APPROVED
by directive of the Ministry of power engineering
dated Nov 11, 85 No. SCh-002/8908

APPROVAL SHEET

GENERAL-PURPOSE FORGINGS FOR TURBINES AND COMPRESSORS.
SPECIFICATION.

OST 108.958.04-85

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UDC 669.14-412 Group V03

INDUSTRY STANDARD

GENERAL-PURPOSE FORGINGS FOR TURBINES AND COMPRESSORS. SPECIFICATION.

OKP 41 2100
OST 108.958.04-85
First publication

By directive of the Ministry of power engineering dated Nov 11, 1985 No. SCh-002/8908, this Specification shall be valid from Jul 01, 86 till Jul 01, 91.

Failure to comply with the standard will be subject to legal prosecution.

This standard applies to general-purpose forgings for turbines and compressors, made of carbon steel, alloy steel, and high-alloy steel, by hammering or hot stamping.

This standard does not apply to one-piece forged rotor and shaft blanks, welded rotor, disc and blade blanks, and does not supersede any current specification for certain forging types to which special manufacturing requirements apply, such as special heat treatment, etc.

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1. OPERATING REQUIREMENTS

1.1. Forgings shall be manufactured pursuant to the provisions of this standard, according to detail drawings approved by the customer, and to the manufacturer's duly approved technology.

1.2. Operating requirements stated on the part drawing shall include: test groups to GOST 8479-70 (to be defined by customer); for forgings of groups IV and V – types and scope of additional tests, including: ultrasonic test (UST), macrostructure control, hot yield point measurement – upon agreement between manufacturer and customer. Recommended ultrasonic and macrostructure control rates are given in annexes 1 and 2.

Note. Forgings of shaft-turning gear pinions, half-couplings and half-coupling fittings, as well as steam turbine body parts with a capacity exceeding 50 MW shall be subjected to mandatory macrostructure and ultrasonic controls. In case of UST control, flaws of equivalent diameter exceeding 2 mm shall be recorded. Flaws of equivalent diameter over 2 to 4 mm (inclusive) in a number not exceeding twenty, spaced at least 20 mm, and flaws of equivalent diameter over 4 to 5 mm (inclusive) in a number not exceeding five, spaced at least 30 mm shall be allowed (up to ten flaws of equivalent diameter over 2 to 4 mm (inclusive) shall be allowed in body parts and pinions).

1.3. To designate the forging material, the drawing shall read as follows:

for group I forgings: gr. I OST 108.958.04-85;

for group II or III forgings with hardness HB 163 to 207:

gr. II (III) HB 163-207 OST 108.958.04-85;

for group IV or V forgings with strength class SC50: gr. IV (V) SC50 OST 108.958.04-85.

1.4. Ingots, blooms, forged or rolled blanks, bars shall be used to manufacture forgings.

1.5. Forgings are made of steels of which the chemical composition meets the requirements set in tables 1 and 2.

Table 1

Steel grade designation	Chemical composition standard designation
15, 20, 25, 35, 40, 45	GOST 1050-74
15X, 15XM, 18X2H4MA (25X2H4BA), 38X2MUA, 38XH3MFA, 40X, 40XFA, 40XH, 40XH2MA	GOST 4543-71
12MX, 12X1MF, 15X5M, 20X3MVF (EI 415, EI 579), 25XIMF (EI 10)	GOST 20072-74
15X11MF (1X11MF), 18X11MNFB (2X11MFBN, EP 291), 20X12VNMF (2X12VNMF, EP 428), 20X13 (2X13), 30X13 (3X13), 15X12VNMF (EI 802, EI 952), 18X12VMBFR (2X12VMBFR, EI 993), 12X13 (1X13), 14X17H2 (1X17H2, EI268), 08X13 (0X13, EI 496), 08X16H13M2B (IX16H13M2B, EI 680), 12X18H9 (X18H9), 12X18H9T (X18H9T), 08X18H10T (0X18H10T, EI 914), 12X18H10T (X18H10T), 31X19H9MVBT (EI 572), XH35VT (EI 612)	GOST 5632-72

1.6. Permissible limit deviations of element weight contents from reference rates provided in table 2 shall meet table 3.

1.7. When forgings are made of in-house ingots, steel shall be melted in a Martin or electric arc furnace. Metal may be workedin ladle refiners and degassers; vacuum induction melting, electroslag remelting and vacuum-arc remelting can be used.

Table 2

Steel grade designation	Element's mass content, %										
	carbon	silicon	manganese	chrome	nickel	niobium	molybdenum	vanadium	copper	sulfur	phosphor
									max.		
20GS	0.16-0.22	0.60-0.80	1.00-1.30	max. 0.30	max. 0.30	-	-	-	0.30	0.030	0.030
30X2HMFA	0.27-0.34	0.17-0.37	0.30-0.60	1.60-2.00	1.40-1.80	-	0.40-0.55	0.18-0.28	0.30	0.025	0.025
34XM	0.30-0.40	0.17-0.37	0.40-0.70	0.90-1.30	max. 0.50	-	0.20-0.30	-	0.30	0.030	0.030
34XMA									0.30	0.025	0.025
34XH1M	0.30-0.40	0.17-0.37	0.50-0.80	1.30-1.70	1.30-1.70	-	0.20-0.30	-	0.30	0.030	0.030
34XH1MA									0.30	0.025	0.025
34XH3M	0.30-0.40	0.17-0.37	0.50-0.80	0.70-1.10	2.75-3.25	-	0.25-0.40	-	0.30	0.030	0.030
34XH3MA									0.30	0.025	0.025
25X1M1FA	0.21-0.29	max. 0.37	0.30-0.60	1.50-1.80	max. 0.40	-	0.90-1.05	0.22-0.32	0.25	0.022	0.035
15X1M1F	0.12-0.19	0.17-0.37	0.40-0.70	1.20-1.60	max. 0.30	-	0.90-1.10	0.22-0.35	0.30	0.025	0.030
06X12H3D	max. 0.06	max. 0.30	max. 0.60	12.0-13.5	2.80-3.20	-	-	-	0.80-1.10	0.025	0.030
10X12HD	max. 0.10	max. 0.40	0.30-0.60	12.0-13.5	1.10-1.50	-	-	-	0.80-1.10	0.025	0.025
13X16H3B	0.10-0.15	0.20-0.70	0.40-0.80	15.5-17.0	2.20-2.80	0.07-0.15	-	-	0.30	0.025	0.025

