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Order of CKTI No. 23-TK/4998 dated September 25, 95

INDUSTRY STANDARD

BLANKS OF ROTORS AND DISCS OF STATIONARY GAS TURBINES AND COMPRESSORS. SPECIFICATION

OST 108.961.05-80

Official edition

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APPROVED AND ENACTED BY Directive of the Ministry of Power Engineering dated September 26, 1980 No. 10K-602/7902.

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UDM 669.14-412 Group V03

INDUSTRY STANDARD

BLANKS OF ROTORS AND DISCS OF STATIONARY GAS TURBINES AND COMPRESSORS. SPECIFICATION.

OKP 08 93009500 OST 108.961.05-80

Enacted originally by

Directive of the Ministry of Power Engineering dated September 26, 1980 No. 10K-602/7902

Term of validity: from Jan 01, 82 to Jan 01, 87

Failure to comply with the standard is subject to legal prosecution.

This standard shall apply to blanks of rotors, discs and parts of rotors of stationary gas turbines and axial compressors.

The standard shall not apply to blanks of welded rotors.

Stamp: STATE COMMITTEE FOR STANDARDIZATION
USSR Council of Ministers
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1. BASIC PARAMETERS AND DIMENSIONS. MATERIALS

1.1. Blanks of rotors for stationary gas turbines and axial compressors are made by forging of ingots weighing up to 65 tons; blanks of discs with a hub height up to 500 mm – also by forging of ingots weighing up to 18 tons.

1.2. Materials for rotor and disc blanks shall be chosen pursuant to this standard. Recommended steel grades and their maximum operating temperatures are shown in table 1.

Table 1

Steel class	Steel grade	Max operating temperature, ºC
Pearlitic	34XH1MA, 34XH3MA, 35XH3MFA, 35XH1M2FA, 27XH3M2FA, 30XH3M2FA, 25X2H4MFA	350
	25X1M1FA (R2MA)	530
	20X3MVF (EI 415)	545
Martensitic-ferritic	18X11MHF6 (EI 291)	550
Martensitic	20X12VHMF (EP 428)	580
Austenitic	31X19H9MV6T (EI 572)	600
	10X11H23T3MR (EP 33, EI 696I)	650

2. TECHNOLOGICAL REQUIREMENTS

2.1. Blanks of rotors and discs for gas turbine and axial compressors shall be manufactured pursuant to the requirements of this standard and of drawings prepared by the manufacturer upon customer’s detail drawings, and validated by the latter.

2.2. Detail drawings of rotor and disc blanks shall specify:

steel grade;

strength class;

designation of this standard;

specific requirements.

In addition, detail drawings of rotors shall specify:

most stressed end of rotor;

locations of bearings.

Blank drawings shall specify the sampling allowances for tests described herein (mechanical test, residual stress test, etc.), and points of non-destructive control and sulfur printing.

2.3. Blank (forging) manufacturing process shall be designed by the manufacturer upon requirements contained in this standard.

2.4. Steel for rotor and disc blanks shall be melted in an acid Martin furnace or in a basic electric arc furnace. The manufacturer may use processing in ladle refiners and degassers (LRD), and degassing while casting. Upon agreement between the manufacturer and the customer, the following may be used:

steel melting in vacuum-induction furnaces;

electro slag remelt (ESR) and vacuum-arc remelt (VAR);

vacuum carbon deoxidation.

When melting pearlitic steel in a basic electric or acid Martin furnace for rotors of over 500 mm diameter, and discs with a hub height in excess of 300 mm, hydrogen content in the ladle sample shall be measured. The findings are not included in the handover documentation, but shall be included in the blank's datasheet.

2.5. Chemical composition of steels shall meet the requirements of table 2.

2.6. Location of rotor blanks in relation to the ingot top shall be decided by the manufacturer, subject to the blank's configuration and weight, convenience of melting and heat treatment, and orientation of most stressed end of the blank.

2.7. When manufacturing rotor and disc blanks, all operations related to melting, forging and heat treating shall be made by the same facility.

As an exception, several operation may be cooperated upon agreement between the manufacturer and the customer, subject to the consent of Ministry of Power Engineering.

2.8. Rotor and disc blanks shall be supplied after final heat treatment and pre-machining. Eventually, upon agreement between the parties, final heat treatment is allowed without pre-machining.

Note. Upon agreement between the manufacturer and the customer, heat treatment of rotor blanks without axial canal is allowed, with subsequent trepanning along the axle and mechanical testing of trepanned samples on longitudinal specimens. Normal values of mechanical properties of trepanned samples shall be agreed between the manufacturer and the customer.

