00	–	–	–	–	–	–
	25Г	0.22-0.30	0.17-0.37	0.70-1.00	–	–	–	–	–	–
	30Г	0.27-0.35	0.17-0.37	0.70-1.00	–	–	–	–	–	–

Continuation table 1

Group of steel	Grade of steel	Mass fraction of elements, %								
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum	Aluminium	Titanium	Vanadium
Manganese	35Г	0.32-0.40	0.17-0.37	0.70-1.00	–	–	–	–	–	–
	40Г, 40ГР	0.37-0.45	0.17-0.37	0.70-1.00	–	–	–	–	–	–
	45Г	0.42-0.50	0.17-0.37	0.70-1.00	–	–	–	–	–	–
	50Г	0.48-0.56	0.17-0.37	0.70-1.00	–	–	–	–	–	–
	10Г2	0.07-0.15	0.17-0.37	1.20-1.60	–	–	–	–	–	–
	30Г2	0.26-0.35	0.17-0.37	1.40-1.80	–	–	–	–	–	–
	35Г2	0.31-0.39	0.17-0.37	1.40-1.80	–	–	–	–	–	–
	40Г2	0.36-0.44	0.17-0.37	1.40-1.80	–	–	–	–	–	–
	45Г2	0.41-0.49	0.17-0.37	1.40-1.80	–	–	–	–	–	–
	50Г2	0.46-0.55	0.17-0.37	1.40-1.80	–	–	–	–	–	–
	47ГТ	0.44-0.52	0.10-0.22	0.90-1.20	–	–	–	–	**0.06-0.12**	–
Chromium-Manganese	18ХГ	0.15-0.21	0.17-0.37	0.90-1.20	0.90-1.20	–	–	–	–	–
	18ХГТ	0.17-0.23	0.17-0.37	0.80-1.10	**1.00-1.30**	–	–	–	**0.03-0.09**	–
	20ХГР	0.18-0.24	0.17-0.37	0.70-1.00	**0.75-1.05**	–	–	–	–	–

Continuation table 1

Group of steel	Grade of steel	Mass fraction of elements, %								
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum	Aluminium	Titanium	Vanadium
Chromium-manganese	27ХГР	0.25-0.31	0.17-0.37	0.70-1.00	0.70-1.00	–	–	–	–	–
	25ХГТ	0.22-0.29	0.17-0.37	0.80-1.10	**1.00-1.30**	–	–	–	**0.03-0.09**	–
	30ХГТ	0.24-0.32	0.17-0.37	0.80-1.10	**1.00-1.30**	–	–	–	**0.03-0.09**	–
	40ХГТР	0.38-0.45	0.17-0.37	0.80-1.00	**0.80-1.10**	–	–	–	**0.03-0.09**	–
	25ХГМ	0.23-0.29	0.17-0.37	0.90-1.20	**0.90-1.20**	–	**0.20-0.30**	–	–	–
	38ХГМ	0.34-0.40	0.17-0.37	0.60-0.90	**0.80-1.10**	–	**0.15-0.25**	–	–	–
Chrome-silicon	33ХС	0.29-0.37	1.0-14	0.30-0.60	1.30-1.60	–	–	–	–	–
	38ХС	0.34-0.42	1.0-1.4	0.30-0.60	**1.30-1.60**	–	–	–	–	–
	40ХС	0.37-0.45	1.2-1.6	0.30-0.60	**1.30-1.60**	–	–	–	–	–
Chrome-molybdenum and chrome-molybdenum-vanadium	15ХМ	0.11-0.18	0.17-0.37	0.40-0.70	**0.80-1.10**	–	**0.40-0.55**	–	–	–
	20ХМ	0.15-0.25	0.17-0.37	0.40-0.70	**0.80-1.10**	–	**0.15-0.25**	–	–	–
	30ХМ	0.26-0.34	0.17-0.37	0.40-0.70	**0.80-1.10**	–	**0.15-0.25**	–	–	–

Continuation table 1

Group of steel	Grade of steel	Mass fraction of elements, %								
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum	Aluminium	Titanium	Vanadium
Chrome-molybdenum and chrome-molybdenum-vanadium	30XMA	0.26-0.33	0.17-0.37	0.40-0.70	0.80-1.10	–	**0.15-0.25**	–	–	–
	35XM	0.32-0.40	0.17-0.37	0.40-0.70	**0.80-1.10**	–	**0.15-0.25**	–	–	–
	38XM	0.35-0.42	0.17-0.37	0.35-0.65	**0.90-1.30**	–	**0.20-0.30**	–	–	–
	30X3MΦ	0.27-0.34	0.17-0.37	0.30-0.60	**2.30-2.70**	–	**0.20-0.30**	–	–	**0.06-0.12**
	40XMΦA	0.37-0.44	0.17-0.37	0.40-0.70	**0.80-1.10**	–	**0.20-0.30**	–	–	**0.10-0.18**
Chrome-vanadium	15XΦ	0.12-0.18	0.17-0.37	0.40-0.70	0.80-1.10	–	–	–	–	0.06-0.12
	40XΦA	0.37-0.44	0.17-0.37	0.50-0.80	**0.80-1.10**	–	–	–	–	**0.10-0.18**
Nickel-molybdenum	15H2M (15HM)	0.10-0.18	0.17-0.37	0.40-0.70	–	1.50-1.90	**0.20-0.30**	–	–	–
	20H2M (20HM)	0.17-0.25	0.17-0.37	0.40-0.70	–	**1.50-1.90**	**0.20-0.30**	–	–	–
Chrome-nickel and chrome-nickel with boron	12XH	0.09-0.15	0.17-0.37	0.30-0.60	**0.40-0.70**	**0.50-0.80**	–	–	–	–
	20XH	0.17-0.23	0.17-0.37	0.40-0.70	**0.45-0.75**	**1.00-1.40**	–	–	–	–
	40XH	0.36-0.44	0.17-0.37	0.50-0.80	**0.45-0.75**	**1.00-1.40**	–	–	–	–

Continuation table 1

Group of steel	Grade of steel	Mass fraction of elements, %								
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum	Aluminium	Titanium	Vanadium
Chrome-nickel and chrome-nickel with boron	45XH	0.41-0.49	0.17-0.37	0.50-0.80	0.45-0.75	1.00-1.40	–	–	–	–
	50XH	0.46-0.54	0.17-0.37	0.50-0.80	0.45-0.75	1.00-1.40	–	–	–	–
	20XP	0.16-0.23	0.17-0.37	0.60-0.90	0.70-1.10	0.80-1.10	–	–	–	–
	12XH2	0.09-0.16	0.17-0.37	0.30-0.60	0.60-0.90	1.50-1.90	–	–	–	–
	12XH3A	0.09-0.16	0.17-0.37	0.30-0.60	0.60-0.90	2.75-3.15	–	–	–	–
	20XH3A	0.17-0.24	0.17-0.37	0.30-0.60	0.60-0.90	2.75-3.15	–	–	–	–
	30XH3A	0.27-0.33	0.17-0.37	0.30-0.60	0.60-0.90	2.75-3.15	–	–	–	–
	12X2H4A	0.09-0.15	0.17-0.37	0.30-0.60	1.25-1.65	3.25-3.65	–	–	–	–
	20X2H4A	0.16-0.22	0.17-0.37	0.30-0.60	1.25-1.65	3.25-3.65	–	–	–	–
Chrome-silicon-manganese and chrome-silicon-manganese-nickel	20ХГСА	0.17-0.23	0.9-1.2	0.80-1.10	0.80-1.10	–	–	–	–	–
	25ХГСА	0.22-0.28	0.9-1.2	0.80-1.10	0.80-1.10	–	–	–	–	–
	30ХГС	0.28-0.35	0.9-1.2	0.80-1.10	0.80-1.10	–	–	–	–	–
	30ХГСА	0.28-0.34	0.9-1.2	0.80-1.10	0.80-1.10	–	–	–	–	–

Continuation table 1

Group of steel	Grade of steel	Mass fraction of elements, %								
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum	Aluminium	Titanium	Vanadium
Chrome-silicon-manganese and chrome-silicon-manganese-nickel	35ХГСА	0.32-0.39	1.1-1.4	0.80-1.10	1.10-1.40	–	–	–	–	–
	30ХГСН2А (30ХГСНА)	0.27-0.34	0.9-1.2	1.00-1.30	**0.90-1.20**	**1.4-1.8**	–	–	–	–
Chrome-manganese nickel and chrome-manganese-nickel with titanium and boron	15ХГН2ТА (15ХГНТА)	0.13-0.18	0.17-0.37	0.70-1.00	0.70-1.00	1.4-1.8	–	–	0.03-0.09	–
	20ХГНР	0.16-0.23	0.17-0.37	0.70-1.00	**0.70-1.10**	**0.80-1.10**	–	–	–	–
	20ХГНТР	0.18-0.24	0.17-0.37	0.80-1.10	**0.40-0.70**	**0.40-0.70**	–	–	**0.03-0.09**	–
	38ХГН	0.35-0.43	0.17-0.37	0.80-1.10	**0.50-0.80**	**0.70-1.00**	–	–	–	–
	14ХГН	0.13-0.18	0.17-0.37	0.70-1.00	**0.80-1.10**	**0.80-1.10**	–	–	–	–
	19ХГН	0.16-0.21	0.17-0.37	0.70-1.10	**0.80-1.10**	**0.80-1.10**	–	–	–	–
Chrome-nickel-molybdenum	20ХН2М (20ХНМ)	0.15-0.22	0.17-0.37	0.40-0.70	**0.40-0.60**	1.6-2.0	**0.20-0.30**	–	–	–
	30ХН2МА (30ХНМА)	0.27-0.34	**0.17-0.37**	0.30-0.60	**0.60-0.90**	**1.25-1.65**	**0.20-0.30**	–	–	–
	38Х2Н2МА (38ХНМА)	0.33-0.40	**0.17-0.37**	0.25-0.50	**1.30-1.70**	**1.3-1.7**	**0.20-0.30**	–	–	–

Continuation table 1

Group of steel	Grade of steel	Mass fraction of elements, %								
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum	Aluminium	Titanium	Vanadium
Chrome- nickel molybdenum	40XH2MA (40XHMA)	0.37-0.44	0.17-0.37	0.50-0.80	0.60-0.90	1.25-1.65	**0.15-0.25**	–	–	–
	40X2H2MA (40X1HBA)	0.35-0.42	0.17-0.37	0.30-0.60	**1.25-1.65**	**1.35-1.75**	**0.20-0.30**	–	–	–
	38XH3MA	0.33-0.40	0.17-0.37	0.25-0.50	**0.80-1.20**	**2.75-3.25**	**0.20-0.30**	–	–	–
	18X2H4MA (18X2H4BA)	0.14-0.20	0.17-0.37	0.25-0.55	**1.35-1.65**	**4.0-4.4**	**0.30-0.40**	–	–	–
	25X2H4MA (25X2H4BA)	0.21-0.28	0.17-0.37	0.25-0.55	**1.35-1.65**	**4.0-4.4**	**0.30-0.40**	–	–	–
Chrome-nickel-molybdenum-vanadium and chrome-nickel-vanadium	30XH2MΦA (30XH2BΦA)	0.27-0.34	0.17-0.37	0.30-0.60	**0.60-0.90**	2.0-2.4	**0.20-0.30**	–	–	0.10-0.18
	36X2H2MΦA (36XH1MΦA)	0.33-0.40	**0.17-0.37**	0.25-0.50	**1.30-1.70**	**1.30-1.70**	**0.30-0.40**	–	–	**0.10-0.18**
	38XH3MΦA	0.33-0.40	**0.17-0.37**	0.25-0.50	**1.20-1.50**	**3.0-3.5**	**0.35-0.45**	–	–	**0.10-0.18**
	45XH2MΦA (45XMΦA)	0.42-0.50	**0.17-0.37**	0.50-0.80	**0.80-1.10**	**1.3-1.8**	**0.20-0.30**	–	–	**0.10-0.18**
	20XH4ΦA	0.17-0.24	**0.17-0.37**	0.25-0.55	**0.70-1.10**	**3.75-4.15**	–	–	–	**0.10-0.18**
Chrome-aluminum and chrome-aluminum-molybdenum	38X2MЮA (38XMЮA)	0.35-0.42	**0.20-0.45**	0.30-0.60	**1.35-1.65**	–	**0.15-0.25**	**0.7-1.1**	–	–

Continuation table 1

Group of steel	Grade of steel	Mass fraction of elements, %								
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum	Aluminium	Titanium	Vanadium
chrome-manganese-nickel with molybdenum and titanium	20ХГНМ	0.18-0.23	0.17-0.37	0.70-1.10	0.40-0.70	0.40-0.70	**0.15-0.25**	–	–	–
	40ХГНМ	0.37-0.43	0.17-0.37	0.50-0.80	**0.60-0.90**	**0.70-1.10**	**0.15-0.25**	–	–	–
	25ХГНМТ	0.23-0.29	0.17-0.37	0.50-0.80	**0.40-0.60**	**0.80-1.10**	**0.40-0.50**	–	**0.04-0.09**	–

Note:-

1. Chemical composition of steel – category III should correspond the norms specified in table 1 for the corresponding grade of steel.

2. In the denotation of grade, the first two digits specify the average contents of carbon in hundreds fraction of percent, letters, after digit denote: Р – Boron, Ю – aluminium, С- silicon, Т – Titanium, Ф– Vanadium, Х – Chromium, Г – manganese, Н – Nickel, М – Molybdenum, В – Tungsten. The digit after letter specifies the approximate contents of alloying elements in complete units. The absence of digits denotes that this alloying element upto 1.5% is contained in the grade. The letter "А" at the end of description of grade denotes the «high quality steel». Very high quality steel is denoted by the letter III, after dash at the end of description of grade for example – quality – 30ХГС, high quality – 30ХГСА; Very high quality – 30ХГС – III, 30ХГСА – III.

The denotations of grades of steel corresponding to already existing GOST 4343 – 61 and technical specification are given in the brackets.