Notes:

1. For steel grade 15X1M1F made by scrap process, nickel's mass content up to 0.4% is allowed.
2. In steel grade 25X1M1FA, cumulative mass content of sulfur and phosphor shall not exceed 0.40%.

Table 3

Element	Limit variance, %								
	20GS	30X2HMFA	34XM, 34XMA	34XH1M, 34XH1MA	34XH3M, 34XH3MA	25X1M1FA	15X1M1F	06X12H3D, 10X12HD	13X16H3B
Carbon	±0.01	±0.01	±0.02	±0.02	±0.02	±0.01	±0.01	-	±0.01
Silicon	±0.10	±0.02	+0.05/-0.02	+0.05/-0.02	+0.05/-0.02	+0.03	+0.05/-0.02	+0.10	±0.10
Manganese	+0.15/-0.05	±0.05	±0.05	±0.05	±0.05	-	±0.05	-	±0.10
Chrome	+0.10	±0.10	±0.10	±0.10	±0.10	-	±0.10	-0.20 (06X12H3D) +0.15 (10X12HD)	±0.30
Nickel	+0.15	±0.10	±0.10	±0.15	±0.15	-	+0.10	±0.10	±0.10
Niobium	-	-	-	-	-	-	-	-	±0.01
Molybdenum	-	±0.03	±0.03	±0.03	±0.03	-	±0.05	-	-
Vanadium	-	±0.02	-	-	-	-	±0.05	-	-
Copper	+0.10	-	+0.10	+0.10	+0.10	-	+0.10	±0.10	+0.10
Sulfur	-	+0.005	-	-	-	-	-	-	+0.005
Phosphor	-	+0.005	-	-	-	-	-	-	+0.005

Note. When steel is made by vacuum arc remelting, limit variance of manganese mass content between plus 0.05 and minus 0.10% is allowed.

The teeming method shall be determined by manufacturer. Ingots of steel grade 10X12HD and 06X12H3D weighing above 21 t shall be vacuum-teemed.

Note. Steels produced by special methods are added in the end of the steel designation after dash with the following letters: VA – vacuum-arc remelt, S – electroslag remelt, VI – vacuum-induction melting.

1.8. Forging dimensions shall take into account the machining and heat-treat allowances, oversize allowances, process laps and control test laps.

1.9. Machining allowances and permitted variances for forgings made by press-forging shall comply with GOST 7062-79, by hammer-forging – with GOST 7829-70, by hot stamping – with GOST 7505-74, for forgings made of high-alloy steels – with manufacturer's in-house regulations.

1.10. Forgings are heat-treated either rough, or after pre-machining. The heat treatment conditions are determined by manufacturer and specified in the forging's quality data sheet. Hardness of group I-II forgings to GOST 8479-70 after or without initial heat treatment shall meet the values in table 4.

1.11. Mechanical properties and hardness of group IV-V forging metal to GOST 8479-70 after final heat treatment shall meet the values in table 5.

1.12. For forgings of steel grades 20X3MVF, 20X13, 30X13, 40X, 10X12HD of groups II and III to GOST 8479-70, metal hardness after final heat treatment shall meet the values in table 6, and for forgings of other steel grades – in table 5.

Table 4

Steel grade designation	Test group to GOST 8479-70	Supply condition	Hardness, HB max.
15	I	after or without initial heat treatment	not determined
20	I		
25	II		179
40	II		217
45	II		229
15X	II		179
40X	II	after initial heat treatment	241
		without initial heat treatment	255
15XM, 12MX, 12X1MF	II	after initial heat treatment	207
		without initial heat treatment	217
15X1MF	II	after initial heat treatment	229
25X1MF	II		255
20X3MVF	II		269
38X2MUA	II		255
34XM (A)	II	after initial heat treatment	241
		without initial heat treatment	269
34XH1M (A)	II	after initial heat treatment	269
34XH3M (A)	II		269
30X2HMFA	II		269
08X13, 12X13	II		241
20X13	II		241
30X13	II		255
14XI7H2	II		285
20X12VHMF	II		269
13X16H3B	II		285
12X18H9, 08X18H10T, 12X18H9T, 12X18H10T	I	without initial heat treatment	not determined