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Table 2

Steel grade	Mass fraction of the element, %											
	carbon	silicon	manganese	sulfur	phosphor	copper	chrome	nickel	molybdenum	tungsten	vanadium	other elements
				max								
34XH1MA	0.30-0.40	0.17-0.37	0.50-0.80	0.022	0.025	0.25	1.30-1.70	1.30-1.70	0.20-0.30	-	-	-
34XH3MA	0.30-0.40	0.17-0.37	0.50-0.80	0.022	0.025	0.25	0.70-1.10	2.75-3.25	0.25-0.40	-	-	-
35XH3MFA	0.30-0.39	0.17-0.37	0.25-0.50	0.022	0.025	0.20	1.10-1.40	2.75-3.25	0.30-0.40	-	0.08-0.15	-
35XH1M2FA	0.32-0.40	0.17-0.37	0.50-0.80	0.022	0.025	0.25	1.30-1.70	1.30-1.70	0.40-0.60	-	0.10-0.20	-
27XH3M2FA	0.24-0.30	0.17-0.37	0.20-0.45	0.020	0.020	0.30	1.35-1.75	3.25-3.75	0.45-0.60	-	0.08-0.18	-
30XH3M2FA	0.26-0.32	0.17-0.37	0.20-0.50	0.022	0.025	0.25	1.20-1.70	3.00-3.50	0.40-0.65	-	0.10-0.20	-
25X2H4MFA	0.21-0.29	0.17-0.37	0.25-0.55	0.020	0.025	0.25	1.60-1.90	3.30-3.70	0.35-0.60	-	0.10-0.20	-
25X1M1FA (R2MA)	0.21-0.29	0.17-0.37	0.30-0.60	0.022	0.025	0.20	1.50-1.80	up to 0.40	0.90-1.05	-	0.22-0.32	-
20X3MVF (EI 415)	0.17-0.24	0.17-0.40	0.25-0.?0	0.022	0.025	0.25	2.40-3.30	up to 0.50	0.35-0.55	0.30-0.50	0.60-0.85	-
18X11MNFB (EP 291)	0.15-0.21	up to 0.60	0.?0-1.00	0.025	0.030	-	10.00-11.50	0.50-1.00	0.80-1.10	-	0.20-0.40	niobium 0.20-0.45
20X12VNMF (EP 428)	0.17-0.23	up to 0.60	0.50-0.90	0.025	0.030	-	10.50-12.50	0.50-0.90	0.50-0.70	0.70-1.10	0.15-0.30	-
31X19H9MVBT (EI 572)	0.28-0.35	up to 0.60	0.80-1.50	0.020	0.030	0.30	18.00-20.00	9.00-11.00	1.00-1.50	1.00-1.50	-	titanium 0.20-0.50 niobium 0.20-0.50

Steel grade	Mass fraction of the element, %											
	carbon	silicon	manganese	sulfur	phosphor	copper	chrome	nickel	molybdenum	tungsten	vanadium	other elements
				max								
10XIIH23T3MP (EP 33, EI 696M)	up to 0.10	up to 0.60	up to 0.60	0.010	0.025	-	10.00-12.50	21.00-25.00	1.00-1.60	-	-	titanium 2.60-3.20 aluminum up to 0.80 boron up to 0.02

Notes:

1. When steel is made by remelting, an index shall be added to the grade designation – S for electroslag remelt, VA for vacuum-arc remelt.
2. Minor variances from the prescribed chemical composition, with the exception of sulfur, phosphorus, and the lower threshold of molybdenum for pearlitic steels may be tolerated upon permission of the manufacturer's chief metallurgist.
3. For pearlitic steels melted in acid Martin furnaces or in electric furnaces, silicon variance is tolerated up to +0.05%.
4. Aggregate content of sulfur and phosphorus in steel grades 34XH1MA, 34XH3MA, 25X1MFA (R2MA) shall not exceed 0.04%.
5. For VAR steel, manganese variance of ±0.15% is tolerated; for ESR steel – silicon variance of -0.05%. For ESR steel, sulfur content shall not exceed 0.015%.
6. For vacuum carbon deoxidated steel, silicon content of up to 0.1% is tolerated.
7. Maximum hydrogen content in degassed rotor and disc blank metal shall not exceed $3 cm^3/100$ g.

2.9. Final heat treatment shall follow the procedure prescribed by the manufacturer and validated by the head metal technology organization, and shall ensure the rate of mechanical properties meeting the requirements of table 3.

2.10. The designation of the blank (forging) shall contain the strength class (SC) and the reference to this standard, for example:

SC 65 OST 108.961.05-80.

2.11. When tested cold for bend to the prescribed bend angle, the specimen's surface shall be free from cracks, scabs, and laminations.

2.12. No flaw shall be allowed on the surface of rotor and disc blanks, if their removal depth exceeds 2/3 of the rated one-side customer mechanical finish allowance.

After heat treatment, a customer mechanical finish allowance of at least 3 mm per side shall be left in cut points.

No flaw is allowed on finished surfaces of working necks and bearing fit points on rotors, and of disc hub holes.

2.13. The etched surface of rotor and disc blanks shall be free of cracks, flakes, porosity, shrinkholes, big non-metallic inclusions, or accumulations of small inclusions, folds, scabs, and foreign matters. No chain-type position of inclusions is allowed.

Notes:

1. A big non-metallic inclusion is an inclusion sized over 2 mm.
2. An accumulation of non-metallic inclusions is a group of flaws not exceeding 1 mm in size, in a number exceeding 10, with spaces between them not exceeding 5-time size of the biggest flaw.