3. The steel of grades 30Г2, 35Г2, 40Г2, 45Г2, 50Г2 as per the requirements of customer may be supplied with contents of manganese 1.2 – 1.6%

4. For steel of grade 20ХГР, 20ХНР, 20ХГНР, 27ХГР and 18Х2Н4МА, Technical addition of titanium as per calculation (without calculation of loss) upto 0.06 % is permitted.

5. In steel, containing letter Р in the denotation of grade, boron is added as per the calculation (without calculating the loss) in quantity not more than 0.005% In this case, its residual contents in steel should not be less than 0.0010%

6. In steel, alloy with molybdenum, grade 38ХМ, 30ХН2МА, 30Х2Н2МА, 40Х2Н2МА, 38ХН3МА, 18Х2Н4МА, 25Х2Н4МА, 30ХН2МФА partial or complete substitution of molybdenum by tungsten is permitted.

During partial substitution of molybdenum by tungsten, one part by weight of molybdenum is substituted by three parts by weight of tungsten; In this case, the total contents of molybdenum and tungsten should correspond to the norms specified in table 1.

According to the requirement of customer, the steels with grade 38XB, 30XH2BA, 30X2H2BA, 40X2H2BA, 38XH3BA, 18X2H4BA, 25X2H4BA, and 30XH2BΦA is manufactured.

Mass fraction of tungsten in these steels should be as follows:

30XB	0.50 – 0.80%	38XH3BA	0.50 – 0.80%
30XH2BA	0.50 – 0.80%	18X2H4BA	0.80 – 1.2 %
38X2H2BA	0.50 – 0.80%	25X2H4BA	0.80 – 1.2%
40X2H2BA	0.60 – 0.90%	30XH2BΦA	0.50 – 0.80%

In specified grade of steel, partial replacement of tungsten by residual molybdenum is permitted at the rate of: one part by weight of molybdenum is substituted by three parts by weight of tungsten. In this case, mass fraction of tungsten should not be less than:

38XB	0.30%	38XH3BA	0.30%
30XH2B2A	0.30%	18X2H4BA	0.50%
38X2H2BA	0.30%	25X2H4BA	0.50%
40X2H2BA	0.40%	30XH2BΦA	0.30%

7. Presence of tungsten upto 0.20%, molybdenum upto 0.15%, titanium upto 0.03% (excluding the steels of grade, mentioned in note No 4) and vanadium upto 0.05 % in steels not alloyed by these elements is not the reason for rejection.

8. Steel grade 38XH3MΦA as per order of customer may be manufactured with mass fraction of molybdenum 0.20-0.30%.

9. Mass fraction of nitrogen in oxygen in converter steel should not exceed for thin sheet of rolling and strip – 0.006 %; for other type of rolling – 0.008%.

10. In accordance with the order, in steel grade 15X, 20X, 30X, 35X, 40X, 45X, 40XH, 15XΦ, 30XMA mass fraction of silicon 0.10 – 0.37% and in steel grade 20X and 30X mass fraction of manganese 0.40-0.80%.

11. As per the requirements of customer, in steel non – alloyed by chromium and nickel, mass fraction of manganese may be decreased to value of manganese equivalent, which is equal to:

$Э_М = 0.3$ (Сч, %) + 0.5 (Ni, %) + 0.7 (Си, %),

Where Сч, Ni, Си – residual mass fraction of chromium, nickel and copper should not exceed the norms of table 2. In this case, mass fraction of manganese in steel should not be less than 0.35 %.

(Amended edition, Amendment No. 1, 2, 4, 5)

Table 2

Category of steel	Mass fraction of elements in % not more than.				
	Phosphorous	Sulphur	Copper	Nickel	Chromium
Quality	0.035	0.035	0.30	0.30	0.30
High quality	0.025	0.025	0.30	0.30	0.30
Very high quality	0.025	0.015	0.25	0.30	0.30

Note: -

1. For high quality steels, melted in the main martin furnaces and in the furnaces with acid lining content of phosphorus up to 0.030% is permitted.

In accordance with order in steel, manufactured with scrap process and scrap - ore process, residual mass fraction of nickel and chromium should not more than 0.40 % each.

2. Quality steel of all grades can be manufactured with mass fraction of sulphur and phosphorus in accordance with requirements of tables 2 for high quality steel. In this case, letter A is added to nomenclature of grade of steel.

(Amended edition, Amendment No. 2.5)

2.4 In finished roll and forgings, while observing the norm of mechanical properties and other requirements of present standard, deviations on chemical composition are allowed. Permissible deviation should correspond to those specified in table 3.

Table 3

Name of element	Upper limit of mass fraction of elements, in %	Permissible deviation, in %	Name of element	Upper limit of mass fraction of elements, in %	Permissible deviation, in %
Carbon	As per table 1	± 0.01	Vanadium	0.06 – 0.12	+ 0.02
				0.10 – 0.18	± 0.02
Aluminium	As per table 1	± 0.10	Manganese	Less than 1.0	± 0.02
				1.0 and above	± 0.05
Silicon	Less than 1.0	± 0.02	Nickel	Less than 2.5	- 0.05
	1.0 and above	± 0.05		2.5 and above	- 0.10
Titanium	As per table 1	± 0.02	Molybdenum	As per table 1	± 0.02
Chromium	Less than 1.0	± 0.02	Tungsten	As per table 1	± 0.05
	1.0 and above	± 0.05			

Note:- In quality steels, the deviation on contents of Sulphur and phosphorus by not more than + 0.005% of each is allowed as per the approval of customer.

(Amended addition, Amendment No. 2)

2.5. In accordance with the indent, the hot rolled and forged roll stock are supplied both in heat treated condition (annealed, highly tempered or normalized with high tempering) and without heat treatment; calibrated and with special surface finish,

roll stock is manufactured by cold worked or heat treated condition (annealed, tempered, normalized, hardened and tempered).

2.6 The brinell hardness (HB) of annealed or high tempered roll stock with diameter or thickness above 5 mm should correspond to the norms specified in table 4.

Table 4

Group of steel	Grade of steel	Diameter of indent, mm, not less than	Hardness number, HB, maximum
Chromium	15X	4.5	179
	15XA	4.5	179
	20X	4.5	179
	30X	4.4	187
	30XPA	3.9	241
	35X	4.3	197
	38XA	4.2	207
	40X	4.1	217
	45X	4.0	229
	50X	4.0	229
Manganese	15Г	4.7	163
	20Г	4.5	179
	25Г	4.3	197
	30Г	4.3	197
	35Г	4.2	207
	40Г, 40 ГР	4.2	207
	45Г	4.0	229
	50Г	4.0	229
	10Г2	4.3	197
	30Г2	4.2	207
	35Г2	4.2	207
	40Г2	4.1	217
	45Г2	4.0	229
	50Г2	4.0	229
	47ГТ	3.8	255
Chrome-manganese	18ХГ	4.4	187
	18ХГТ	4.1	217
	20ХГР	4.3	197
	27ХГР	4.1	217
	25ХГТ	4.1	217
	30ХГТ	4.0	229
	40ХГТР	4.0	229
	38ХГМ	+	+

Continuation of table 4.

Group of steel	Grade of steel	Diameter of indent, mm, not more than	Hardness number, HB, not more than
Chrome – silicon	**33XC**	**3.9**	**241**
	38XC	**3.8**	**255**
	40XC	**3.8**	**255**
Chrome - molybdenum and chrome - molybdenum - vanadium	**15XM**	**4.5**	**179**
	20XM	**4.5**	**179**
	30XM	**4.0**	**229**
	30XMA	**4.0**	**229**
	35XM	**3.9**	**241**
	38XM	**3.9**	**241**
	30X3MΦ	**4.0**	**229**
	40XMΦA	**3.7**	**269**
Chrome - vanadium	**15XΦ**	**4.4**	**187**
	40XΦA	**3.9**	**241**
Nickel - molybdenum	**15H2M (15HM)**	**4.3**	**197**
Chrome – nickel and chrome – nickel with boron	**12XH**	+	+
	20XH	**4.3**	**197**
	40XH	**4.2**	**207**
	45XH	**4.2**	**207**
	50XH	**4.2**	**207**
	12XH2	**4.2**	**207**
	12XH3A	**4.1**	**217**
	20XH3A	**.3.8**	**255**
	12X2H4A	**3.7**	**269**
	20X2H4A	**3.7**	**269**
	30XH3A	**3.9**	**241**
Chrome-silicon-manganese and chrome-silicon-manganese-nickel	**20XГCA**	**4.2**	**207**
	25XГCA	**4.1**	**217**
	30XГC	**4.0**	**229**
	30XГCA	**4.0**	**229**
	30XГCH2A (30XГCHA)	**3.8**	**255**
	35XГCA	**3.9**	**241**
Chrome-manganese-nickel and chrome-manganese-nickel with titanium and boron	**15XГH2TA (15XГHTA)**	**3.7**	**269**
	20XГHP	**4.3**	**197**
	14XГH	+	+
	19XГH	+	+
	38XГH	**4.0**	**229**

Continuation of table 4.

Group of steel	Grade of steel	Diameter of indentation, mm, not less than	Hardness number, HB, not more than
Chrome – nickel - molybdenum	**20XH2M (20XHM)**	**4.0**	**229**
	30XH2MA (30XHMA)	**3.9**	**241**
	38X2H2MA (38XHMA)	**3.7**	**269**
	40XH2MA (40XHMA)	**3.7**	**269**
	40X2H2MA (40X1HBA)	**3.8**	**255**
	38XH3MA	**3.7**	**269**
	18X2H4MA (18X2H4BA)	**3.7**	**269**
	25X2H4MA (25X2H4BA)	**3.7**	**269**
Chrome – nickel – molybdenum – silicon and chrome – nickel - silicon	**30XH2MΦA**	**3.7**	**269**
	36X2H2MΦA (36XH1MΦA)	**3.7**	**269**
	38XH3MΦA	**3.7**	**269**
	45XH2MΦA (45XHMΦA)	**3.7**	**269**
	20XH4ΦA	**3.7**	**269**
Chrome – aluminium and chrome aluminium with molybdenum	**38X2MЮA (38XMЮA)**	**4.0**	**229**
Chrome – manganese – nickel with molybdenum and titanium	**20XГHM**	+	+
	40XГHM	+	+
	25XГHMT	+	+

Note:

1. Upon agreement between manufacturer and customer, it is permitted to manufacturer the roll stock without annealing and high tempering with hardness, corresponding to norms, indicated in table 4.

2. The hardness of calibrated roll in annealed or high tempered condition as well as hot rolled steel, normalized with subsequent high tempering can exceed the hardness value by 15 units of HB specified in table 4.

3. The hardness of roll stock of grade 20XHP, 25XГM, 20H2M (20HM) and 20XГHTP is set as per agreement between manufacturer and customer.

4. Hardness norm for roll stock, manufactured in normalized condition are set as per the agreement with manufacturer and customer.

5. (Delete, Amendment No. 5).

6. Sign "+" denotes that up to 01. 01. 92 hardness are determined for the accumulation of data and results of tests, indicated in the document about the quality.

2.5, 2.6 (Amended edition, Amendment No. 1, 2, 3, 4, 5).

2.7. The hardness of work hardened steel with diameter or thickness above 5 mm, should be not more than BHN 269 (Diameter of indentation, not less than 3.7 mm) or set as per the agreement between manufacturer and customer, except the roll of grades 15X, 15XA, 20X, 30X, 35X, 15Г, 18ХГТ, 15ХФ, 38Х2МЮА (38ХМЮА), the hardness of which should correspond to the norms specified in table5.

Table 5.

Grades of steel	Diameter of indentation, in mm, not less than	Hardness number in HB, not more than
15X, 15XA	4.1	217
20X	4.0	229
30X	3.9	241
35X	3.8	255
15Г	4.2	207
18ХГТ	4.0	229
15ХФ	4.1	217
30Х2МЮА (38ХМЮА)	3.8	255

(Amended edition, Amendment No. 2, 5)

2.8.The hardness of annealed and cold worked calibrated steel and with special surface finish of roll with diameter upto 5 mm inclusive as well as hardening with tempering the roll of all dimensions is set as per the agreement between manufacturer and customer.

(Amended edition, Amendment No. 5)

2.9.The mechanical properties of roll at normal temperature, to be determined for longitudinal heat-treated samples or samples, manufactured from heat-treated blanks should correspond to the norms specified in table 6. Inspection of mechanical properties of calibrated steel and with special surface finish of roll is carried out according to the requirement of customer with the specification in conventional designation of letter M.

Roll stock made up of chromium nickel molybdenum, chromium nickel molybdenum steels are tested additionally for impact strength at normal temperature for samples of type 11 as per GOST 9454 – 78

Note: - Samples for mechanical tests of roll, to be manufactured in the hardened and tempered conditions, are not subjected to heat treatment; the norms of mechanical properties are set as per the agreement between manufacturer and customer.