Table 5

Steel grade designation	Strength class	Specimen position[1]	Mechanical properties at 20°C [2]						Max. blank thickness [3], mm
			Yield limit, $\sigma_{0.2}$, MPa (kgf/mm^2)	Ultimate tensile strength, MPa, σ_v (kgf/mm^2)	Relative elongation, δ, %	Relative contraction, ψ, %	Impact resilience (KCU), kJ/m^2 (kgf/mm^2)	Hardness, HB	
			min.						
15	SC 18	L	to GOST 8479-70						
20	SC 18,20	L	idem						
25	SC 20,25	L	- " -						
35	SC 18,20,22,25, 28,32,35	L	- " -						
40	SC 28,32	L	- " -						
45	SC 25,28,32,35, 40	L	- " -						
20GS	SC 25	L	- " -						
15X	SC 35	L	- " -						
40X	SC 35,40,45,50	L	- " -						
	SC 60 A	L	590-675 (60-75)	735 (75)	14	45	59 (6.0)	235-272	75
	SC 70 A	L	675-835 (70-85)	835 (85)	13	42	59 (6.0)	262-311	50
40XFA	SC 50	L	to GOST 8479-70						
	SC 60 A	L	590-675 (60-75)	735 (75)	14	45	59 (6.0)	235-277	80
	SC 70 A	L	675-835 (70-85)	835 (85)	13	42	59 (6.0)	262-311	80
	SC 75 A	L	735-880 (75-90)	880 (90)	13	40	59 (6.0)	277-327	80
40XH	SC 50	L	to GOST 8479-70						
40XH2MA	SC 60,75	L	idem						
12MX	SC 25	L	- " -						
15XM	SC 25	L	- " -						
	SC 26 A	L	255 (26)	440 (45)	22	46	59 (6.0)	131-174	300
	SC 50 A	L	490 (50)	615 (63)	18	50	69 (7.0)	217-248	100
12X1MF	SC 25	L	to GOST 8479-70						
	SC 26 A	L	256 (26)	470 (48)			59 (6.0)	131-174	250
18X2H4MA	SC 75	L	to GOST 8479-70						
15X1M1F	SC 32	L	315-540 (32-55)	570 (58)	17	40	49 (5.0)	163-207	400
	SC 35	L	to GOST 8479-70						
	SC 35 A	T	345-542 (35-55)	540 (55)	15	45	39 (4.0)		400
25X1MF	SC 60,75	L	to GOST 8479-70						
	SC 50	L	490-605 (50-62)	635 (65)	18	50	69 (7.0)	196-229	250
	SC 60 A	L	590-685 (60-70)	735 (75)	16	50	59 (6.0)	229-269	200
	SC 70 A	L	685-785 (70-80)	815 (83)	16	50	59 (6.0)	255-285	200

Table 5 continued

Steel grade designation	Strength class	Specimen position[1]	Mechanical properties at 20°C [2]						Max. blank thickness [3], mm
			Yield limit, $\sigma_{0.2}$, MPa (kgf/mm^2)	Ultimate tensile strength, MPa, σ_v (kgf/mm^2)	Relative elongation, δ, %	Relative contraction, ψ, %	Impact resilience (KCU), kJ/m^2 (kgf/mm^2)	Hardness, HB	
			min.						
25X1M1FA	SC 45	L	440 (45)	635 (65)	16	50	59 (6.0)	207-241	300
	SC 60	L	590-675 (60-75)	735 (75)	15	50	59 (6.0)	241-269	200
20X3MVF	SC 67	L	655 (67)	785 (80)	13	40	49 (5.0)	241-302	200
30X2HMFA	SC 65	L	640-930 (65-95)	735 (75)	12	40	44 (4.5)	255-311	>800 to 1000
	SC 70	L	685-930 (70-95)	785 (80)	12	40	44 (4.5)	262-311	>600 to 800
	SC 75	L	735-980 (75-100)	835 (85)	12	40	49 (5.0)	269-321	>400 to 600
	SC 80	L	785-980 (80-100)	880 (90)	12	45	49 (5.0)	285-321	400
38XH3MFA	SC 65,70,75,80	L	to GOST 8479-70						
38X2MUA	SC 60	L	590 (60)	735 (75)	13	40	49 (5.0)	235-277	300
	SC 60 A	L	590-735 (60-75)	735 (75)	14	45	59 (6.0)	235-277	220
	SC 75	L	735 (75)	880 (90)	13	40	59 (6.0)	277-321	100
34XM 34XMA	SC 40	L	to GOST 8479-70						300
	SC 45	L	idem						200
	SC 50	L	- " -						200
35XM	SC 25,28,32,35, 40,45,50	L	- " -						
34XH1M 34XH1MA	SC 50	T	490 (50)	655 (67)	12	35	49 (5.0)	217-248	500
	SC 60	L	590 (60)	735 (75)	12	35	49 (5.0)	235-277	350
	SC 60 A	L	590-785 (60-80)	735 (75)	14	45	59 (6.0)	235-277	100
					13	40	49 (5.0)	235-277	>100 to 300
					12	35	44 (4.5)	235-277	>300 to 500
	SC 65 A	L	640-835 (65-85)	785 (80)	13	42	59 (6.0)	248-293	100
					12	38	49 (5.0)	248-293	>100 to 300
	SC 70	L	685 (70)	835 (85)	12	35	49 (5.0)	262-311	300
	SC 70 A	L	685-835 (70-85)	835 (85)	13	42	59 (6.0)	261-311	100
					12	38	49 (5.0)	262-311	>100 to 300
		T	685-835 (70-85)	835 (85)	12	35	49 (5.0)	262-293	150
	SC 75	L	735 (75)	880 (90)	12	35	49 (5.0)	277-321	250
	SC 75 A	L	735-880 (75-90)	880 (90)	13	40	59 (6.0)	277-321	100