Table 3

Steel grade	Intended use	Strength class	Test temperature, ºC	Position of specimen	Conventional 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)	Bending angle, degrees
						min.				
34XH1MA	Rotors	SC50	20	L	490-687 (50-70)	638 (65)	15	40	5.9 (6.0)	150
				T	462-687 (47-70)	608 (62)	11	32	4.4 (4.5)	120
		SC60	20	L	589-785 (60-80)	706 (72)	15	40	5.9 (6.0)	150
				T	559-785 (57-80)	667 (68)	11	32	4.4 (4.5)	120
		SC70	20	L	687-883 (70-90)	853 (87)	14	40	5.9 (6.0)	150
				T	667-834 (68-85)	814 (83)	11	32	4.4 (4.5)	120
	Discs	SC50	20	T	490-687 (50-70)	657 (67)	15	40	4.9 (5.0)	150
		SC60	20	T	589-785 (60-80)	765 (78)	14	40	4.9 (5.0)	120
		SC70	20	T	667-834 (68-85)	814 (83)	12	40	4.9 (5.0)	120
34XH3MA	Rotors	SC70	20	L	687-883 (70-90)	853 (87)	14	40	5.9 (6.0)	150
				T	667-834 (68-85)	814 (83)	11	32	4.4 (4.5)	120
	Discs	SC70	20	T	667-834 (68-85)	814 (83)	12	40	4.9 (5.0)	120

Table 3 (continued)

Steel grade	Intended use	Strength class	Test temperature, ºC	Position of specimen	Conventional 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)	Bending angle, degrees
						min.				
35XH3MFA	Rotors	SC70	20	L	678-834 (70-85)	804 (82)	14	40	5.9 (6.0)	150
				T	678-834 (70-85)	804 (82)	12	30	4.9 (5.0)	120
35XH1M2FA	Rotors	SC65	20	L	638-834 (65-85)	804 (82)	14	40	5.9 (6.0)	150
				T	638-834 (65-85)	765 (78)	11	32	4.4 (4.5)	120
	Discs	SC70	20	T	667-834 (68-85)	814 (83)	12	40	4.9 (5.0)	120
27XH3M2FA	Rotors	SC65	20	L	667-834 (68-85)	853 (87)	14	40	5.9 (6.0)	150
				T	667-834 (68-85)	814 (83)	11	32	4.4 (4.5)	120
	Discs	SC70	20	T	667-834 (68-85)	814 (83)	11	32	4.4 (4.5)	120
30XH3M2FA	Rotors, discs	SC70	20	T	687-834 (70-85)	834 (85)	12	35	5.9 (6.0)	120
25X2H4MFA	Rotors, discs	SC70	20	T	667-834 (68-85)	814 (83)	12	40	4.9 (5.0)	120
25X1M1FA (R2MA)	Rotors, discs	SC60	20	L	608-736 (60-75)	716 (73)	16	40	3.9 (4.0)	180
				T	608-736 (60-75)	716 (73)	13	35	3.9 (4.0)	150
	Discs	SC60	500	T	≥440 (45)	-	-	-	-	-

Table 3 (continued)

Steel grade	Intended use	Strength class	Test temperature, ºC	Position of specimen	Conventional 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)	Bending angle, degrees
						min.				
20X3MVF (EI 415)	Rotors	SC60	20	L	589-736 (60-75)	736 (75)	13	40	4.9 (5.0)	150
				T	589-736 (60-75)	716 (73)	11	32	3.9 (4.0)	120
			400	T	539 (55)	-	-	-	-	-
	Discs	SC70	20	T	657-795 (67-81)	785 (80)	13	40	4.9 (5.0)	120
			550	T	≥392 (40)	-	-	-	-	-
18X11MNFB (EP 291)	Rotors	SC50	20	L	490-638 (50-65)	687 (70)	16	40	4.9 (5.0)	-
				T	490-638 (50-65)	687 (70)	13	35	3.9 (4.0)	-
			550	T	≥353 (36)	-	-	-	-	-
	Discs	SC80	20	T	≥785 (80)	883 (90)	10	30	2.5 (2.5)	-
20X12VNMF (EP 426)	Rotors	SC60	20	L	589-736 (60-75)	785 (80)	15	35	4.4 (4.5)	180
				T	589-736 (60-75)	755 (77)	14	32	3.9 (4.0)	150
	Discs	SC65	20	T	635-785 (65-75)	785 (80)	14	35	4.9 (5.0)	150
			550	T	≥392 (40)	-	-	-	-	-

Table 3 (continued)

Steel grade	Intended use	Strength class	Test temperature, ºC	Position of specimen	Conventional 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)	Bending angle, degrees
						min.				
31X19H9MVBT (EI 572)	Rotors, discs	SC35	20	P	343 (35)	667 (68)	25	25	5.9 (6.0)	-
				T	343 (35)	667 (68)	20	20	4.9 (5.0)	-
	Discs		600	T	245 (25)	-	-	-	-	-
10X11H23T3MP (EP 33, EI 696M)	Discs	SC75	20	T	736 (75)	1079 (110)	14	15	-	-

Notes:

1. L – longitudinal specimen; T – tangential specimen.
2. Acceptance measurements for rotors include: yield limit, relative contraction, impact resilience, and bend test. Variance of hardness values for points around the circumference of the rotor barrels shall not exceed 294 MPa (30 Brinell units), and 392 MPa (40 Brinell units) along the length.
3. Acceptance measurements for discs include: yield limit, relative contraction, impact resilience, bend test. Hardness number variance between the rim and the hub shall not exceed 343 MPa (35 Brinell units), and between individual points of the rim or of the hub shall not exceed 294 MPa (30 Brinell units).
4. Hardness test shall only be conducted to check the evenness of the blank heat treatment, while absolute hardness values are not included in the acceptance measurements.
5. When specified in the drawing, the conventional yield limit shall be measured at higher temperatures. The test temperature and the yield limit value shall be specified in the detail drawing. This measurement is not an acceptance value, however, it shall be listed in the blank’s datasheet.