Table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium	Not less than					
		1st hardening or normalizing	2nd hardening									
Chromium	15X 15XA	880	770-820	Water or oil	180	Air or oil	490 (50)	690 (70)	12	45	69 (7)	15
	20X	880	770-820	Water or oil	180	Air or oil	635 (65)	780 (80)	11	40	59 (6)	15
	30X	860	—	Oil	500	Water or oil	685 (70)	880 (90)	12	45	69 (7)	25
	30XPA	900 Air	860	Oil	200	Air	1275 (130)	1570 (160)	9	40	49 (5)	-
	35X	860	—	Oil	500	Water or oil	735 (75)	910 (93)	11	45	69 (7)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $\left(\frac{kgf.m}{cm^2}\right)$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C										
		1st hardening or normalization	2nd hardening	Cooling medium	Temperature °C	Cooling medium	Not less than					
Chromium	38XA	860	-	Oil	550	Water or oil	785 (80)	930 (95)	12	50	88 (9)	25
	40X	860	-	Oil	500	Water or oil	785	980	10	45	59 (6)	25
	45X	840	-	Oil	520	Water or oil	835 (85)	1030 (105)	9	45	49 (5)	25
	50X	830	-	Oil	520	Water or oil	885 (90)	1080 (110)	9	40	39 (4)	25
Mang-anese	15Г	880	-	Air	-	-	245 (25)	410 (42)	26	55	-	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $\left(\frac{kgf.m}{cm^2}\right)$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalization	2nd hardening				Not less than					
Manganese	20Г	880	-	Air	-	-	275 (28)	450 (46)	24	50	-	25
	25Г	880	-	Water or air	560	Air	295 (30)	490 (50)	22	50	88 (9)	25
	30Г	860	-	Water or air	600	Air	315 (32)	540 (55)	20	45	78 (8)	25
	35Г	860	-	Water or air	600	Air	335 (34)	560 (57)	18	45	69 (7)	25
	40Г, 40ГР	860	-	Water or air	600	Air	355 (36)	590 (60)	17	45	59 (6)	25
	45Г	850	-	Oil or air	600	Air	375 (38)	620 (63)	15	40	49 (5)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $\left(\frac{kgf.m}{cm^2}\right)$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalization	2nd hardening				Not less than					
Manganese	50Г	850	-	Oil or air	600	Air	390 (40)	650 (66)	13	40	39 (4)	25
	47ГТ	820-870	-	Air	-	-	1) 375 (38)	620 (63)	15	40	-	25
							2) 390 (40)	640 (65)	12	30	-	25
		920	-	Air	-	-	245 (25)	420 (43)	22	50	-	25
	30Г2	880	-	Oil or air	600	Air	345 (35)	590 (60)	15	45	-	25
	35Г2	870	-	Oil or air	650	Air	365 (37)	620 (63)	13	40	-	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalization	2nd hardening				Not less than					
Manganese	40Г2	860	–	Oil or air	650	Air	380 (39)	660 (67)	12	40	–	25
	45Г2	850	—	Oil or air	650	Air	400 (41)	690 (70)	11	40	—	25
	50Г2	840	—	Oil or air	650	Air	420 (43)	740 (75)	11	35	—	25
Chrome-manganese	18ХГ	880	–	Oil	200	Air or oil	735 (75)	880 (90)	10	40	–	15

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature		Cooling medium	Temperature °C	Cooling medium	Not less than					
		1st hardening or normalization	2nd hardening									
Chrome - Manganese	18ХГТ	880 - 950 Air	870	Oil	200	Air or water	885 (90)	980 (100)	9	50	78 (8)	-
	20ХГР	880	-	Oil	200	Air or oil	785 (80)	980 (100)	9	50	78 (8)	15
	27ХГР	870	-	Oil	200	Air	1175 (120)	1370 (140)	8	45	59 (6)	-
	25ХГТ	880-950 Air	850	Oil	200	Water, oil or air	1) 980 (100) 2) 1080 (110)	1270 (130) 1470 (150)	10 9	50 45	69 (7) 59 (6)	- -

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $\left(\frac{kgf.m}{cm^2}\right)$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature		Cooling medium	Temperature °C	Cooling medium	Not less than					
		1st hardening or normalization	2nd hardening									
Chrome - Manganese	30XГТ	880 - 950 Air	850	Oil	200	Water, oil or air	1275 (130)	1470 (150)	9	40	59 (6)	-
	40XГТР	840	-	Oil	550	Water, oil or air	785 (80)	980 (100)	11	45	78 (8)	25
	25XГМ	860	-	Oil	200	Air	1080 (110)	1180 (120)	10	45	78 (8)	-
	38XГМ	870	-	Oil	580-620	Air	785 (80)	930 (95)	11	-	78 (8)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium	Not less than					
		1st hardening or normalizing	2nd hardening									
Chromium-silicon	33XC	920	-	Water or oil	630	Water or oil	685 (70)	880 (90)	13	50	78 (8)	25
	38XC	900	-	Water or oil	630	Water or oil	735 (75)	930 (95)	12	50	69 (7)	25
	40XC	900	-	Water or oil	540	Water or oil	1) 1080 (110)	1230 (125)	12	40	34 (3.5)	25
		Austempering at 900-910°C in nitrate at 330-350°C and then cooling in air					2) 1080 (110)	1230 (125)	12	40	49 (5)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C										
		1st hardening or normalization	2nd hardening	Cooling medium	Temperature °C	Cooling medium	Not less than					
Chrome-molybdenum and chrome-molybdenum-vanadium	15XM	860	-	Air	650	Air	275 (28)	440 (45)	21	55	118 (12)	30
	20XM	880	-	Water or oil	500	Air	590 (60)	780 (80)	12	50	88 (9)	15
	30XM	880	-	Oil	540	Water or oil	735 (75)	930 (95)	11	45	78 (8)	15
	[illegible]A	880	-	Oil	540	Water or oil	735 (75)	930 (95)	12	[illegible]	88 (9)	15
	35XM	850	-	Oil	560	Water or oil	835 (85)	930 (95)	12	45	78 (8)	25
	38XM	850	-	Oil	580	Air	885 (90)	980 (100)	11	45	69 (7)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature										
		1st hardening or normalization	2nd hardening	Cooling medium	Temperature °C	Cooling medium	Not less than					
Chrome-molybdenum and chrome-molybdenum-vanadium	30ХЗМФ	870	-	Oil	620	Water or oil	835 (85)	980 (400)	12	55	98 (10)	25
	40ХМФА	860	-	Oil	580	Oil	930 (95)	1030 (105)	13	50	88 (9)	25
Chrome - vanadium	15ХФ	880	760-810	Water or oil	180	Air or oil	540 (55)	740 (75)	13	50	78 (8)	15
	40ХФА	880	-	Oil	650	Water or oil	735 (75)	880 (90)	10	50	88 (9)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalization	2nd hardening				Not less than					
Nickel-molybdenum	15H2M (15HM)	860	770-820	Oil	180	Air	635 (65)	830 (85)	11	50	78 (8)	15
	20H2M (20HM)	860	-	Oil	180	Air	685 (70)	880 (90)	10	50	78 (8)	15
Chrome-nickel and chrome-nickel with boron	12XH	910	-	Water or oil	150-180	Air	440 (45)	640 (65)	10	-	88 (9)	
	20XH	860	760-810	Water or oil	180	Water, oil or air	590 (60)	780 (80)	14	50	78 (8)	15
	40XH	820	-	Water or oil	500	Water or oil	785 (80)	980 (100)	11	45	69 (7)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $\left(\frac{kgf.m}{cm^2}\right)$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalization	2nd hardening				Not less than					
Chrome-nickel and chrome-nickel with boron	45XH	820	–	Water or oil	530	Water or oil	835 (85)	1030 (105)	10	45	69 (7)	25
	50XH	820	—	Water or oil	530	Water or oil	885 (90)	1080 (110)	9	40	49 (5)	25
	20XHP	930-950 air	—	Oil	200	Air or oil	980 (100)	1180 (120)	10	50	88 (9)	15
	12XH2	860	–	Water or oil	180	Air or oil	590 (60)	780 (80)	12	50	88 (9)	15

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalizing	2nd hardening				Not less than					
Chrome-nickel and chrome-nickel with boron	12XH3A	860	760-810	Water or oil	180	Air or oil	685 (70)	930 (95)	11	55	88 (9)	15
	20XH3A	820	-	Oil	500	Water or oil	735 (75)	930 (95)	12	55	108 (11)	15
	12X2H4A	860	760-800	Oil	180	Air or oil	930 (95)	1130 (115)	10	50	88 (9)	15
	20X2H4A	860	780	Oil	180	Air or oil	1080 (110)	1270 (130)	9	45	78 (8)	15

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square) , mm
		Hardening			Tempering							
		Temperature °C										
		1st hardening or normalization	2nd hardening	Cooling medium	Temperature °C	Cooling medium	Not less than					
	30ХН3А	820	-	Oil	530	Water or oil	785 (80)	980 (100)	10	50	78 (8)	25
Chrome-silicon-manganese and chrome-silicon-manganese-nickel	20ХГСА	880	-	Oil	500	Water or oil	635 (65)	780 (80)	12	45	69 (7)	15
	25ХГСА	880	-	Oil	480	Water or oil	835 (85)	1080 (110)	10	40	59 (6)	15
	30ХГС	880	-	Oil	540	Water or oil	835 (85)	1080 (110)	10	45	44 (4.5)	25
	30ХГСА	880	-	Oil	540	Water or oil	835 (85)	1080 (110)	10	45	49 (5)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C										
		1st hardening or normalization	2nd hardening	Cooling medium	Temperature °C	Cooling medium	Not less than					
Chrome-silicon-manganese and chrome-silicon-manganese-nickel	35ХГСА	Austempering at temperature 880°C in the mixture of potassium and sodium nitrate, having temperature 280-310°C, cooling in air										
		950 oil 700 air	890	Oil	230	Air or oil	1275 (130)	1620 (165)	9	40	39 (4)	-
	30ХГСН2А (30ХГСНА)	900	-	Oil	260	Air or oil	1375 (140)	1620 (165)	9	45	59 (6)	-

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalization	2nd hardening				Not less than					
Chrome-manganese-nickel and chrome-manganese-nickel with titanium, molybdenum and boron	15ХГН2ТА (15ХГНТА)	960 air	840	Oil	180	Air or oil	735 (75)	930 (95)	11	55	98 (10)	15
	20ХГНР	930-950 air	780-830	Oil	200	Air or oil	1080 (110)	1270 (130)	10	50	88 (9)	15
	20ХГНТР	850	-	Oil	200	Oil	980 (100)	1180 (120)	9	50	78 (8)	15
	14ХГН	870	-	Oil	150-180	Air	835 (85)	1080 (110)	8	-	78 (8)	-
	19ХГН	870	-	Oil	150-180	Air	930 (95)	1180-1520 (120-155)	7	-	69 (7)	-
	38ХГН	850	-	Oil	570	Water or oil	685 (70)	780 (80)	12	45	98 (10)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalization	2nd hardening				Not less than					
Chrome-manganese-nickel and chrome-manganese-nickel with titanium, molybdenum and boron	20ХГНМ	860	–	Oil	150-180	Air	930 (95)	1180-1570 (120-160)	7	-	59 (6)	-
	40ХГНМ	840	—	Oil	560-620	Air	835 (85)	980 (100)	12	-	88 (9)	25
	25ХГНМТ	860	—	Oil	190	Air	1080 (110)	1180 (120)	10	40	49 (5)	25
Chrome- nicke' molybdenum	20ХН2М (20ХНМ)	860	780	Oil	200	Water or oil	685 (70)	880 (90)	11	50	78 (8)	15
	30ХН2МА (30ХНМА)	860	-	Oil	530	air	785 (80)	980 (100)	10	45	78 (8)	15
	38Х2Н2МА (38ХНМА)	870	–	Oil	580	Air or oil	930 (95)	1080 (110)	12	50	78 (8)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C		Cooling medium	Temperature °C	Cooling medium						
		1st hardening or normalization	2nd hardening				Not less than					
Chrome – nickel-molybdenum	40XH2MA (40XHMA)	850	-	Oil	620	Water or oil	1) 930 (95)	1080 (110)	12	50	78 (8)	25
							2) 835 (85)		12	55	98 (10)	25
	40X2H2MA (40X1HBA)	870	-	Oil	600	Water or oil	930 (95)	980 (100)	10	45	78 (8)	25
	38XH3MA	850	-	Oil	590	Air	980 (100)	1080 (110)	12	50	78 (8)	25
	18X2H4MA (18X2H4BA)	950	860	Air	200	Air or oil	1) 835 (85)	1130 (115)	12	50	98 (10)	15
		950 Air	860	Oil	550	Air or oil	2) 785 (80)	1030 (105)	12	50	118 (12)	15

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C										
		1st hardening or normalizing	2nd hardening	Cooling medium	Temperature °C	Cooling medium	Not less than					
Chrome-nickel-molybdenum	25X2H4MA (25X2H4BA)	850	-	Oil	560	oil	930 (95)	1080 (110)	11	45	88 (9)	25
Chrome-nickel-molybdenum-silicon and chrome-silicon-nickel	30XH2MΦA	860	-	Oil	680	Air	785 (80)	880 (90)	10	40	88 (9)	25
	36X2H2MΦA (36XH1MΦA)	850	-	Oil	600	Air	1080 (110)	1180 (120)	12	50	78 (8)	25
	38XH3MΦA	850	-	Oil	600	Air	1080 (110)	1180 (120)	12	50	78 (8)	25
	45XH2MΦA (45XHMΦA)	860	-	Oil	460	Oil	1) 1275 (130) 2) 1325 (135)	1420 (145) 1470 (150)	7 7	35 35	39 (4) 39 (4)	- -
	20XH4ΦA	850	-	Oil	630	Water	685 (70)	880 (90)	12	50	98 (10)	25

Continuation of table 6

Group of steel	Grade of steel	Heat treatment					Yield point, σ_T, N/мм² (kgf/mm²)	Ultimate strength, σ_B, N/мм² (Kgf/mm²)	Relative elongation δ_5, %	Relative reduction of area ψ, %	Impact strength KCU, $(\frac{kgf.m}{cm^2})$	Cross section al dimension of blank for heat treatment (diameter of round or side of square), mm
		Hardening			Tempering							
		Temperature °C										
		1st hardening or normalization	2nd hardening	Cooling medium	Temperature °C	Cooling medium	Not less than					
Chrome – aluminium and chrome –aluminium with molybdenum	38X2MIOA	940	-	Water or oil	640	Water or oil	835 (85)	980 (10)	14	50	88 (9)	30

Note:

1. During heat treatment of blanks as per modes, specified in table 6, the following deviations on the heating temperature are permitted:
   During hardening ..... ± 15° C
   At low tempering ..... ± 30° C
   At high tempering..... ± 50° C
2. Hardening of blank in air made of steel grade 18X2H4MA, cut from bar with diameter or thickness 80 mm and more, is carried out in housing.
3. The norms of mechanical properties belong to samples, taken from bars having diameter or thickness upto 80 mm inclusive.

While testing, the bars having diameter or thickness above 80 to 150 mm, reduction in relative elongation by 2 abs%; relative reduction in area by 5 abs% and Impact strength by 10 % in compliance with the norms specified in table 6 are permitted.