Table 5continued

Steel grade designation	Strength class	Specimen position[1]	Mechanical properties at 20°C [2]						Max. blank thickness [3], mm
			Yield limit, $\sigma_{0.2}$, MPa (kgf/mm^2)	Ultimate tensile strength, MPa, σ_v (kgf/mm^2)	Relative elongation, δ, %	Relative contraction, ψ, %	Impact resilience (KCU), kJ/m^2 (kgf/mm^2)	Hardness, HB	
			min.						
34XH3M 34XH3MA	SC 60 A	L	590-785 (60-80)	735 (75)	12	35	44 (4.5)	235-277	>300 to 500
	SC 65	L	640 (65)	785 (80)	11	33	44 (4.5)	248-293	500
	SC 65 A	L	640-835 (65-85)	785 (80)	11	33	44 (4.5)	248-293	>300 to 500
	SC 70	L	685 (70)	835 (85)	11	33	44 (4.5)	262-311	400
	SC 70 A	L	685-835 (70-85)	835 (85)	11	33	39 (4.0)	262-311	>300 to 500
		T	685-835 (70-85)	835 (85)	12	35	49 (5.0)	262-293	>150 to 400
	SC 75	L	735 (75)	880 (90)	12	35	49 (5.0)	277-321	300
	SC 75 A	L	735-880 (75-90)	880 (90)	12	35	49 (5.0)	277-321	>100 to 300
	SC 80	L	785 (80)	930 (95)	11	35	49 (5.0)	293-331	150
	SC 80 A	L	785-930 (80-95)	930 (95)	12	40	59 (6.0)	293-331	100
					11	35	49 (5.0)	293-331	>100 to 300
15X5M	SC 40	L	395 (40)	540 (55)	18	50	59 (6.0)	187-229	200
	SC 45	L	440 (45)	635 (65)	14	40	49 (5.0)	197-235	100
15X11MF	SC 50	L	490 (50)	685 (70)	14	40	59 (6.0)	212-248	250
		T	490 (50)	685 (70)	12	35	49 (5.0)	212-248	250
	SC 50 A	L	490-605 (50-62)	685 (70)	16	50	59 (6.0)	212-248	200
	SC 55	L	540 (55)	685 (70)	13	35	49 (5.0)	223-262	130
		T	540 (55)	655 (67)	10	32	39 (4.0)	223-262	130
	SC 55 A	L	540-665 (55-68)	705 (72)	15	50	59 (6.0)	223-262	130
15X12VNMF	SC 60	L	590 (60)	735 (75)	15	35	44 (4.5)	229-235	150
18X11MNFB	SC 60	L	590-705 (60-72)	755 (77)	14	50	59 (6.0)	229-255	200
	SC 65	L	640-755 (65-77)	785 (80)	14	50	59 (6.0)	248-277	200
18X12VMBFR	SC 70	L	685-785 (70-80)	835 (85)	14	45	59 (6.0)	255-285	100
08X13	SC 35	L	345 (35)	590 (60)	14	35	39 (4.0)	170-217	150
12X13	SC 40	L	390 (40)	615 (63)	15	40	49 (5.0)	187-229	300
	SC 42 A	L	410 (42)	635 (65)	20	50	69 (7.0)	187-229	120
20X13	SC 45	L	440 (45)	635 (65)	14	40	49 (5.0)	197-235	250
	SC 50	L	490 (50)	655 (67)	13	40	44 (4.5)	212-248	200

Table 5 continued

Steel grade designation	Strength class	Specimen position[1]	Mechanical properties at 20°C [2]						Max. blank thickness[3], mm
			Yield limit, $\sigma_{0.2}$, MPa (kgf/mm^2)	Ultimate tensile strength, MPa, σ_v (kgf/mm^2)	Relative elongation, δ, %	Relative contraction, ψ, %	Impact resilience (KCU), kJ/m^2 (kgf/mm^2)	Hardness, HB	
			min.						
20X13	SC 50 A	L	490 (50)	685 (70)	16	50	59 (6.0)	217-241	150
							54 (5.5)	217-241	>150 to 300
	SC 55	L	540 (55)	685 (70)	12	35	39 (4.0)	223-262	150
	SC 60 A	L	590-705 (60-72)	785 (80)	14	45	49 (5.0)	241-269	100
30X13	SC 55	L	540 (55)	685 (70)	12	35	39 (4.0)	223-262	>150 to 300
	SC 60	L	590 (60)	735 (75)	12	35	29 (3.0)	235-277	250
	SC 70 A	L	685 (70)	835 (85)	12	40	34 (3.5)	269-302	100
	SC 80 A	L	785 (80)	930 (95)	10	35	24 (2.5)	285-321	70
14X17H2	SC 45	L or T	440 (45)	590 (60)	15	35	39 (4.0)	207-285	200
08X18H10T 12X18H9 12X18H910 12X18H10T	SC 20	L	195 (20)	490 (50)	35	40	-	-	300
20X12VNMF	SC 60	L	590 (60)	735 (75)	15	35	44 (4.5)	235-277	150
		T	590 (60)	735 (75)	13	30	39 (4.0)		
13X16H3B	SC 45	L or T	440 (45)	590 (60)	15	35	39 (4.0)	207-285	200
31X19H9MVBT	SC 34	L	335 (34)	590 (60)	20	25	39 (4.0)	-	250
08X16H13M2B	SC 23	L	225 (23)	540 (55)	40	55	78 (8.0)	137-170	250
06X12H3D	SC 60	L	588 (60)	686 (70)	12	35	58 (6.0)	207-293	250
XH35BT	SC 40	L	392 (40)	735 (75)	15	30	58 (6.0)	207-255	300

Notes:

1. Abbreviations: L – longitudinal specimens, T – tangential specimens. A in strength class designation means that forgings with specified mechanical properties are supplied upon agreement between manufacturer and customer.
2. Acceptance measurements include: yield limit, relative contraction, and impact resilience. To be specified on the drawing, the yield limit shall be measured at a higher temperature (test temperature and yield limit value shall be specified in the part drawing). This property is not an acceptance value, but shall be listed on the quality data sheet.
3. Maximum blank thickness is its maximum design section for heat treatment purposes.
4. Forgings can be made of improved grade steel (34XMA, 34XH1MA, and 34XH3MA) upon agreement between manufacturer and customer.