3. A chain of non-metallic inclusions is a group of flaws 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.
4. Any disputable question regarding macrostructure flaws shall be settled by agreement between the manufacturer and the customer.

2.13.1. On the etched surface of rotor and rotor part blanks, on any 25 cm^2 area, no single non-metallic inclusion, sized up to 1 mm, in a number exceeding 5; or sized up to 1.5 mm, in a number exceeding 2, shall be allowed; on any etched area, the number of such flaws shall not exceed 15. No flaw sized under 0.4 mm shall be taken into account, unless they are positioned in an accumulation or in a chain.

2.13.2. On the etched surface of disc blanks, no single non-metallic inclusion, sized up to 2 mm inclusive, in a number exceeding 15, shall be allowed. No non-metallic inclusion sized under 1 mm shall be taken into account, unless they are positioned in an accumulation or in a chain.

2.14. The surface of rotor channel subjected to periscopic inspection shall be free of cracks, flakes, scale, residual shrinkage porosity, major non-metallic inclusions, accumulations of non-metallic inclusions, or inclusion chains. No single non-metallic inclusion sized up to 1.5 mm inclusive, in a number exceeding 25, or sized between 1.5 and 3 mm inclusive, in a number exceeding 10, shall be allowed.

Accumulations of small non-metallic inclusions sized up to 1.5 mm inclusive, in a number exceeding 10, on an area up to 60 cm^2, shall not be allowed.

No single non-metallic inclusion sized under 1 mm shall be taken into account.

Notes:

1. A major non-metallic inclusion is an inclusion sized over 3 mm.
2. On the surface of GTT-3 turbine rotor channel, made of EP 428 steel grade, additional single non-metallic inclusions sized between 3 and 5 mm inclusive, in a number up to 5, are allowed.
3. Flaws sized beyond the above rates shall be allowed upon agreement between the manufacturer and the customer.

2.15. If necessary, local peeling or overall reboring of the rotor blank channel is allowed. In case of reboring, any variance from the dimensions stated on the drawing shall be approved by the customer.

2.16. Sulfur prints taken from outer surfaces of rotor blanks as per the drawing shall match the first three points, and of discs – the first two points of four-point scales No.1 and No.2 NKMZ.

Sulfur prints taken from blanks made of ingots weighing up to 25 tons shall be assessed on scale No.1, and of ingots weighing over 25 tons – on scale No. 2.

2.17. Ultrasonic test (UST) shall not detect in the metal of rotor and disc blanks any crack, flake, residual shrinkage porosity, as well as individual flaws and segregates of which conventional dimensions, as compared to the reference (flat reflectors), and the number exceed the normal rates referred to in 2.17.1 and 2.17.2below.

Note.

Any variance from the rates referred to in 2.17.1 and 2.17.2 below for blanks made of austenite steels with low sounding ability, and for discs without hub hole, shall be agreed between manufacturer and customer.

2.17.1. In the metal of rotor blanks, the following shall not be allowed:

flaws with equivalent diameter of 2 to 4 mm inclusive, in a total number over 30, including over 10 on the barrel, with spaces between individual flaws being less than 50 mm;

single flaws with equivalent diameter of 2 to 4 mm inclusive, positioned on both ends of the blank, at a space of less than 50 mm, if aligned parallel to the axle; less than 30 mm, if lying on the same circumference; and less than 15 mm, if lying on the same radial direction or distributed randomly;

accumulations of flaws detected when setting the instrument to the reference hole of 2 mm Ø.

Notes:

1. Individual single flaws sized below 2 mm shall not be taken into account.
2. A flaw shall be deemed single, if the space exceeds its three-time indication length.
3. An accumulation of flaws is their mutual arrangement, such that when setting the instrument to the butt bottom of the reference hole of 2 mm Ø, positioned at the same depth as the flaws, the space between the latter does not exceed three-time indication length of a single flaw.

2.17.2. In the metal of disc blanks, the following shall not be allowed:

in the volume of the disc hub – flaws with equivalent diameter of 2 to 4 mm inclusive, in a number over 10, with spaces between them below 30 mm, including over 5 of the said 10 flaws with a space between them being below 25 mm, if lying on the same radius;

in the volume of the disc body – single flaws with equivalent diameter of 2 to 3 mm inclusive, in a number over 10, with spaces between them below 50 mm, if lying on the same radius, and below 20 mm, if distributed randomly; or flaws with equivalent diameter of 2 to 4 mm inclusive, in a number over 8, with spaces between them below 50 mm;

accumulations of flaws detected when setting the instrument to the reference hole of 2 mm Ø.

Notes:

1. Individual single flaws sized below 2 mm shall not be taken into account.
2. A flaw shall be deemed single, if the space exceeds its three-time indication length.
3. An accumulation of flaws is their mutual arrangement, such that when setting the instrument to the butt bottom of the reference hole of 2 mm Ø, positioned at the same depth as the flaws, the space between the latter does not exceed three-time indication length of a single flaw.

2.18. Should the ultrasonic control detect any flow beyond the above normal rates, the blank's acceptability shall be negotiated between manufacturer and customer.

2.19. Residual stresses in rotor blanks after final heat treatment shall not exceed 49 MPa (5 kgf/mm^2).

Rotor blanks with a barrel diameter below 400 mm shall not be controlled for presence of residual stresses.