Reduction in relative elongation by 3 abs%, relative reduction in area by 10 abs% and Impact strength by 15 % is permitted for bars having diameter and thickness 151 mm and more.

The norms of mechanical properties of samples and bars made of steel having diameter or thickness more than 100 mm rolled or forged into square having dimension 90 – 100 mm should correspond to those specified in table 6.

For steel with standardized ultimate strength of not less than 1180 N / mm² (120 kgf/mm²), reduction in norms of Impact strength by 9.8 J / cm² (1 kgf. m / cm²) is permitted during simultaneous increase in ultimate strength by not less than 98 N / mm² (10 kgf/mm²).

4. Norms of Impact strength are given for the samples of type 1 as per GOST 9454 – 78.
5. While determining the mechanical properties of steel as per the agreement between manufacturer and customer, change in the mode of heat treatment is permitted as specified in table 6 with corresponding correction of norms of mechanical properties.
6. Before hardening, it is permitted to carry out normalization. For steel, meant for hardening with currents of high frequency, normalization before hardening is to be carried out as per the agreement with customer.
7. It is permitted to carry out tests of rolls made up of steel of all grades after single hardening provided the norms given in table 6 are observed.
8. In those cases, if during tensile test, position of yield is not detected on the metal, do not determine the yield point (σ_T), it is permitted to determine the conventional yield point ($\sigma_{0.2}$).
9. The bars with section less than that specified in table 6 are subjected to heat treatment in the complete section of roll.
10. In column "dimension of section of blanks for heat treatment (round and square) "symbol "__" shows that heat treatment is done on finished samples.
11. Customer should specify the version of mechanical properties steel roll made of grades 25ХГТ, 40ХС, 40ХН2МА (40ХНМА), 18Х2Н4МА (18Х2Н4ВА); 47ГТ and 45ХН2МФА (45ХНМФА). During absence of specification of version of mechanical properties, manufacturer selects them.
12. Norms of mechanical properties of roll made of steel grade 38ХГМ and 14ХГН upto 01.01.92 are not the sign of rejection.
13. It is permitted to carry out second hardening at temperature 860°C with cooling in oil, for rolling made of steel grade 45ХН2МФА (45ХНМФА) with version of mechanical properties 2.

(Amended edition, Amendment No. 4 and 5).

2.10 Bar made of steel of grades 15X, 20X, 30X, 30XPA, 35X, 40X, 45X, 18ХГТ, 20ХГР, 27ХГР, 30ХГТ, 25ХГМ, 38ХС, 30ХМА, 40ХФА, 12ХН3А, 20ХН3А, 12Х2Н4А and 30ХГСА manufactured according to the requirement of customer with normalized hardenability in the limits of complete marking of strip (dotted line) or with narrow strip (solid line) continuously specifying in conventional code of letter P.

The strips of hardenability and diameter of bars, having the same hardness as the facial samples after the volumetric hardening in water and oil at a corresponding distance from the cooling of face of sample and the place of measurement of hardness along the section of bar are given in drawings 1 – 18 of annexure 1.

Variation limits of hardness (maximum and minimum) along the length of endwise samples for solid and dotted lines of hardenability are given in annexure 2.

For bars, made up of steels of grade 30XPA, norms of hardenability are set as per the agreement between manufacture and customer.

Note:

1. Upon agreement between manufacture and customer, manufacture of bar of steel by checking the hardenability, it is permitted to carry out inspection of mechanical properties, if the manufacturer guarantees the conformity of those properties to norms, specified in table 6.

2. Hardenability test of bars made up of steel of all grades except boron contents need not be carried out in case of conformity of norms of hardenability to the requirement of present standard.

Variation limits of hardness (maximum and minimum) along the length of endwise sample may be changed as per the agreement between manufacture and customer.

2.11. On the surface of bars, meant for hot working and cold drawing including the turned and roughened surface 1, the local defects should be removed by trimming or by dressing to a width of not less than five times of the depth.

The depth of dressing the defects should not exceed the norms, specified in table 7. Not more than two dressings to maximum depth are permitted in one section of bar with size (diameter or thickness) more than 140 mm.

Separate small notches, dents, ripples in the limits of half of sum of limit deviations are permitted on the surface of bars without dressing. Hairline cracks are not permitted.

Separate small notches, dents and ripples in the limits of half of the sum of limit deviations and also minor hairline cracks with depth not exceeding $1/4^{th}$ of the limit deviation on dimension not more than 0.2 mm are permitted on the surface of bar without dressing. Hairline cracks are not permitted on the surface of bar made of very high-quality steel. Other requirements for the surface - for the bar of surface quality of group 1.

Table 7

Dimension of bar	Depth of dressing of defects, not more than	
	Bar made of quality steel and high quality steel	Bar made of very high quality steel
Above 200	6 % of dimension	3 % of dimension
From 140 to 200	5 % of dimension	3 % of dimension
From 80 to 140	Sum of limit deviation	Half of the sum of limit deviation
Less than 80	Half of the sum of limit deviation	

On the surface of bar of surface quality of group 3, local defects are not permitted, if their depth to be determined by inspection filing and by blanking, calculated from nominal size, exceeds the norms, indicated in table 8.

Table 8

Dimension of bar in mm	Depth of dressing of defects, not more than	
	Bar made of quality steel and high quality steel	Bar made of very high quality steel
100 and more	Sum of limit deviation	Negative tolerance
Less than 100	Negative tolerance	

(Amended edition, Amendment No. 5)

2.12. (Deleted, Amendment No. 5)

2.13. Quality of surface and requirements on trimming of end face calibrated bar should correspond to GOST 1051 – 73, bar with special surface finish - GOST 14955 – 77.

(Amended edition, Amendment No. 2)

2.14. The decarburizing of bar with turned, roughened and ground surface and bars with special surface finish meant for hardening with high frequency current is not permitted.

As per the requirement of customer, steel to be manufactured without the turning, roughly machining and grinding, with a mass fraction of carbon more than 0.3 % (as per the lower limit), total depth of decarburized layer (ferrite + transition zone) is checked which should not exceed 1.5 % of diameter or thickness.

(Amended edition, Amendment No. 2.5)

2.15. Bar should be evenly trimmed. The rumpled ends and burrs are permitted. The slant of cut of bar with dimension upto 30 mm, is not regulated, more than 30 mm - it should not exceed 0.1 diameters or thickness. It is permitted to manufacture the bar having dimension upto 40 mm of off-measure length with the untrimmed ends is permitted.

Rolled bar stock is manufactured on the demand of customer:

with standardized value of crumpling of ends not more than 70 mm;

with dimension upto 140 mm without burrs and rumpled ends.

(Amended edition, Amendment № 5).

2.16. Bar of surface quality of group 1 is tested for upsetting in hot condition.

Note. Manufacturing concern can not conduct testing for upsetting of bar with dimension more than 80 mm.

2.17. Macrostructure of bar during inspection on etched template or on fracture, should not have shrinkage cavity, porosity, blisters, cracks, peeling, slag inclusions and flakes and should corresponds to the requirements, specified in table 9.

Table 9

Category of steel	Macrostructure of bar in points, not more than							
	Shrinkage porosity	Non-homogeneous point	Liquation square	General spotted liquation	Liquation at the edge	Shnrinkage liquation	Sub crust bubbles	Inter crystalline cracks
Quality	3	3	3	1	1	1	Not permitted	
High quality	2	2	2	Not permitted		1		
Very high quality	1	1	1	Not permitted				

Note:

1. In bar, made up of high quality steel of grade 30ХГСА, 35ХГСА, 25ХГСА and 20ХГСА, the liquation square not more than 3 points and in the bar made up of quality and high quality steel of grades 38Х2МЮА – liquation at the edge or general spotted liquation not more than 2 points is permitted.
2. In bar, made up of very high quality steel, sub layer crystallization and light profile of not more than 3 points is permitted.
3. In steels, meant for cold machining, sub crust blowholes to depth of not more than the half of the tolerance on diameter or thickness are permitted.
4. In steel of grades 12Х2Н4МА and 25Х2Н4МА with dimension more than 160 mm, permissible degree of development of inter-crystalline cracks is set as per the agreement between both manufacture and customer.
5. It is permitted to carry out the testing of macrostructure of bars by the method of ultrasonic inspection (УЗК).

2.16 – 2.17. **(Amended edition, Amendment No. 2.5).**

2.18. As per the requirement of customer, steel is supplied :

а) With contracted limits of contents of carbon and alloy elements in comparison with those specified in table 1, as per indent of automobile industry without considering the permissible deviation on carbon, specified in table 3;

б) With the mass fraction of sulphur and phosphorous not more than 0.025 %, each in quality steel. In this case, letter "A" is added at the end of steel grade;

в) With the mass fraction of sulphur not more than 0.015 % in high qualitative steel and not more than 0.012 % - in very high quality steel;

г) With the mass fraction of phosphorous not more than 0.020 % in high quality steel and not more than 0.012 % - in very high quality steel;

д) By limiting the contents of sulphur as per lower limit not less than 0.020 % in qualitative steel;

е) With mass fraction of copper not more than 0.20 % in steel, meant for hot working under pressure;

ж) In etched condition;

з) With standardized purity as per non-metallic inclusions;

и) By determining the mechanical properties in bar with dimension not more than 80 mm on cross sectional samples;

к) With standard hardness, not specified in table 4, in supply condition and also with less hardness in comparison with hardness specified in table 4;

л) By determining the Impact strength at normal temperature on the samples of type 11 as per GOST 9454 – 78 for steel of group not specified in point 2.9;

м) By determining the Impact strength at temperature minus 60° C and by determining the fraction of viscous component in the fraction of sample of type 1 as per GOST 9454 – 78 (for steels, meant for machines and mechanism of northern version);

н) With standard finish of steel as to hairline cracks to be detected on the surface of parts by magnetic method or by etching. Contamination of steel should not exceed the norms, specified in table 10;

о) With standard austenitic grain size, which should not be larger than the number 5, austenitic grain size for steel of grade 38Х2МЮА (38ХМЮА) should not be larger than the number 4. The presence of grains of 3 numbers, which occupy the area on ground joint less than 10 % is permitted;

п) With the inspection of machining;

р) With standard hardenability for steel of grades, not included in point 2.10;

c) By checking the macrostructure by etching and as per fracture simultaneously;

т) By checking the waviness in fracture;

у) By checking the banding and ferrite-pearlite structure and widmannstatten structure;

ф) In heat treated condition (hardening + tempering);

ц) With the standard of mass fraction of nitrogen in steel, smelted in the electric furnaces;

ш) by determination of mass fraction of residual of tungsten, vanadium, titanium, molybdenum for each melting.

Note: The norms as per sub point а, и, з, к, л, м, р, с, у, ф, ц by inspection methods of purity of steel for hairline cracks (sub point н), inspection of machinability (sub point п), waviness in the ruptures (sub point т), banding and windmanststten structure (sub point у) if they are not specified in special standard on the metallic bar are set by agreement between manufacture and customer or by corresponding technical document, approved in set order.

Table 10

Total area of part surface to be checked, in cm^2	Number of permissible hairline cracks in steel			Maximum length of hair line cracks in steel, in mm		Total extent of hairline cracks in steel, in mm		
	Quality steel	High quality steel	Very high quality steel	Quality and high quality steel	Very high quality steel	Quality steel	High quality steel	Very high quality steel
Upto 50	5	2	1	6	3	10	5	3
above 50-100	6	3	2	7	3	10	8	5
above 100-200	8	4	2	8	4	20	10	6
above 200-300	10	6	3	9	4	30	15	8
above 300-400	11	8	4	10	5	40	20	10
above 400-600	12	9	5	12	6	60	30	18
above 600-800	13	10	5	14	6	80	40	24
above 800-1000	15	11	6	15	7	100	50	30

Note:

1. For every subsequent 200 cm^2 of inspection surface of finish parts, the area of which exceeds 1000 cm^2, maximum one hairline crack is permitted with length not more than that specified for the area 1000 cm^2 with corresponding increase in total length of hairline crack.

2. On the parts, with surface area exceeding 200 cm^2, maximum 5 hairline cracks are permitted, on the sections of surface with area 10 cm^2 for quality and high quality steel, and – maximum 3 hairline cracks is permitted for very high quality steel.

(Amended edition, Amendment No. 1, 2, 5).

3. ACCEPTANCE RULES

3.1. (Deleted, Amendment No. 2).

3.2. Bars, strips and bundles are supplied in batches, consisting of steel of same melt, same dimension and same mode of heat treatment. Each batch should accompany the document about the quality according to GOST 7566 —81.

(Amended edition, Amendment No. 2)

3.3. For checking the quality of steel, samples are taken from the batch of bars, strips and bundles:

а) for chemical analysis of sample according to GOST 7565 – 81. Inspection of residual content of copper, nickel, chromium, nitrogen, tungsten, vanadium, molybdenum and titanium is carried out periodically, not less than once in a quarter;

б) for checking the surface quality and dimension – all bars, strips and bundles;

в) for the inspection of macrostructure as per rupture or by etching, for the tensile testing and impact bending - two bars, bundles or two strips;

г) for the bulging test and determining the depth of decarburized layer — three bars, strips or bundles;

д) for checking the hardness - 2 % bars, bundles or strips having dimension more than 30 mm, also, on one bar from 1T of bars, bundles or strips with dimension 30 mm and less, but not less than five bars, bundles or strips;

е) for the determination the hardenability and grain size - on one bar, bundle or one strip from the melting - ladle for steel of all grades, except those containing boron, and on two bars, bundle or two strips from the melting - ladle of steel of grades, which contain boron.

ж) for determining the nonmetallic inclusions - samples according to GOST 1778 - 70.

(Amended edition, Amendment No. 2, 5).

3.4. On obtaining of unsatisfactory results of tests at least on one of the parameters, repeated tests are carried out according to GOST 7566 —81. The results of repeated tests are final.