Table 6

Steel grade designation	Hardness, HB	Maximum forging thickness, mm
20X3MVF	241-302	300
	293-331	200
20X13	HRC_E 30-34	50
	197-235	300
	212-248	250
	223-262	200
	235-277	150
	248-293	100
30X13	235-277	300
	248-293	250
	262-311	200
	285-321	150
	321-375	100
	HRC_E 40-45	70
	HRC_E 45-53	50
10X12HD	207-255	500
40X	HRC_E 29-41	50
	HRC_E 22-30	100

1.13. When measuring mechanical properties on transverse, tangential, or radial specimens, reference values of properties can be lowered to GOST 8479-70 (in cases not covered by table 5).

1.14. According to drawing requirements, forgings of steel grades 08X18H10T, 12X18H9T, 12X18H10T, 31X19H9MVBT shall be resistant to inter-crystalline corrosion (ICC).

1.15. Surface of forgings shall be free of cracks, folds, blisters, sand holes.

On untreated forging surfaces, rolled-in scale, hammer marks, as well as low-angle chipping or peeling of flaws are allowed, provided that the depth of such flaws is not beyond the minimum permissible dimensions of forgings to GOST 7062-79, GOST 7829-70, or GOST 7505-74.

On treated forging surfaces, single flaws are allowed and not subject to removal, provided that their depth determined by control chipping or peeling is such that at least 25% of the one-side nominal allowance remains for machining purposes.

1.16. Forgings shall be free of flakes, cracks, shrinkage porosity.

1.17. Forgings subjected to cold or heated straightening after heat treatment shall be subject to temper drawing for stress relieving purposes.

For forgings of group I to III, subsequent tempering can be omitted, provided that the required properties are ensured after melting.

1.18. Upon agreement between manufacturer and customer, forgings shall be unscaled. The scale removal method shall be specified on the drawing or in the order terms.

2. ACCEPTANCE RULES

2.1. Subject to their intended use, blanks shall be made available for acceptance in batches (groups I to IV), or individually (group V), rough (unmachined) or after pre-machining.

Terms of batching and scope of tests, subject to the forging group, shall meet the requirements of GOST 8479-70.

2.2. Blanks shall be subject to piece-by-piece inspection:

visual – to check the surface quality and the marking;

dimensional – to measure the dimensions.

2.3. When forgings are made of metal melted by the manufacturer, the steel's chemical composition shall be defined as per ladle analysis data.

When forgings are made of rolled stock or of cut ingots, the steel grade and chemical composition are established by the metal manufacturer's quality data sheet.

2.4. Mechanical properties and hardness of forgings are measured according to the test group specified on the drawing.

2.5. Specimen cut points, their number, sampling method shall be to GOST 8479-70.

In order to measure the yield limit at high temperature according to the drawing requirement, an additional specimen shall be cut out of the sample, for teat testing purposes.

2.6. If a specimen test fails due to any flaw detected in the specimen during the test, the test shall be deemed void, and the specimen shall be replaced.

2.7. When estimating metal's susceptibility to ICC, in case the specimen is destroyed for any reason other than corrosion, it is allowed to prepare a report upon the data of a metallographic study.

2.8. Scope of forgings' etching control for macrostructure is defined in the drawing. Should the drawing contain no such directions, 2% of forgings, but at least two templates of each melt, shall be subject to control. Macrostructure control can be done on the forging itself.

2.9. If a mechanical test fails, forgings shall be re-tested according to GOST 8479-70.

If a macrostructure control fails, the control shall be repeated on a double number of samples from the same melt. In case of failure, the batch shall be accepted following piece-by-piece control.

2.10. Forgings in which flakes are found shall be rejected; all other forgings of the batch may be accepted following individual control only.

3. TEST METHODS

3.1. Visual and dimensional control of forgings shall be undertaken according to the requirements of this standard and of the drawing. Dimensions shall be checked with a multimeter of required accuracy, in accordance with the manufacturer's in-house process documenttion.

3.2. Chemical composition shall be defined on the melt sample to GOST 7565-81.

For steel made by electroslag and vacuum-arc remelting, chemical composition of the original melt shall be specified, except for manganese in the vacuum-arc remelt metal, which shall be measured in forgings to GOST 7565-81.

3.3. Chemical analysis shall be according to GOST 12344-78, GOST 12345-80, GOST 12346-78, GOST 12347-77, GOST 12348-78, GOST 12350-78, GOST 12352-81, GOST 12353-78, GOST 12355-78, GOST 12356-81, GOST 12359-81, GOST 18895-81, or to other methods ensuring the measurement accuracy as required by this standard.

3.4. Brinell hardness shall be measured to GOST 9012-59, and Rockwell hardness – to GOST 9013-59. Hardness may be measured usingportable devices.

3.5. Tensile test at room temperature shall be to GOST 1497-84 on five-time long specimens, with design part diameter of 10 mm (specimens of 6 or 5 mm in diameter may be used); at higher temperature – to GOST 9651-84 on specimens with design part diameter of 10, 8, or 6 mm.

3.6. Impact tests shall be done in type I specimens to GOST 9454-78.

3.7. Metal shall be tested for susceptibility to intercrystalline corrosion by AC or ACA methods, with sensitization heating, to GOST 6032-84.

3.8. Macrostructure etching control shall be according to manufacturer's instruction. Templates shall be sampled to GOST 10243-75.

3.9. Ultrasonic control shall be to OST 108.958.03-83.

3.10. For control quality test and forgings' conformity to this standard by customer, sampling and testing methods described in section 2 and 3 above shall be used.