Subject to the disc diameter (according to the detail drawing), values of residual stresses after final heat treatment shall be as follows:

for discs with a diameter between 600 and 1,000 mm – 39 MPa (4 kgf/mm^2) or below;

for discs with a diameter over 1,000 mm – 49 MPa (5 kgf/mm^2) or below.

Disc blanks with a diameter below 600 mm shall not be controlled for residual stresses.

2.20. Heat tests of rotor blanks shall be conducted by the customer. If any elastic deflection is detected at exposure to a maximum temperature, which is bigger than specified in the drawing, or any residual deflection is detected after cooling, the blank shall be subjected to an additional tempering at the customer's facility, at a temperature lower than the primary tempering temperature, after which it shall be subjected to a repeated heat test.

2.21. Blank delivery weight is the weight calculated by the manufacturer based on nominal dimensions stated in the delivery drawing.

3. ACCEPTANCE RULES

3.1. Blanks of rotors and discs of gas turbines and axial compressors are classified as forgings subject to one-by-one acceptance using the control methods referred to herein.

3.2. Manufacturer's quality control department shall be responsible for the acceptance of blanks pursuant to the requirements of this standards and of the drawing, upon:

visual examination, dimension and labelling check;

chemical analysis of the metal;

mechanical and hardness tests;

bend tests;

residual stress measurements;

macrostructure control;

ultrasonic control;

periscopic control (for rotors only).

4. TEST METHODS

4.1. Surface of rotor and disc blanks shall be subjected to visual examination. Doubtful areas can be additionally peeled, etched, and inspected using a magnifying lens.

4.2. Dimensional control of rotor and disc blanks shall be done using an all-purpose meter.

4.3. Chemical composition of the rotor and disc blanks' metal shall be defined on a melt sample to GOST 7565-73.

Chemical analysis shall follow the procedures described in GOST 20560-75, GOST 12344-78, GOST 12345-66, GOST 12346-78, GOST 12347-77, GOST 12348-78, GOST 12349-66, GOST 12350-78, GOST 12351-66, GOST 12352-66, GOST 12354-66, GOST 12355-78, GOST 12356-66, GOST 12357-66, GOST 12361-66, and GOST 18895-73.

Chemical composition of ESR- and VAR-melted steel shall be estimated in the original electrode melt, except for manganese content in VAR melt, which shall be estimated after VAR in samples taken from mechanical test samples corresponding to the topside of the ingot.

In the ESR metal, carbon and vanadium contents shall be defined in mechanical test blanks, findings are not included in the acceptance checklist, but shall be listed on the blank's datasheet.

4.4. Samples for mechanical testing shall be cold-cut out of blank allowances after final heat treatment, from areas specified on blank drawings. The following requirements shall apply:

4.4.1. For rotors:

section of sample allowances on blank ends shall not differ from the blank's section in the allowance fit area. The sample allowance on the rotor barrel shall be the barrel's full-sized lengthwise extension. Section of the longitudinal sample may be reduced to the section of the bearing's neck (working neck);

longitudinal specimens shall be cut out of:

both ends of the blank, at a distance from the blank surface equal to one third of its radius;

tangential specimens shall be cut out of the rings taken from the barrel's end; from rotor blanks with a barrel over 1000 mm long, rings shall be cut from both ends of the barrel. In case of any retesting, specimens can be made out of rings lying deeper;

from each longitudinal sample the following shall be made: one specimen for tensile test, one for bending test, and two specimens – for impact test; from each rotor barrel ring – two specimens for tensile test, two specimens for impact test, and one specimen for bend test. Specimens for tensile and impact tests shall be cut out of diametrically opposite areas.

Note:

Upon agreement between manufacturer and customer, mechanical tests can be conducted on longitudinal or on tangential specimens only.

4.4.2. For discs:

from disc blanks with a hub hole finish diameter above 250 mm, sample shall be taken from the inner part of the hub. In case the hub hole finish diameter is below 250 mm, sample shall be taken from the hub butt, or from the outer side of the hub. From disc blanks of SC70 and above, with the hub height of 400 mm and above, an additional sample shall be cut out of the middle third of the hub height. When discs are made without any central hole, sampling points shall be agreed between manufacturer and customer;

from disc blanks with a hole diameter above 250 mm, the following shall be cut out of each sample for mechanical testing: two specimens for tensile test, two for impact test, and one for bend test. From disc blanks of SC70 and above, with the hub height of 400 mm and above, two additional specimens shall be cut for impact test. From disc blanks with a hole diameter below 250 mm, the following shall be cut: one specimen for tensile test and two for impact test. Specimens for tensile and impact tests shall be cut out of diametrically opposite areas.

4.4.3. Should the yield limit be measured at high temperatures, an additional tensile test specimen shall be cut out of the sample.

4.5. Pull test shall be conducted to GOST 1497- on cylindrical specimens of type III No.4, specimens of type III No.6 are allowed as well. Yield limit at high temperatures shall be measured to GOST 9651-73 on 4K specimens; specimens of type 2K and 3K are also allowed.

Impact tests shall be conducted to GOST 9454-78 on KCUI specimens.

4.6. Hardness of rotor blanks shall be determined on each end part in one point, and in the locations of sample rings on the barrel in two diametrically opposite points.

Hardness of disc blanks shall be tested in two diametrically opposite points on the rim, and in one point on each butt.

4.7. Hardness shall be tested to GOST 9012-59. Should it be impossible to measure the hardness on the blank itself, measurement can be made on rings cut for mechanical test or for residual stress test. Hardness can be measured with portable instruments, if so agreed between manufacturer and customer.