(Introduced additionally, Amendment No. 2)

4. TEST METHODS

4.1. Chemical analysis of steel are carried out as per GOST 20560 —81, GOST 12344-88, GOST 12345-88, GOST 12346-78, GOST 12347-77, GOST 12348-78, GOST 12349-83, GOST 12350-78, GOST 12351-81, GOST 12352-81, GOST 12354-

81, GOST 12355-78, GOST 12356-81, GOST 12357-84, GOST 12359-81, GOST 12360 —82, GOST 18895 —81 or by other methods, as per accuracy, not being inferior to standard. Chemical analysis is carried out by standard methods in case of differences.

4.2. Geometric dimensions and the form of rolling stocks are determined with the help of measuring instruments according to GOST 26877 — 86, GOST 162-80, GOST 166-80, GOST 427-75, GOST 3749-77, GOST 5378-88, GOST 6507-78, GOST 7502 —89, and also tools or templates, certified according to GOST 8.001 - 80 or GOST 8.326-78.

4.1; 4.2 **(Amended edition, Amendment No. 5).**

4.3. The surface quality is checked without using the magnifying devices. If necessary, carry out brightening or etching of surface, and for bar with special surface finish having diameter upto 3 mm inclusive, visual inspection is carried out with 10^X magnifying glass additionally. Depth of detected defects on the surface of bar is determined by inspection of dressing or filling.

(Amended edition, Amendment No. 2, 5).

4.4a. From each selected one, bar, strip or bundle are selected for inspection:

for the tensile testing (yield point, ultimate strength, relative elongation, relative reduction of area), upsetting, determinations of depth of decarburized layer, grain size and hardenability - on one sample;

for the testing of impact bending - on each sample of each type;

for inspection of macrostructure — one template.

Sampling from bundles for all types of tests is carried out at a distance not less than 1.5 turns from the end of reeling/unrolling.

(Amended edition, Amendment No. 5).

4.4. Inspection of macrostructure of bar by etching method or as per rupture are carried out according to GOST 10243 - 75, and by ultrasonic – according to the method of plant – supplier.

4.5. Sampling for mechanical tests is carried out according to GOST 7564-73 (version 1).

4.6. Carry out bulging test in hot condition according to GOST 8817 - 82. Samples are heated upto temperature 1150 - 1250° C and upset to 65 % (upto 1/3with respect to original height.

(Amended edition, Amendment No. 5).

4.7. Tensile testing (yield point, ultimate strength, relative elongation, relative reduction of area) is carried out according to GOST 1497 – 84 in round samples of

five-fold length with diameter 5 or 10 mm. It is permitted to conduct tests in full-scale samples by section, not less indicated in table 6.

Tests for Impact strength at normal temperature is carried out in the samples of the type Iand type II according to GOST 9454 - 78, at a temperature minus 60° C - on samples of type 1 according to GOST 9454 —78. It is permitted to carry out Impact strength test on samples of type 3 with thickness of bar less than 10 mm. Test results of bar made of chrome-nickel-molybdenum and chrome-nickel-molybdenum-vanadium steel for Impact strength on samples of type II according to GOST 9454 - 78 should be recorded in document about the quality.

The percentage viscous component in rupture of samples is determined according to the method that given in appendix 3.

It is permitted to use the nondestructive methods of test according to matched procedure.

(Amended edition, Amendment No. 1, 2, 4, 5).

4.8. Depth of decarbonized layer is determined by the method M as per GOST 1763 – 68. Upon agreement between manufacture and customer, it is permitted to determine the decarbonized layer of calibrated steel by method T as per GOST 1763 – 68.

4.9. Grain size is determined as per GOST 5639 – 82. Grain size for steel of case hardening grades is carried out by case hardening method, temper hardening – by oxidation method, steel of grade 38X2MIOA – by etching method.

(Amended edition, Amendment No. 5).

4.10. Hardenability is determined by end hardening method as per GOST 5657 – 69.

4.11. Brinell hardness is determined as per GOST 9012 – 59. Number of indentation – not less than three.

(Amended edition, Amendment No. 4).

4.12. Nonmetallic inclusions is determination as per GOST 1778 – 70.

4.13. Steel bars, which have passed the tests on macro-structure, hardenability and mechanical properties on the large profile , it is permitted that the test results are made applicable to batch low profile bars.

4.14. In case of detection of flakes at least in one bar, the entire metal of this batch is rejected.

4.13, 4.14. **(Amended edition, Amendment No. 2)**

4.15. **(Delete, Amendment No. 2).**

4.16. During the use of static method for inspection of hardness and mechanical properties by manufacturing plant with respect to normative technical documents, approved in established order, it is permitted to not carry out the inspection of

hardness and mechanical properties, provided by present standard. In this case, manufacturer guarantees the conformity of released products to the requirements of present standard. In arbitrary cases and during periodic inspections of quality of products, methods of inspection, provided by present standard are used.

(Introduced additionally, Amendment № 4).

5. PACKING, MARKING, TRANSPORTATION AND STORAGE

5.1. Marking, packing, transportation and storage of roll - according to GOST 7566 - 81 with additions.

5.1.1. Transportation of roll is carried out by all types of transport in accordance with rules of transportation of loads, existing on this form of transport.

Weight of package should not exceed during mechanized loading in open transportation means - 10 T, in covered transportation -1250 kg.

Means of packing - according to GOST 7566 - 81.

By railroad, transportation is accomplished depending on mass and overall dimensions in covered or opened wagons according to GOST 22235 - 76.

(Amended edition, Amendment No. 5).

5.1.2. During the delivery to one address of two or more packages, whose dimensions make it possible to design the transportation packet with overall dimensions according to GOST 24597 - 81, packages should be designed in transport packets according to GOST 21929 – 76.

5.1.3. Marking, packing, transportation and storage of calibrated bar - according to GOST 1051 - 73, bar with special surface finish - according to GOST 14955 - 77.

(Amended edition, Amendment No. 4, 5).

5.2. Minimum weight of roll of one batch (melt) is established as per the agreement between manufacturer and customer.

5.3. As per the requirement of customer, specified in indent, packets, ends or end faces of hot rolled and forged roll, and upon agreement between manufacture and customer calibrated bars made up of steels of all grades depending upon the group should be marked with paint of following colour, specified in table 11.

Table 11

Group of steel	Colour of paint
Chromium	Green + yellow
Manganese	Brown + blue
Chrome – manganese	Blue + black
Chrome – silicon	Blue + red
Chrome – molybdenum and chrome – molybdenum – vanadium	Green + violet
Chrome –vanadium	Green + black
Nickel – molybdenum	Yellow + violet
Chrome – nickel and chrome – nickel with boron	Yellow + black
Chrome – silicon - manganese	Red + violet
Chrome - nickel – molybdenum	Violet + black
Chrome – aluminium and chrome – aluminium with molybdenum	Aluminum colour

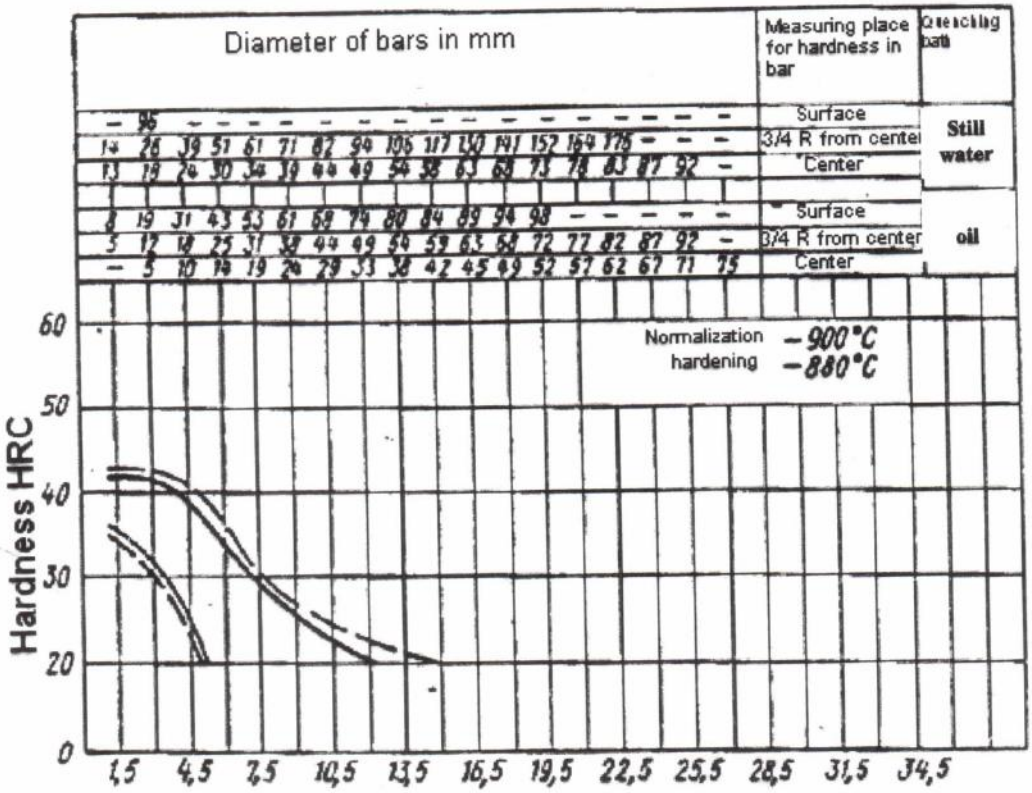
Note: The colour of paint for marking steel rolls of other groups is set as per the agreement between both the sides.

5.2, 5.3. **(Amended edition, Amendment No. 2, 5).**

Annexure 1

HARDENABILITY BANDS FOR STRUCTURAL ALLOY STEEL

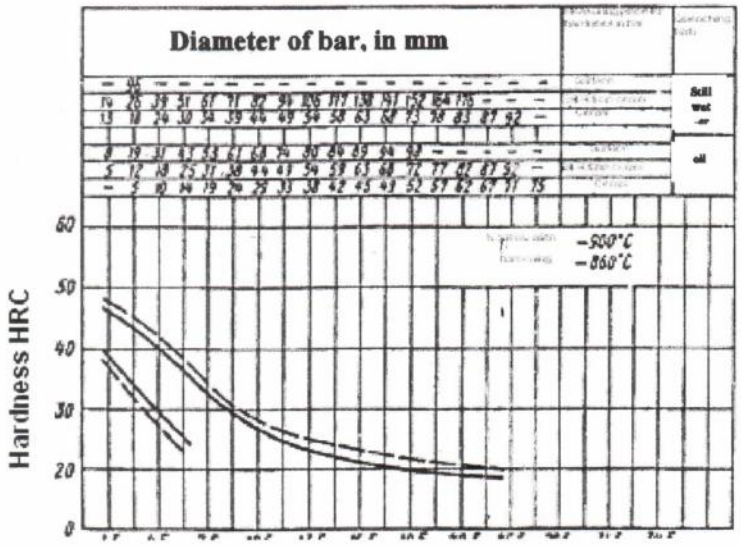
Steel of grade 15X



Distance from cooled end face of sample, in mm.

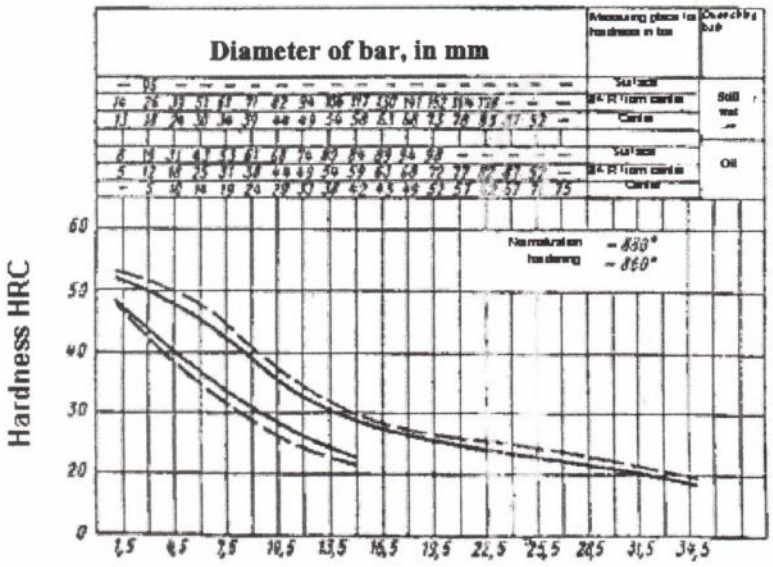
Drawing 1

Steel of grade 20 X



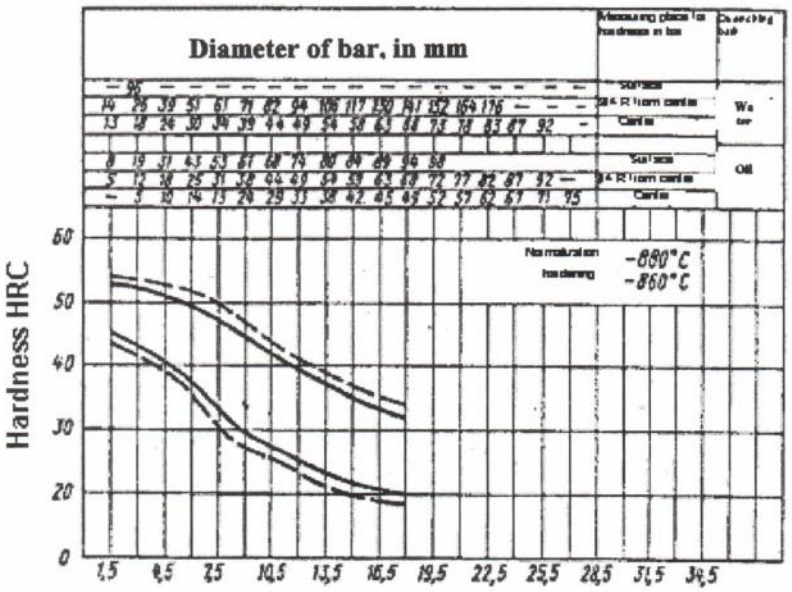
Distance from cooled end face of sample
Drawing 2