4. MARKING, TRANSPORT AND STORAGE

4.1. Marking, content of shipping documents, transport and storage of forgings shall be to GOST 8479-70.

5. MANUFACTURER'S WARRANTIES

5.1. Manufacturer guarantees the conformity of forgings' quality to the requirements of this standard.

Annex 1 (reference)

FORGINGS QUALITY ASSESSMENT UPON ULTRASONIC CONTROL DATA

Flaws of equivalent area S_0 or above shall be recorded.

Flaws of equivalent area S_1 or above shall not be allowed.

Flaws of equivalent area from S_0 to S_1 or above shall not be allowed, if they are considered as extended.

Flaws of equivalent area from S_0 to S_1 or above shall not be allowed, if they are considered as non-extended, but form an accumulation of or more flaws, and the most remote flaws are spaced at a distance equal or lesser than D.

Minimum permissible distance between flaws to be recorded is 20 mm.

Values of S_0, S_1, D and n are given in the table.

Blank thickness, mm	Straight beam probe		Angle beam probe		Allowed number of flaws in any circle of D diameter, mm	
	Recording level, S_o, mm^2	Rejecting level, S_1, mm^2	Recording level, S_o, mm^2	Rejecting level, S_1, mm^2	D	n
100 or below	5	20	10	30	100	4
>100 to 250 incl.	10	20	20	40	100	6
>250 to 400 incl.	10	30	40	70	100	6
above 400	20	40	70	100	100	6

Annex 2 (reference)

MACROSTRUCTURE REQUIREMENTS

Etched forging surface macrostructure shall be free of cracks, flakes, shrinkage porosity, blowholes, laminations, slag inclusions in excess of 2 mm, folds, blisters, and accumulations of minor non-metallic inclusions.

In any etched area, single inclusions are allowed sized up to 2 mm, in a number not exceeding 15.

Inclusions sized below 1 mm shall not be considered, unless they form an accumulation. No chain-type position of inclusions is allowed.

Notes:

1. A chain is a group of inclusions positioned in a line, in a number of at least 5, with spaces between them not exceeding three-time length of the longest flaw making part of the chain.
2. An accumulation is a group of inclusions in a number of at least 10, with spaces between them not exceeding five-time length of the longest flaw making part of the accumulation.
3. Any disputable question regarding macrostructure flaws shall be settled by agreement between the manufacturer and the customer.

LIST

of documents referred to in OST 108.958.04-85

Document designation	**Standard**	**Paragraph**
GOST 8479-70	Forgings of structural carbon and alloy steel. General specification	1.2
GOST 1050-74	High-grade structural carbon steel. Specification	1.5
GOST 4543-71	Structural alloy steel. Specification	idem
GOST 20072-74	Heat-resistant steel. Specification	-“-
GOST 5632-72	Corrosion-resistant, fire-resistant and fireproof high-alloy steels and alloys. Grades and specifications	-“-
GOST 7062-79	Forgings of carbon and alloy steels, made by press forging. Allowances and clearances	1.8
GOST 7829-70	Forgings of carbon and alloy steels, made by open hammer forging. Allowances and clearances	idem
GOST 7505-74	Stamped steel forgings. Clearances, allowances and forging laps	-“-
GOST 7565-81	Cast iron, steel and alloys. Sampling methods for chemical composition determination	3.2
GOST 12344-78	Alloy and high-alloy steels. Carbon content determination methods	3.3
GOST 12345-80	Alloy and high-alloy steels. Sulfur content determination methods	idem
GOST 12346-78	Alloy and high-alloy steels. Silicon content determination methods	-“-
GOST 12347-77	Alloy and high-alloy steels. Phosphor content determination methods	-“-
GOST 12348-78	Alloy and high-alloy steels. Manganese content determination methods	-“-
GOST 12350-78	Alloy and high-alloy steels. Chrome content determination methods	-“-

Continued

Document designation	Standard	Paragraph
GOST 12352-81	Alloy and high-alloy steels. Nickel content determination methods	3.3
GOST 12353-78	Alloy and high-alloy steels. Cobalt content determination methods	idem
GOST 12355-78	Alloy and high-alloy steels. Copper determination methods	-“-
GOST 12356-81	Alloy and high-alloy steels. Titanium content determination methods	-“-
GOST 12359-81	Alloy and high-alloy steels. Nitrogen content determination methods	-“-
GOST 18895-81	Steel. Photoelectric spectral analysis method	-“-
GOST 9012-59	Metals and alloys. Brinell hardness test	3.4
GOST 9013-59	Metals and alloys. Rockwell hardness test. A, B and C scales	idem
GOST 1497-84	Metals. Tensile test methods	3.5
GOST 9651-84	Metals. Tensile test methods at high temperatures	idem
GOST 9454-78	Metals. Impact bending test method at low, room and high temperatures.	3.6
GOST 6032-84	Corrosion-resistant steels and alloys. Intercrystalline corrosion resistance determination methods	3.7
GOST 10243-75	Steel. Test and macrostructure assessment methods	3.8
OST 108.958.03-83	Steel forgings for power engineering equipment. Ultrasonic control method	3.9

Record of amendments to OST 108.958.04-85

Amd.	Sheet (page) number				Doc. No.	Signed	Date	Enactment date
	amended	replaced	new	cancelled				

Group V03

AMENDMENT No. 1 to

OST 108.958.04-85
"GENERAL-PURPOSE FORGINGS FOR TURBINES AND COMPRESSORS. SPECIFICATION"

OKP 41 2100

Stamp: Apr 18, 89

Approved and enacted bydirective of the Ministry of power engineering dated Feb 27, 1989 No. VA-002-1/1867.

Stamps *(illegible)*

Enacted on: May 01, 89

Valid till: Jan 01, 91

On the bottom margin of page 1, insert the note "Verified in 1988".