4.8. Should the detected mechanical properties of rotor and disc blanks fail to meet acceptance requirements, the failed test shall be repeated on a doubled number of respective specimens.

Should the repeated test fail in at least one specimen, the rotor or disc blank shall not be accepted, but can be subjected to a repeated heat test and re-submitted for acceptance. The number of heat treatments shall not exceed two in case of tempering, and three in case of normalizing. An additional tempering shall not be deemed a repeated heat treatment.

After repeated heat treatment and additional tempering, all mechanical tests shall be conducted in full.

4.9. The bend test shall be conducted cold to GOST 14019-68 in specimens sized 10x20x160 mm. Edges of the specimen shall be rounded with a radius of about 1 mm.

When being tested, the specimen shall touch the holder of 40 mm diameter with its wide side (20 mm).

4.10. Rotor blanks shall be tested for presence of residual stresses.

4.10.1. In rotor blanks, rings shall be cut out of the allowance on the barrel, on the maximum diameter side.

In disc blanks, rings shall be cut out of the hub; in disc blanks with a hub higher than 400 mm – out of the rim and the hub. It is allowed to conduct the residual stress control on rings cut for mechanical testing.

4.10.2. Residual stresses shall be measured by measuring the deformation of rings cut with a section of 25x25 mm. Residual stresses shall be calculated by measuring the ring diameter in at least six points before and after cutting the ring using the formula:

$$\sigma_r = 2 \times 10^5 \frac{D_o - D_I}{D_o} \text{ MPa}$$

where:

D_o is the ring's mean outer (inner) diameter before being cut;

D_I is the ring's mean outer (inner) diameter after being cut.

Upon agreement between manufacturer and customer, residual stresses can be measured by a strain meter, using a procedure validated by the head meta technology organization.

4.10.3. Residual stress control shall be conducted by the manufacturer on one disc from a batch subjected to simultaneous heat treatment in the same charge, and in disc blanks with a hub higher than 400 mm – on each disc blank. The customer shall test every disc. Upon agreement between the parties, one-by-one disc control can be conducted by the manufacturer.

4.10.4. Should residual stresses exceed the permissible value, retesting of the same disc, on a newly cut ring, shall be allowed. If the result of the repeated test is unsatisfactory again, the whole batch of disc blanks shall be tested one-by-one for residual stresses. Discs with residual stresses detected in excess of permissible values, shall be subjected to additional stress relieving with subsequent control of residual stresses.

4.11. Rotor and disc blanks shall be subjected to macrostructure control. Macrostructure control shall be conducted by etching and sulfur print taking in areas specified on the delivery drawing, on surfaces with roughness not exceeding R_a 1.25 μm.

Etching shall be done twice: first, by the manufacturer after pre-machining and final heat treatment, and second, by the customer after machining, subject to an allowance within 2 mm per side.

The etched surface shall be inspected twice: 10 minutes after etching and at least 12 hours after etching.

No sulfur prints shall be taken from surfaces of austenite steel blanks.

4.11.1. Rotor necks, barrel butts and fillets of barrel-to-neck shoulders, and also one span between discs, subject to a slot of at least 150 mm, shall be subjected to etching.

Sulfur prints shall be taken from rotor neck and barrel butt surfaces on an at least 90 mm wide strip. Findings of butt sulfur print testing shall be included in the handover checklist.

4.11.2. In disc blanks, surfaces of hub holes and of both butts of the hub shall be etched. Manufacturer may etch one side of the hub.

Sulfur prints shall be taken from hub hole surfaces and from both butts of the hub. If allowed by the hub's geometrical dimensions, the sulfur print strip shall be at least 90 mm wide. Manufacturer shall be taken to half of the hub height; customer – to the full height. Sulfur prints shall be taken from the hub butt surfaces to the full width. Sulfur prints of a disc blank with a hub higher than 450 mm shall be taken by manufacturer from the hub hole surface on four diametrically opposite surfaces to half height of the hub.

Note.

Etching and sulfur printing areas on disc blanks without central hole shall be specified in the drawing and agreed between manufacturer and customer.

4.11.3. Etching and sulfur printing shall follow the procedure prescribed by manufacturer.

4.12. To detect internal flaws, each rotor and disc blank shall be subjected to ultrasonic control (USC).

4.12.1. Should the rotor blank be subjected to heat treatment without prior slot cutting on the barrel, the USC shall be conducted on the barrel and necks once after heat treatment.

4.12.2. Should the rotor blank be subjected to normalizing after slot cutting, the USC shall be conducted on the barrel and necks once before heat treatment. Repeated control after final heat treatment is allowed.

4.12.3. For rotor blanks subjected to hardening after slot cutting, the USC shall be conducted twice: before hardening on the barrel and necks, and after hardening and stress relieving on the necks only.

4.12.4. Disc blanks shall be subjected to USC by manufacturer throughout the full volume of the hub. If the hub is lower than 250 mm, the control shall be conducted on one side, in case the hub is higher – on both sides. The customer shall conduct USC of disc blanks throughout their full volume, according to the list approved by the Ministry of power engineering (rim, body and hub).

Note.

The scope of USC for discs without central hole shall be agreed between manufacturer and customer.

4.12.5. Roughness of the surface subjected to USC shall not exceed R_a 2.5 μm.

4.12.6. Ultrasonic control of disc and rotor blanks shall follow the CNIITmash procedure agreed with manufacturers and customers.