Steel of grade 30X



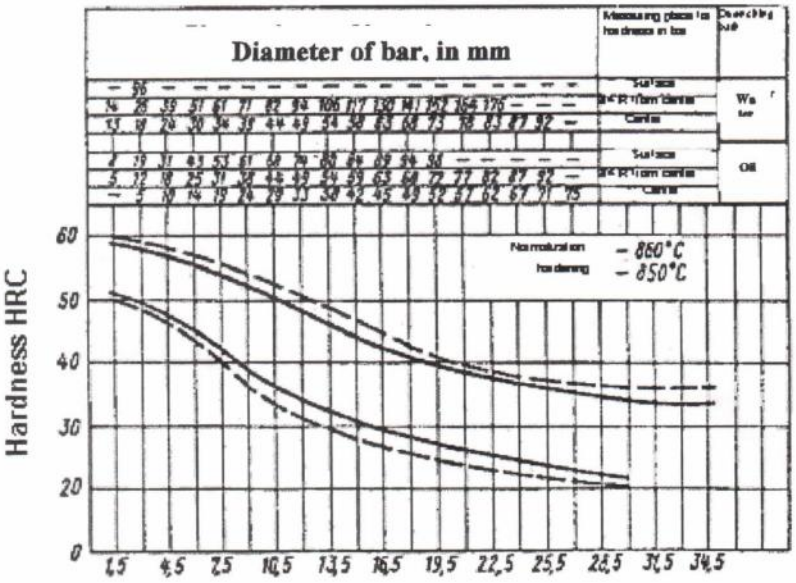
Distance from cooled end face of sample
Drawing 3

Steel of grade 35 X



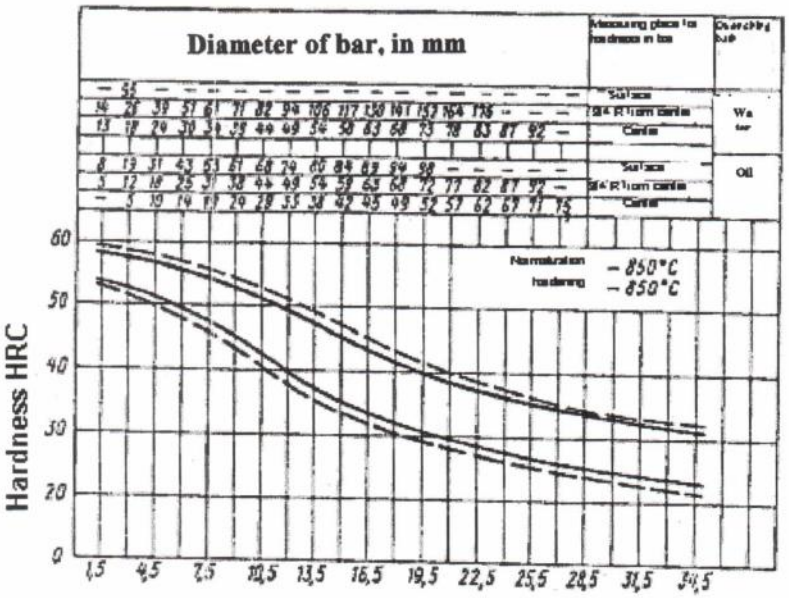
Drawing 4

Steel of grade 40 X



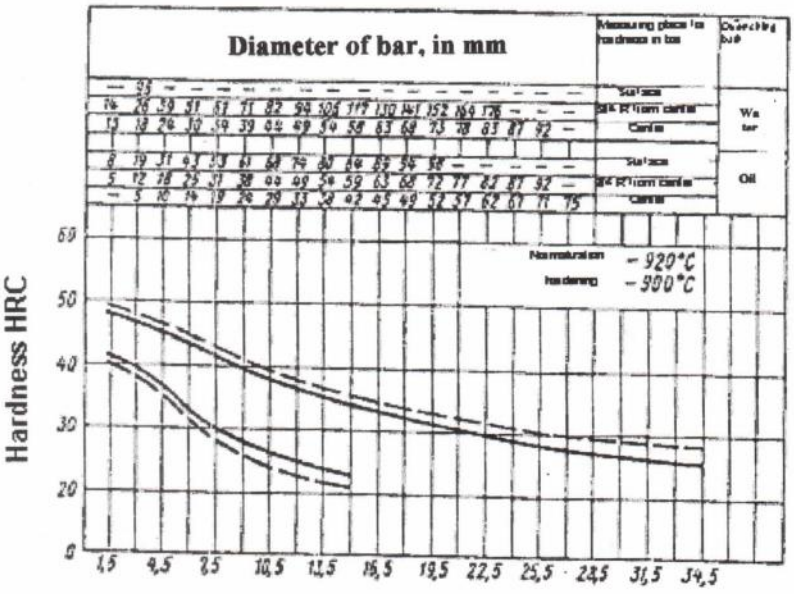
Drawing 5

Steel of grade 45 X



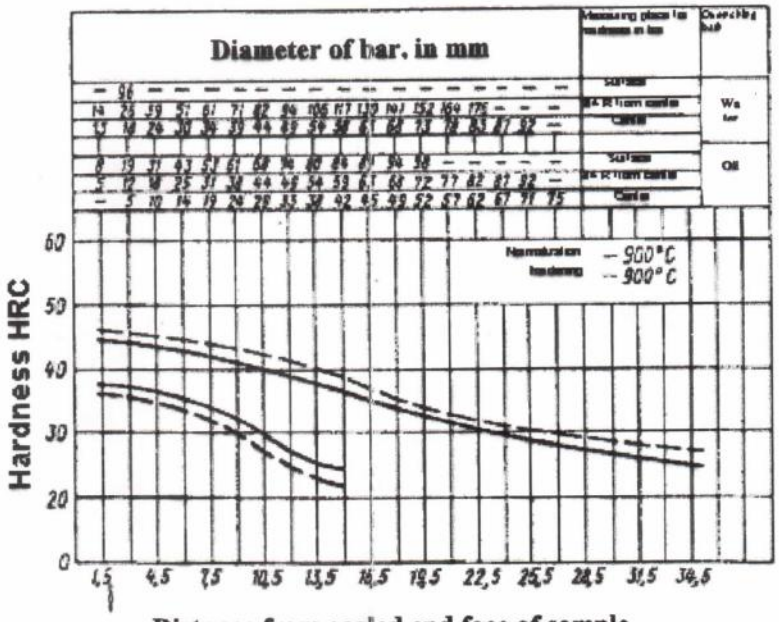
Drawing 6

Steel of grade 18 ХГТ



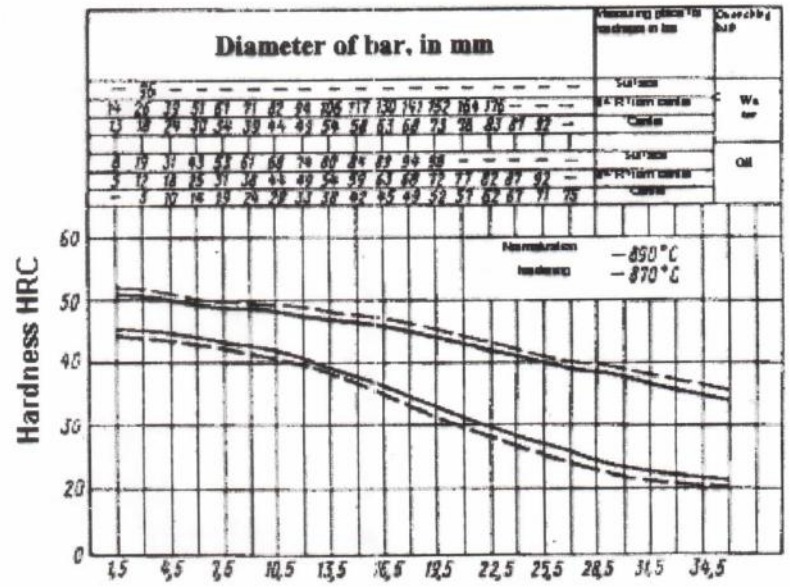
Drawing 7

Steel of grade 20 ХГР



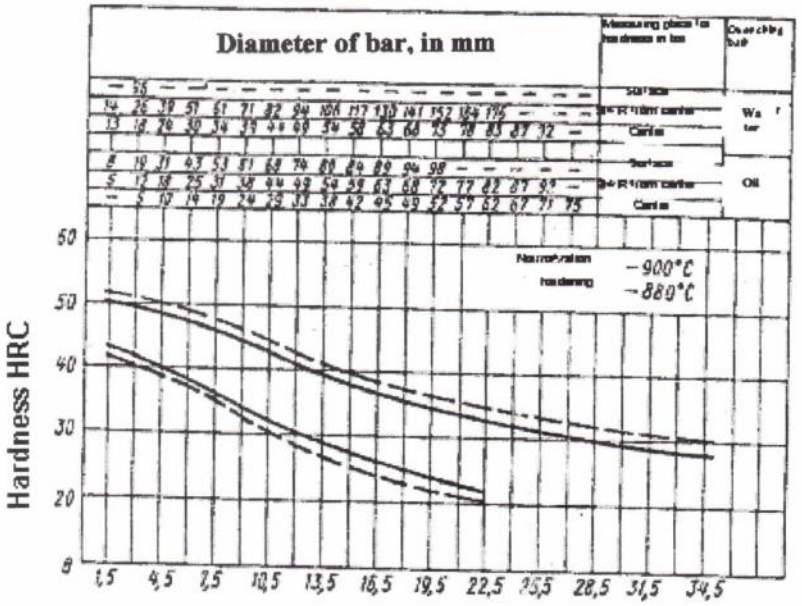
Drawing 8

Steel of grade 27 ХГР



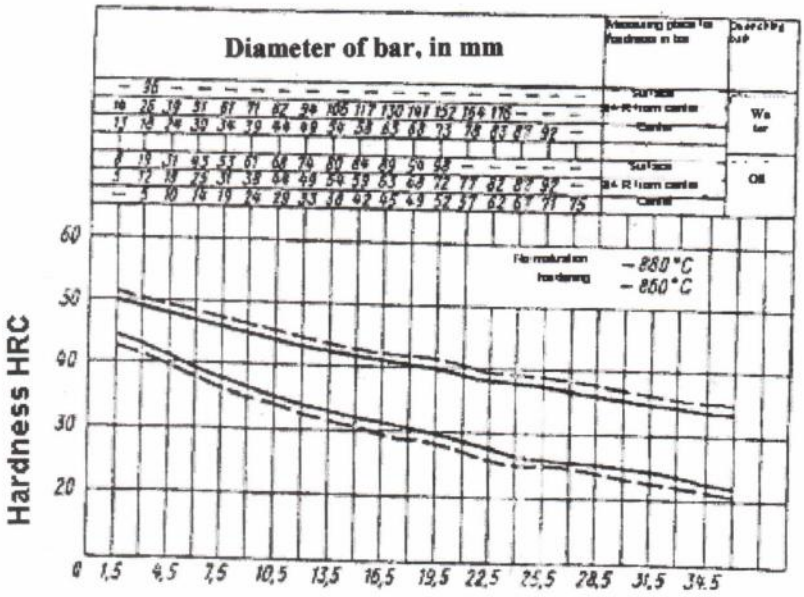
Drawing 9

Steel of grade 30 ХГТ



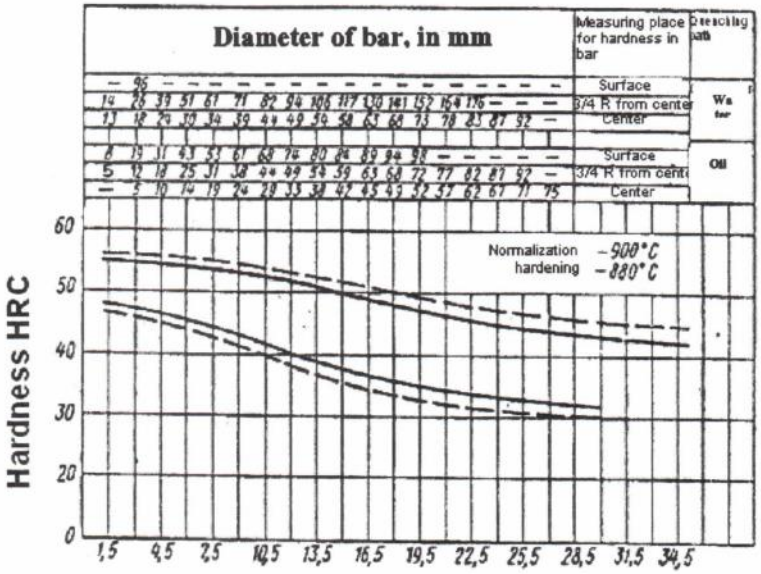
Distance from cooled end face of sample
Drawing 10

Steel of grade 25 ХГМ



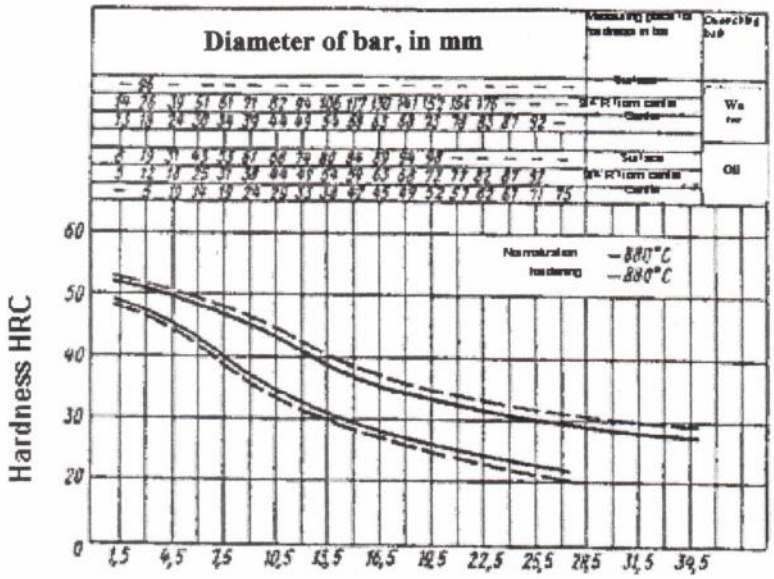
Distance from cooled end face of sample
Drawing 11