Preamble. Paragraph two to read as follows: "This standard does not apply to critical parts of steam and gas turbines and axial-flow compressors manufacturedunder specialdesign specification (discs, impeller wheels, blades, shafts, one-piece forged and welded rotors), and does not supersede any current specification for forgings to which special control or manufacturing requirements apply."

Paragraph 1.2. Note. The words "body parts" shall be followed by words: "…made of steel grade 15X1M1F for…";

add the sentence: "No flaws recorded as extended shall be allowed within the prescribed responsivity".

Paragraph 1.5. Add steel grade 20X1M1F1TP to GOST 20072-74 to table 1.

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on May 10, 89 under No. 836582/01

Paragraph 1.6. Add steel grades 14X2GMR, 20XH3MFA, 05G4MHF and 25X2M1F to table 2.

Steel grade designation	Element's mass content, %												
	carbon	silicon	manganese	chrome	nickel	niobium	molybdenum	vanadium	copper	sulfur	phosphor	boron (design)	titanium
									max.				
14X2GMR	0.10-0.16	0.17-0.37	0.90-1.20	1.30-1.70	max. 0.30	-	0.40-0.50	max. 0.08	0.30	0.030	0.030	0.002-0.006	-
20XH3MFA	0.20-0.25	0.20-0.45	0.40-0.70	1.40-1.80	3.0-3.50	-	0.40-0.60	0.06-0.12	0.30	0.020	0.020	-	-
05G4MHF	max. 0.05	0.30-0.60	3.2-3.70	-	3.0-3.50	-	0.20-0.40	0.08-0.15	0.30	0.020	0.020	-	0.02
25X2M1F	0.22-0.29	0.17-0.37	0.40-0.70	2.10-2.60	max. 0.30	-	0.90-1.10	0.30-0.50	0.30	0.020	0.020	-	-

Table 2. Note 3. "Cumulative mass content of sulfur and phosphor in steel grade 25X1M1FA shall not exceed 0.04%".

Note 4. For steel grade 14X2GMR, the table specifies the design content of boron, entered for steel melting purposes. Actual boron content in steel will not be determined as part of ladle control; this value is optional and will not be included in the certificate (data sheet).

Add steel grades 14X2GMR, 20XH3MFA, 05G4MHF to table 3:

Element	Limit variance, % abs.		
	14X2GMR	20XH3MFA	05G4MHF
Carbon	±0.01	±0.01	-
Silicon	±0.02	±0.03	±0.10
Manganese	±0.05	±0.05	±0.15
Chrome	±0.10	±0.10	-
Nickel	+0.10	±0.15	±0.15
Niobium	-	-	-
Molybdenum	±0.03	±0.03	±0.05
Vanadium	+0.02	+0.02/-0.01	-
Copper	+0.05	+0.05	-
Sulfur	-	+0.005	-
Phosphor	+0.003	+0.005	-

Paragraph 1.10. Add two steel grades to table 4: 14X2GMR and 20XH3MFA:

Steel grade designation	Test group to GOST 8479-70	Supply condition	Hardness, HB max.
14X2GMR	II	after initial heat treatment	255
20XH3MFA	II		269

Paragraph 1.11. Add steel grades 14X2GMR, 20XH3MFA, 05G4MHF, 20X1M1F1TP and 25X2M1F to table 5:

Steel grade designation	Strength class	Specimen position[1)]	Mechanical properties at 20°C [2)]						Max. blank thickness [3)], mm
			Yield limit, $\sigma_{0.2}$, MPa (kgf/mm^2)	Ultimate tensile strength, MPa, σ_v (kgf/mm^2)	Relative elongation, δ, %	Relative contraction, ψ, %	Impact resilience (KCU), kJ/m^2 (kgf/mm^2)	Hardness, HB	
			min.						
14X2GMR	SC 40	T, L	min. 390 (40)	590 (60)	17	35	49 (5.0)	187-248	450
	SC 50	T, L	490-835 (50-85)	655 (67)	15	35	49 (5.0)	212-248	350
	SC 60	T, L	590-835 (60-85)	762 (78)	14	35	49 (5.0)	229-277	250
20XH3MFA	SC 68	T, L	666-880 (68-90)	785 (80)	13	35	49 (5.0)	262-302	300
05G4MHF	SC 50	L	490-545 (50-55)	680-750 (70-75)	18-22	45	49 (5.0)	207-320	350
		T	490-530 (50-55)	680-720 (70-75)	18-20	45	50 (5.0)	207-320	350
20X1M1F1TP	SC 50	L	490-605 (50-62)	635 (65)	18	50	69 (7.0)	196-229	200
	SC 60	L	590-705 (60-72)	715 (73)	16	45	59 (6.0)	217-241	180
	SC 68	L	665-785 (68-80)	785 (80)	15	45	49 (5.0)	241-269	160
25X2M1F	SC 50	L	490-605 (50-62)	640 (65)	18	50	69 (7.0)	196-229	250
	SC 60	L	590-705 (60-72)	735 (75)	16	50	59 (6.0)	229-269	200
	SC 70	L	685-805 (70-82)	825 (84)	19	50	49 (5.0)	255-277	150

In the “Strength class” column, replace “SC 25” by “SC 22, SC 25” for steel grade 12X1MF;

for steel grade 15XM, introduce strength class SC 35 to GOST 8479-70;

for steel grades 34XM, 34XMA, introduce strength class SC 35A:

SC 35 A	L	345 (35)	570 (58)	17	40	49 (5.0)	174-217	500

for steel grade 13X16H3B, introduce strength class SC 70A:

SC 70 A	T	680-880 (68-90)	880 (90)	13	30	39 (5.0)	255-285	150

for steel grade 35XM, introduce strength classes SC 60, SC 60 A, SC 70, SC 75:

SC 60	L	590-735 (60-75)	735 (75)	14	45	59 (6.0)	235-277	150
SC 60 A	L	590 (60)	785 (80)	14	40	49 (5.0)	241-277	100
SC 70	L	675-835 (70-85)	835 (85)	13	42	59 (6.0)	262-311	120
SC 75	L	785-880 (75-90)	880 (90)	13	40	59 (6.0)	277-321	100

for steel grades 34XH1M, 34XH1MA, introduce strength class SC 80:

SC 80	L	785-930 (80-95)	930 (95)	12	40	59 (6.0)	294-331	140

In table 5, in the row for steel grade 15X12VMF, replace HB 229-235 by HB 235-277.