4.13. Rotor channel surface shall be controlled by periscopic inspection with a double or lesser magnification, on a surface with roughness not exceed R_a 2.5 μm, according to manufacturer's procedure.

4.14. Heat tests of rotor blanks shall be conducted to technical guidelines RTM 24.021.02 after final machining. Additional heat test can be conducted after final machining.

5. DOCUMENTATION

5.1. Each rotor and disc blank shall be supplied to customer with a quality certificate (datasheet) attached, which shall specify:

name of manufacturer;

heat number (for ESR and VAR metal – original heat number and ESR/VAR heat number);

blank number;

order number;

manufacturer’s drawing number;

designation of this standard;

steel grade;

melting and teeming method;

chemical composition of the material;

hydrogen content in the ladle sample (for pearlitic steel blanks);

mechanical test data (specifying the specimen type) and hardness measurements;

bend test data;

macrostructure control data;

ultrasonic control data;

residual stress values;

periscopic inspection data (for rotors);

weight of ingot and weight of blank;

details of heat treatment and repeated heat treatment;

details of rotor blank leveling.

The datasheet containing a blank operability report shall be signed by head of manufacturer’s quality control department.

5.2. When manufacturing and controlling the quality of rotor and disc blanks, the following control and technical documentation shall be kept in respect of:

melting process control;

metal’s chemical composition control;

forging process control;

heat treatment process control;

mechanical properties control;

flaw detection control.

The type and form of the documents shall be established by the manufacturer.

6. MARKING, PACKAGING AND TRANSPORT

6.1. Rotor and disc blanks made under this standard pursuant to the drawing, shall have the following marking: drawing number, blanc number, heat number, and for ESR and VAR metal – original heat number and VAR/ESR heat number, ingot number, order number.

6.2. The accuracy of the marking and conformity of blanks' quality to the requirements of this standard shall be certified with the quality control stamp. The marking area shall be outlined with light indelible paint. On rotor blanks, the marking shall be made on the butt corresponding to the bottom side of the ingot; on disc blanks, the marking shall be made on the hub.

6.3. Rotor and disc blanks shall be shipped to the customer pursuant to a supply contract.

6.4. Rotor and disc blanks shall be transported by any vehicle, without special package, on an open platform. Terms of blank transportation shall ensure their safety against mechanical damage and corrosion.

6.5. Surface of rotor blank's axial channel shall be covered with protective grease and plugged on both ends with wooden plugs.

7. MANUFACTURER'S WARRANTIES

7.1. The manufacturer shall guarantee the conformity of rotor and disc blanks' quality to the requirements of this standard.

7.2. Should the customer detect any non-conformity of the blanks to the supply requirements during the check control, the manufacturer shall, upon the customer's request, duly correct the flaws detected as soon as technically possible, or replace the defective blanks with proper ones.

8. SPECIFIC PROVISIONS

8.1. Prior to manufacturing rotor and disc blanks, test blanks shall be manufactured, cut and examined by the manufacturer in the following events:

in case of steel grade change;

in case of increased geometrical dimensions of blanks against those produced before;

in case of fundamental changes in the technology (melting, teeming, forging and heat treatment methods).

Test blanks shall be examined according to the manufacturer's program and methodology, approved by the head metal technology organization and by the customer.

8.2. The manufacturer shall have the right to cut and test the blanks from time to time, in order to check their quality.

ANNEX

For reference

LIST OF DOCUMENTS REFERRED TO IN THIS STANDARD

GOST 1497-73	Metals. Tensile test methods
GOST 7565-73	Steels and alloys. Sampling methodology for chemical composition determination
GOST 9012-59	Metals. Test methods. Brinell hardness test
GOST 9454-78	Metals. Impact bending test method at low, room and high temperatures.
GOST 9651-73	Metals. Tensile test methods at high temperatures.
GOST 12344-78	Alloy and high-alloy steels. Carbon determination methods
GOST 12345-66	Alloy and high-alloy steels. Sulfur content determination methods
GOST 12346-78	Alloy and high-alloy steels. Silicon determination methods
GOST 123477-77	Alloy and high-alloy steels. Phosphor determination methods
GOST 12348-78	Alloy and high-alloy steels. Manganese determination methods
GOST 12349-66	Alloy and high-alloy steels. Tungsten content determination methods
GOST 12350-78	Alloy and high-alloy steels. Chrome determination methods
GOST 12351-66	Alloy and high-alloy steels. Vanadium content determination methods
GOST 12352-66	Alloy and high-alloy steels. Nickel content determination methods

GOST 12354-66	Alloy and high-alloy steels. Molybdenum content determination methods
GOST 12355-78	Alloy and high-alloy steels. Copper determination methods
GOST 12356-66	Alloy and high-alloy steels. Titanium content determination methods
GOST 12357-66	Alloy and high-alloy steels. Aluminum content determination methods
GOST 12361-66	Alloy and high-alloy steels. Niobium content determination methods
GOST 14019-68	Metals. In-process bending test methods
GOST 18895-73	Steels. Photoelectric spectral analysis method
GOST 20560-75	Alloy and high-alloy steels. General requirements to chemical analysis methods
TG 24.021.02	Steam and gas turbines. Hot test of turbine rotors and shafts

Record of amendments to OST 108.961.05-80

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

TABLE OF CONTENTS

APPROVED by
Deputy Minister of Power Engineering
Signed Y.V. Kotov
Seal: [illegible]
Mar 12, 1981

Effective date
Jan 01, 1982

Group V 21

AMENDMENT No. 1 to

OST 108.961.05-80
"BLANKS OF ROTORS AND DISCS OF STATIONARY GAS TURBINES AND COMPRESSORS. SPECIFICATION"

---

1. Insert the following note in clause 2.11:

   "Note. Disc blanks for gas turbine plants (GTP) GTK-10 and GTN-25 shall not be tested for cold bend".