Steel of grade 38 XC



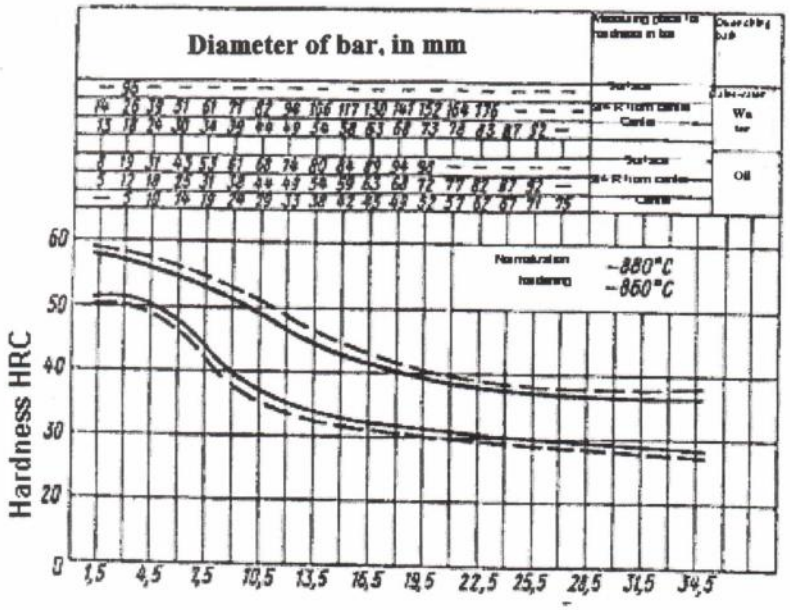
Distance from cooled end face of sample
Drawing 12

Steel of grade 30 XMA



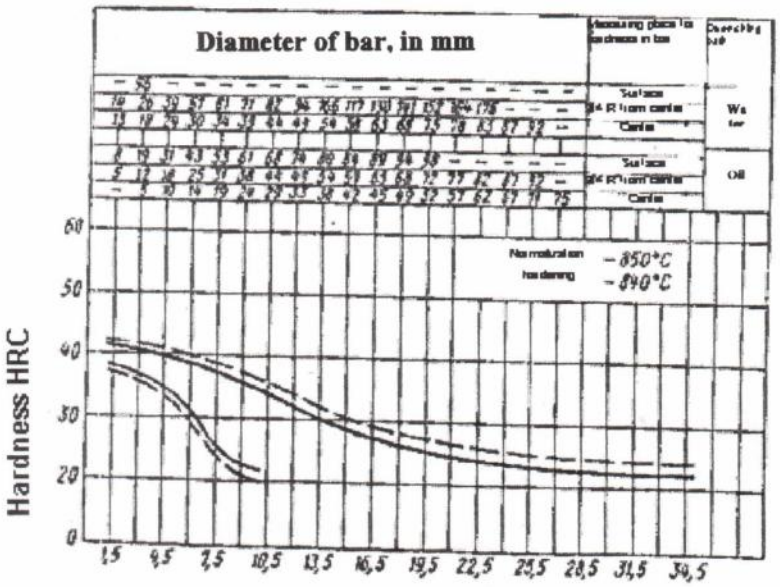
Distance from cooled end face of sample
Drawing 13

Steel of grade 40 ХФА



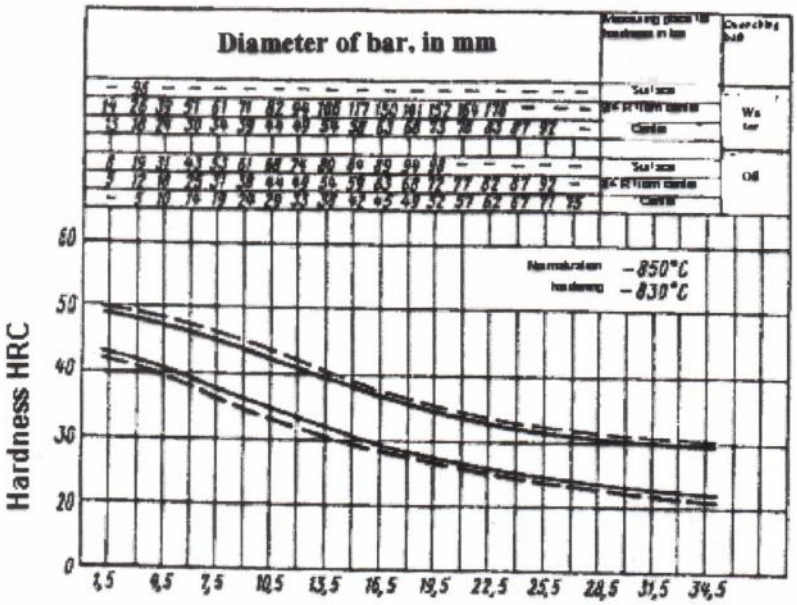
Drawing 14

Steel of grade 12 ХН3А



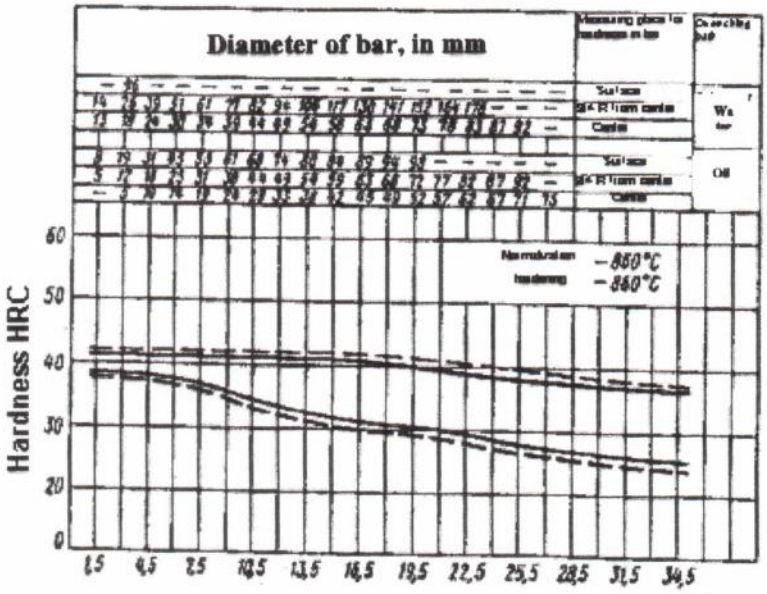
Drawing 15

Steel of grade 20 X3A



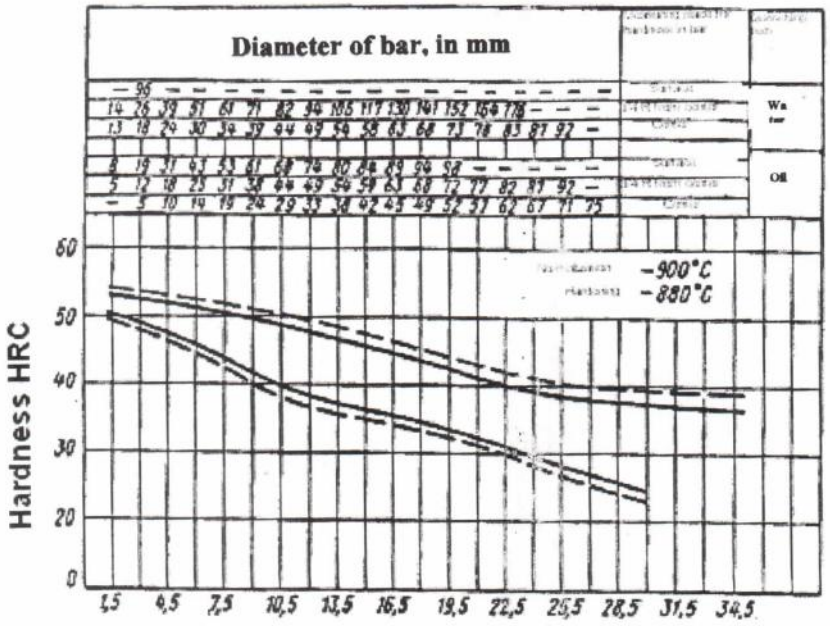
Distance from cooled end face of sample
Drawing 16

Steel of grade 12 X2H4A



Distance from cooled end face of sample
Drawing 17

Steel of grade 30 ХГСА



Drawing 18

Annexure 2

PARAMETERS OF REDUCED AND GRADE – CHARACTERISTIC RANGE
(Limits of variation of hardness HRC along the length of front sample)

Distance from end face, in mm	Hardness for hardenability range, HRC															
	1		2		1		2		1		2		1		2	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	Steel of grade															
	15X				20X				30X				35X			
1.5	42	35.5	43	34.5	46	39	47.5	37.0	51.5	47.5	53.0	46.5	52.0	45.0	54.0	43
3.0	41	32.5	43	30	43.5	34	45.0	32.0	50.0	44.0	52.0	42.5	52.0	43.0	53.0	41
4.5	38	25.5	41	23	40	29.5	42.5	27.0	48.0	40.0	50.0	38.5	50.5	41.0	52.5	39
6.0	34	—	37	—	36.5	25	38.5	22.5	45.5	37.0	48.0	35.0	49.5	37.0	52.0	35
7.5	28.5	—	31	—	32.5	22	34.0	20.0	43.5	33.5	45.0	32.0	47.0	33.0	50.0	30
9.0	24.5	—	27	—	29.5	—	30.5	—	39.5	31.0	41.0	29.0	45.0	29.0	47.0	27
10.5	22	—	24	—	26.5	—	28.0	—	36.0	28.5	37.5	26.5	42.0	28.0	44.0	26
12.0	20.5	—	22.5	—	24.5	—	26.5	—	33.0	26.5	34.5	24.5	39.5	25.5	42.0	23
13.5	—	—	21	—	23	—	25.0	—	30.5	24.5	32.0	23.0	37.0	23.0	39.0	21
15.0	—	—	20	—	22	—	24.0	—	29.0	23.0	30.0	22.0	36.0	22.0	37.0	20
16.5	—	—	—	—	21.5	—	23.5	—	27.5	—	28.5	—	34.0	21.0	36.0	19
18.0	—	—	—	—	21	—	22.5	—	26.5	—	27.5	—	33.0	20.0	34.5	18
19.5	—	—	—	—	20	—	22.0	—	26.0	—	27.0	—	—	—	—	—
21.0	—	—	—	—	—	—	21.5	—	25.0	—	26.5	—	—	—	—	—
24.0	—	—	—	—	—	—	—	—	24.0	—	25.0	—	—	—	—	—
27.0	—	—	—	—	—	—	—	—	22.5	—	23.5	—	—	—	—	—
30.0	—	—	—	—	—	—	—	—	21.0	—	22.0	—	—	—	—	—
33.0	—	—	—	—	—	—	—	—	19.5	—	20.5	—	—	—	—	
36.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
39.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

1 – REDUCED RANGE
2 – GRADE – CHARACTERISTIC RANGE

Continuation

Distance from end face, in mm	Hardness for hardenability range, HRC															
	1		2		1		2		1		2		1		2	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	Steel of grade															
	40X				45X				18XГТ				30XГТ			
1.5	58.5	51	59.5	49	58	54	59	53	48	41	49	40	50.5	43.5	52	41.5
3.0	58	49.5	59	48	57.5	52.5	58.5	51.5	46	39.5	48	38	49.5	42.5	51	40.5
4.5	57	47.5	58	46.5	56.5	51	57.5	50	45	36	46	35	48.5	40.5	50	39
6.0	55.5	45	56.5	43.5	56	49.5	57	48	43	33	44.5	31	47.5	38.5	49	37
7.5	53.5	40.5	56	38	54.5	47.5	56	46	41	30	43	28	46.5	36.5	48	35
9.0	52.5	39	54	38.5	53	46.5	54	43.5	39.5	28	41	25.5	44.5	34.5	46.5	32.5
10.5	50.5	36.5	52.5	33.5	51.5	42.5	53	41	38	26.5	39.5	24	43	32.5	44.5	30.5
12.0	48	34	51	31	49.5	40	51.5	38	36.5	25	38	22.5	41.5	30.5	43	28.5
13.5	46	32.5	49	29.5	47.5	37.5	49.5	36	35.5	24	36.5	21.5	40	29	41.5	27
15.0	46.5	30.5	48	28	46	35	48	33	34	23	36	21	38	28	40	26
16.5	42.5	29.5	44.5	26.5	44	34	45.5	32.5	33	8	34.5	—	37	26.5	38.5	24
18.0	41	28	42.5	26	42	32	43.5	31	32	—	33.5	—	36	25	37.5	23
19.5	39.5	27	41	25	40.5	31	42	29.5	31	—	33	—	35	24	36.5	22
21.0	38.5	26.5	39.5	24	39	29.5	40.5	28.5	30.5	—	32	—	34	23	36	21
24.0	36.5	24.5	38	22.5	36	28	38	26.5	29	—	31	—	32	—	34	—
27.0	35	23	36.5	21.5	35	26.5	36	25	27.5	—	29.5	—	30.5	—	32.5	—
30.0	34	22	36	20	32.5	25.5	34	24	26.5	—	29	—	29.5	—	31.5	—
33.0	—	—	—	—	32.5	24	33	22.5	26	—	28	—	28.5	—	30.5	—
36.0	—	—	—	—	31	23	32.5	21.5	—	—	—	—	—	—	—	—
39.0	—	—	—	—	31	21.5	32.5	20.5	—	—	—	—	—	—	—	—