Insert note 5:

“5. For compressor and booster discs, mechanical property rates in the table are given for tangential specimens, with the following upper yield limit:

for steel grade 34XMA SC50 $\sigma_{0.2}$ = 50-70;

for steel grade 34XH1MA SC70 $\sigma_{0.2}$ = 70-93;

for steel grades 34XH1MA, 34XH3MA SC75 $\sigma_{0.2}$ = 75-96.”

Insert note 6:

"6. Forgings of steel grade 35XM in strength classes SC 70 and SC 75, and of steel grades 34XH1M and 34XH1MA in strength class SC 80 shall be manufactured upon agreement between manufacturer and customer".

Insert note 7:

"7. Forgings of steel grades 08X18H10T, 12X18H9T, 12X18H10T shall be supplied upon agreement with manufacturer, with additional hardness (HB 131-170) and impact resilience (at least 88 J/mm^2) rating".

Paragraph 1.13. Insert sentence:

"For forgings of compressor and booster discs, referred to in note 5 to table 5, no lowering of mechanical property rates on tangential specimens shall be allowed".

Paragraph 3.3. Add references to GOST 12351-81, GOST 12354-81, GOST 12361-82.

Paragraph 3.8. The word "templates shall be sampled" shall be followed by words: "…and flaw type shall be identified…", further unamended.

First deputy head ofMain technologydepartment of the Ministry of Power Engineering *signed Feb 02, 89* V.P. Kuchumov

Head of quality economy, standardization, benchmarking, metrology department	*signed*	A.N. Poltaretskiy
Deputy CEO of research and production concern for machine building technology	*signed*	V.P. Borisov
Head of industry department for metrology and standardization	*signed*	B.P. Grigoriev
Head of materials technology department	*signed*	G.A. Tulyakov
Head of industry laboratory for metal and blank Aleksandrov regulations	*signed*	V.P.
Executive in charge	*signed*	L.K. Pirogova
Assistant executive:		
CTO ofV.I. Lenin Nevsky Plant production group	*signed*	K.B. Sarantsev
Deputy Chief Metallurgist	*signed*	V.N. Tokarev
Acting head of standardization department	*signed*	Y.M. Pavlov

VALIDATED by:

Chief technology officer of Leningrad Metal Plant production group for turbine construction
signed Dec 12, 88
I.S. Shmarin

CEO of I.I. Polzunov research and production group for research and design of power plant equipment
signed
V.K. Ryzhkov

Group V03

AMENDMENT No. 2 to OST 108.958.04-85
"GENERAL-PURPOSE FORGINGS FOR TURBINES AND COMPRESSORS. SPECIFICATION"

OKP 41 2100

Stamp: Oct 25, 91

Approved and enacted bydirective of the Ministry of power engineering dated Oct 21, 91 No. 3-3333/129.

Stamps *(illegible)* Enacted on: Dec 01, 91

The validity term of the standard be extended till Jul 01, 96.

Paragraph 1.7. Insert the following sentence in the first item: "In case of steel processing in a ladle refiner and degasser (LRD), the cumulative content of sulfur and phosphor may be limited to the following values, if so required by customer: for steel grades covered by GOST 5632, and steel grades 06X12H3D, 10X12HD, 13X16H3B – max. 0.035%, for other steel grades – max. 0.025%".

Table 2. For steel grade 20XH3MFA, in the "carbon" column, replace the value "0.20-0.25" by "0.18-0.23".

Table 5. Add strength class SC40 in the row for steel grade 15X1M1F with the following mechanical property rates determined in longitudinal specimens: $\sigma_{0.2}$ = 390-590 (40-60), σ_v n.m. = 590 (60), δn.m. 14, ψ n.m. 40, KCU n.m. 39 (4.0), HB = 170-217; maximum blank thickness – 300 mm.

Row SC 50 for steel grades 34XH1M, 34XH1MA. In the "Hardness" column, replace the value "217-248" by "212-248".

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Paragraph 2.8. In the second sentence, the words "…but at least…" shall be followed by "…two templates of each melt from the same end corresponding to the top of the ingot", further unamended.

Paragraph 2.9. Words "re-tested" shall be followed by "and heat-treated repeatedly, if required", further unamended.

Director of technology department of Tyazhenergomash Group	seal (*illegible*)	*signed* *Oct 14, 91*	N.D. Sheglovitov
Deputy CEO of research and production concern for machine building technology		*signed*	V.P. Borisov
Head of industry department for metrology and standardization		*signed*	B.P. Grigoriev
Head of materials technology department		*signed*	G.A. Tulyakov

VALIDATED by:

Chief technology officer of V.I. Lenin Nevsky Plant production group
seal *signed* *(illegible)*

Chief technology officer of Leningrad Metal Plant production group for turbine construction
signed Jun 18, 91
A.D. Balashov

CEO of I.I. Polzunov research and production group for research and design of power plant equipment
12/46z dated Jan 18, 91
V.K. Ryzhkov