1 – REDUCED RANGE
2 – GRADE – CHARACTERISTIC RANGE

Continuation

Distance from end face, in mm	Hardness for hardenability range, HRC															
	1		2		1		2		1		2		1		2	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	Steel of grade															
	20ХГР				27ХГР				25ХГМ				30ХМА			
1.5	44.5	37.5	46.0	36.0	50.5	45.0	51.5	44.0	50.0	44.0	51.0	43.0	52.0	49.0	53.0	48.0
3.0	44.0	37.0	45.5	35.5	50.5	45.0	51.5	44.0	49.0	42.5	50.0	41.5	51.0	47.5	52.0	46.5
4.5	43.5	36.5	45.0	35.0	50.0	44.5	51.0	43.5	48.0	41.0	49.0	40.0	50.0	46.0	51.0	44.5
6.0	43.0	33.5	44.5	33.5	50.0	44.5	51.0	43.5	47.0	39.0	48.0	38.0	48.5	43.5	49.5	42.0
7.5	42.5	33.5	44.0	32.0	49.0	43.5	50.5	42.5	46.0	37.5	47.5	36.0	47.0	40.0	48.0	39.0
9.0	41.0	32.0	43.0	30.0	48.5	43.5	50.0	42.0	45.0	36.5	46.5	35.0	45.0	37.0	46.5	35.5
10.5	40.0	30.0	42.5	27.5	48.0	43.0	49.5	41.5	44.0	35.5	45.5	34.0	43.5	34.5	45.0	33.5
12.0	39.0	27.5	41.5	25.0	47.5	41.5	49.0	40.0	43.0	34.5	45.0	33.0	41.5	33.0	43.0	31.5
13.5	37.5	25.5	40.0	23.0	47.0	40.0	48.5	38.5	42.5	33.5	44.0	32.0	39.0	31.5	40.5	30.0
15.0	37.0	24.0	39.0	22.0	46.5	39.0	48.0	37.5	42.0	33.0	43.0	30.5	36.5	29.5	38.0	28.0
16.5	35.0	—	37.0	—	46.0	36.5	47.5	35.0	41.0	31.5	42.5	29.5	35.5	28.5	37.0	27.0
18.0	34.0	—	36.5	—	45.0	35.5	46.5	33.0	40.5	31.0	42.0	28.5	34.5	27.5	36.0	26.0
19.5	33.0	—	34.0	—	44.0	34.0	46.0	32.0	39.5	30.0	41.0	27.5	33.5	26.5	35.0	25.0
21.0	31.5	—	33.0	—	43.0	32.0	44.5	30.0	38.5	29.0	40.5	26.5	32.5	25.5	34.0	24.5
24.0	29.5	—	31.0	—	41.5	29.0	42.5	27.0	37.5	27.0	39.5	25.0	31.0	24.0	32.5	22.0
27.0	28.0	—	29.5	—	40.0	26.5	41.0	25.0	36.5	26.0	38.5	24.5	30.0	22.0	32.0	20.5
30.0	26.5	—	28.5	—	38.0	24.0	39.0	23.0	35.5	25.0	37.5	23.5	29.0	—	31.0	—
33.0	25.5	—	27.5	—	36.0	22.5	37.5	21.5	34.5	24.0	36.0	22.5	28.0	—	30.0	—
36.0	25.0	—	27.0	—	34.0	21.5	35.0	20.0	33.5	22.5	35.0	21.0	—	—	—	—

1 – REDUCED RANGE
2 – GRADE – CHARACTERISTIC RANGE

Continuation

Distance from end face, in mm	Hardness for hardenability range, HRC											
	1		2		1		2		1		2	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	Steel of grade											
	38XC				40XΦA				12XH3A			
1. 5	55	48	56	46. 5	58	51. 5	59. 5	50	41	38	41. 5	37
3. 0	55	47. 5	56	45. 5	57	51. 5	58. 5	50	40. 5	36. 5	41. 5	35. 5
4. 5	54. 5	46. 5	56	45	56	50. 5	57. 5	49	39. 5	34. 5	40. 5	33
6. 0	54	45. 5	55. 5	44	54. 5	48	56. 5	46. 5	38. 5	31	39. 5	29. 5
7. 5	53. 5	44. 5	55	43	53. 5	43. 5	55	42	36. 5	25. 5	39	23
9. 0	53	43. 5	54. 5	41. 5	51	39. 5	53	38	35. 5	22. 5	37	21
10. 5	52. 5	42	54	40	49	37	51	35	34	—	35. 5	—
12. 0	52	40. 5	53. 5	38. 5	47. 5	35	49	33. 5	32	—	33. 5	—
13. 5	51	39	53	37	44. 5	34	46. 5	32. 5	30	—	31. 5	—
15. 0	50	38	52	36	43. 5	33. 5	45	32	28. 5	—	30	—
16. 5	49	36. 5	51	34. 5	41. 5	32. 5	43	31	27	—	29	—
18. 0	48	35. 5	50	34	40. 5	32	41. 5	30. 5	26	—	28	—
19. 5	47. 5	35	49. 5	33	39	31. 5	40. 5	30	25	—	27	—
21. 0	46. 5	34. 5	49	32. 5	38. 5	31	39. 5	29. 5	24. 5	—	26. 5	—
24. 0	45	33	47. 5	31	37. 5	30	38. 5	29	23. 5	—	25. 5	—
27. 0	44	32. 5	46. 5	30. 5	36. 5	29. 5	37. 5	28. 5	23	—	24. 5	—
30. 0	43	32	45	30	36. 5	29. 5	38	28	22. 5	—	24	—
33. 0	42. 5	29	45	27	36. 5	28. 5	37. 5	27. 5	22. 5	—	24	—
36. 0	42	25	44. 5	23	36. 5	28	37. 5	27	—	—	—	—
39. 0	41	22	44	20	36. 5	25. 5	37. 5	25	—	—	—	—
42. 0	—	—	—	—	36. 5	23	37. 5	22. 5	—	—	—	—
45. 0	—	—	—	—	36. 5	21	37. 5	20	—	—	—	—
48. 0	—	—	—	—	—	—	—	—	—	—	—	—

1 – REDUCED RANGE
2 – GRADE – CHARACTERISTIC RANGE

Continuation

Distance from end face, in mm	Hardness for hardenability range, HRC											
	1		2		1		2		1		2	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	Steel of grade											
	20XH3A				12X2H4A				30XГCA			
1.5	49	43	49.5	41.5	41.5	37.5	42	37	53	50	54	49
3.0	48	41.5	49	40.5	41.5	36.5	42	36	52	49	53	47.5
4.5	47.5	40.5	48.5	39.5	41.5	36.5	42	36	51.5	47	52	46
6.0	46.5	39	47.5	37.5	41.5	36.5	42	36	50.5	45.5	51.5	44.5
7.5	44.5	37.5	46	36	41.5	37	42	36	50	44	51	43
9.0	43.5	35.5	44.5	34	41.5	35	42	34	49.5	41.5	51	40
10.5	42	33	43	32.5	41.5	33.5	42	32.5	48.5	40.5	50	38
12.0	40	32.5	41.5	31	41.5	33	42	32	47.5	38	49.5	36.5
13.5	39	31.5	40	30	41.5	32.5	42	31.5	46.5	37	48.5	35.5
15.0	37.5	30.5	39	29	41.5	31	42	30	45.5	36.5	47	35
16.5	36	29.5	37.5	27.5	41.5	30.5	42	29.5	44.5	35.5	46	34.5
18.0	35	28	36	27	40	30	41	29	43	34.5	45	33.5
19.5	34	27	35	26	39.5	30	41	29	42	33.5	44	32
21.0	33	26.5	34	25.5	39	29.5	40.5	28.5	41	32	43	31
24.0	31	25	32	24.5	38	28.5	40	26.5	39.5	30	41.5	28
27.0	30	24.5	31.5	23.5	38	27	40	26	38	27.5	40	25
30.0	30	23	31	22	37.5	27.5	39	26	37	25	39	23
33.0	29.5	22.5	30.5	21	36	26	38	24	37	22	39	20.5
36.0	29	22.5	30	21	—	—	—		—	—	—	—
39.0	28	21.5	29	20	—	—	—	—	—	—	—	—
42.0	28	21.5	29	20	—	—	—	—	—	—	—	—
45.0	28	21.5	29	20	—	—			—	—	—	—
48.0	27	21.5	28	20	—	—	—	—	—	—	—	—

1 – REDUCED RANGE
2 – GRADE – CHARACTERISTIC RANGE

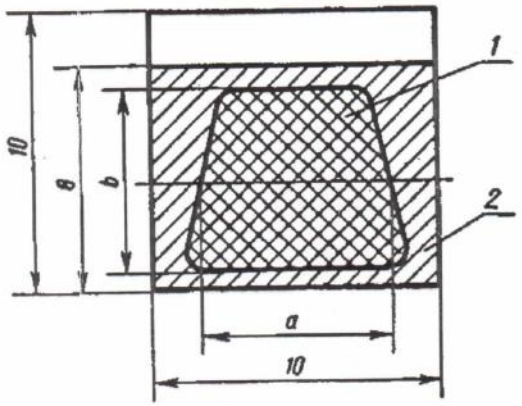
ANNEXURE 3
Recommended

METHOD FOR DETERMINING THE PERCENTAGE VISCOUS COMPONENT IN FRACTURE OF IMPACT SAMPLES (FOR HEAT TREATABLE STEEL)

1. Percentage of viscous components in fracture of impact samples characterizes the resistance of steel to brittle fractures.

Brittle component in the fracture of impact sample with section 8 x 10 mm has the type of trapezoid (drawing 1). Area of this trapezoid F_1 is set as per the degree of increase in fraction of brittle component (drawing 2).

Diagram of impact fracture



1 – Area of fracture to be covered by brittle component.
2 – Area to be covered by viscous component

Drawing 1.

As per rule viscous component is located around brittle component. Area F_1 occupied by brittle component, is defined as the product of mean line of trapezium a to height b (refer to drawing 1). Ratio of this area to entire area of fracture F (80 mm^2) comprises the portion of brittle component in fracture (X) in percentages:

$$X = \frac{F_1}{F} \cdot 100$$

Correspondingly, viscous component (B) in the percentages is equal:

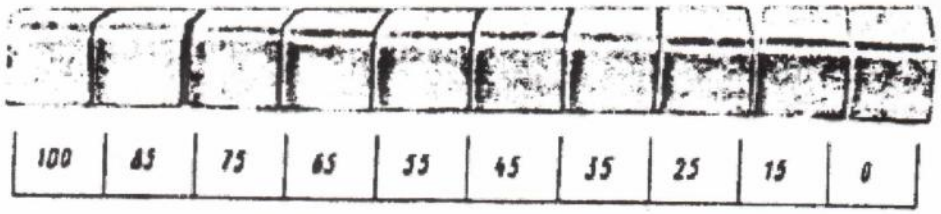
$$B = (100 - X)$$

2. Measurement of the parameters (a, b) area, occupied by brittle components, is carried out by scale with accuracy up to 0.5 mm; in this case measurement error should not exceed 5 %. Knowing parameters a and b, percentage of component is determined according to table.

Height of trapezium b, in mm	Viscous component in the fracture of impact samples, %																	
	Mean line of trapezium a, in mm																	
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10
1.0	99	98	98	97	96	96	95	94	94	93	92	92	91	91	90	89	89	88	88
1.5	98	97	96	95	94	93	92	92	91	90	89	88	87	86	85	84	83	82	81
2.0	98	96	95	94	92	91	90	89	88	86	85	84	82	81	80	79	77	76	75
2.5	97	95	94	92	91	89	88	86	84	83	81	80	78	77	75	73	72	70	69
3.0	96	94	92	91	89	87	85	83	81	79	77	76	74	72	70	68	66	64	62
3.5	96	93	91	89	87	85	82	80	78	76	74	72	69	67	65	63	61	58	56
4.0	95	92	90	88	85	82	80	77	75	72	70	67	65	62	60	57	55	52	50
4.5	94	92	89	86	83	80	77	75	72	69	66	63	61	58	55	52	49	46	44
5.0	94	91	88	85	81	78	75	72	69	66	62	59	56	53	50	47	44	41	37
5.5	93	90	86	83	79	76	72	69	66	62	59	55	52	48	45	42	38	35	31
6.0	92	89	85	81	77	74	70	66	62	59	55	51	47	44	40	36	33	29	25
6.5	92	88	84	80	76	72	67	63	59	55	51	47	43	39	35	31	27	23	19
7.0	91	87	82	78	74	69	65	61	56	52	47	43	39	34	30	26	21	17	12
7.5	91	86	81	77	72	67	62	58	53	48	44	39	34	30	25	20	16	11	6
8.0	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0

In such cases, when high strength is not required, percentage of viscous component is permitted to be determined with the help of visual comparison of the form of fracture (on brittle component) with scale (refer to drawing 2).

Scale for the determination of viscosity of component in the fracture of impact sample



Drawing 2

SUPERSEDES GOST 1050 – 60 (in the part of stamp 15Г, 20Г, 25Г, 30Г, 25Г, 40Г, 45Г, 50Г);

GOST 1051 – 59 (in the part of alloyed steel, except surface quality and packing);

GOST 4543 – 61

REFERENCE OF NORMATIVE – TECHNICAL DOCUMENTATION

Code of НТД, in which reference is given	Point number, Sub point
GOST 8.001 – 80	4.2
GOST 8.323 – 78	4.2
GOST 162 – 80	4.2
GOST 166 – 80	4.2
GOST 427 – 75	4.2
GOST 2216 – 84	4.2
GOST 2590 – 88	2.1
GOST 2591 – 88	2.1
GOST 2879 – 88	2.1
GOST 3749 – 77	4.2
GOST 5378 – 88	4.2
GOST 6507 – 78	4.2
GOST 7502 – 89	4.2
GOST 12344 – 88	4.1
GOST 12345 – 88	4.1
GOST 12349 – 83	4.1
GOST 12350 – 78	4.1
GOST 12351 – 81	4.1
GOST 12359 – 81	4.1
GOST 18895 – 81	4.1
GOST 22235 – 76	5.1.1
GOST 26877 - 86	4.2

Republication with Amendment No. 1, 2, 3, 4, 5, approved in 1977, July 1982, February 1987, June 1987.
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