2. Insert note 2 in clause 4.4.1:

   "Notes: 1. …

   2. Samples for bend test shall be taken from the compressor rotor of GTP GTK-10 on the barrel only".

AMENDMENT No. 1 to OST 108.961.05-80

Drafted by CNIITMash Research and Production Association for Machine Building Technology

Seal: [illegible]

CEO	*signed*	E.T. Dolbenko
Head of standardization department	*signed*	V.V. Shumilin
Head of industry regulation and research department, project lead	*signed*	A.V. Prosvirin
Principal investigator	*signed*	I.I. Ivanov

PREPARED FOR APPROVAL by Technical Department of the Ministry of Power Engineering

Head of Technical Department	*signed*	V.P. Goloviznin
Head of general technology division	*signed*	M.V. Nosanov

Seal: Ministry of Power Engineering * Moscow

VALIDATED

Head of Metallurgy and Metallurgical Production Administration of the Ministry of Power Engineering	*signed*	V.P. Kuchumov

Production association “Lenin Nevsky Plant”

Chief Technology Officer	*signed*	G.V. Bufalov

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Production association for turbine construction “Leningrad metal plant”

Chief Technology Officer	*signed*	A.P. Ogurtsov

Production association for turbine construction “Kharkov turbine plant”

Chief Technology Officer	Letter No, II-40-18/13-225 dated Jan 30, 81	V.V. Ugolnikov

Seal: [illegible]

Polzunov Research and Production Association for research and design of power plant equipment

CEO	*signed*	N.M. Markov
Head of industry standardization department	*signed*	P.M. Khristyuk

APPROVED by
First Deputy Minister of Power Engineering
Signed V.M. Velichko
Seal: [illegible]
Jul 20, 1982

Effective date
Oct 01, 1982

Group V 21

AMENDMENT No. 2 to OST 108.961.05-80
"BLANKS OF ROTORS AND DISCS OF STATIONARY GAS TURBINES AND COMPRESSORS. SPECIFICATION"

---

1. Clause 2.4 be restated as follows:

"2.4. Steel for rotor and disc blanks shall be melted in an acid Martin furnace or in a basic electric arc furnace, with subsequent degassing. The manufacturer may use processing in ladle refiners and degassers (LRD) or in circulation degassers, degassing while teeming or teeming in a protective atmosphere. Upon agreement between the manufacturer and the customer, the following may be used:

steel melting in vacuum-induction furnaces;

electro slag remelt (ESR) and vacuum-arc remelt (VAR);

vacuum carbon deoxidation (in this case, pearlitic steels may be melted in basic Martin furnaces with LRD processing).

Ingots weighing 16 tons or below, or austenitic steel ingots may be teemed without degassing and inert gas shield.

When melting pearlitic steel in a basic electric or acid Martin furnace without subsequent degassing for rotors of over 500 mm diameter, and discs with a hub height of over 300 mm, hydrogen content in the ladle sample shall be measured. The findings are not included in the handover checklist, but shall be included in the blank's datasheet."

2. In tables 1, 2, 3, steel grade 20X3MVF (EM-415) be designated as 20X3MVFA (EM-415A).

3. Note to clause 2.8 be restated as follows:

"Upon agreement between the manufacturer and the customer, heat treatment of rotor blanks without axial canal is allowed. For rotors with finish canal diameter 110 mm and above, subsequent trepanning along the axle and mechanical testing of trepanned samples on longitudinal specimens shall be conducted. Normal values of mechanical properties of trepanned samples shall be agreed between the manufacturer and the customer."

4. Note 7 to table 2 be deleted.

5. In clause 4.3 and in the annex, the reference to:

   GOST 12345-66 be replaced with GOST 12345-80

   GOST 12351-66 be replaced with GOST 12351-81

   GOST 12352-66 be replaced with GOST 12352-81

   GOST 12354-66 be replaced with GOST 12354-81

   GOST 12356-66 be replaced with GOST 12356-81

   GOST 20560-75 be replaced with GOST 20560-81

6. Insert the following phrase at the end of clause 4.13:

"Inner surface of axial canal of up to 300 mm diameter shall be subjected to periscopic inspection".

7. Starting with the words "hydrogen content…", be restated as follows: "hydrogen content in the ladle sample (for pearlitic steel blanks melted without subsequent degassing", further unamended.

8. In table 3, the line for steel grade 20XI2VHMF (EP-426) be amended as follows:

Steel grade	Intended use	Strength class	Test temperature, ºC	Position of specimen	Conventional 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)	Bending angle, degrees
						min.				
20X12VNMF (EP 426)	Rotors	SC55	20	L	559-716 (55-75)	755 (77)	15	40	3.9 (4.0)	180
				T	559-716 (55-75)	755 (77)	13	30	3.4 (5.5)	150
	Rotor end parts	SC60	20	L	589-736 (60-75)	785 (80)	15	35	4.4 (4.5)	180
				T	589-736 (60-75)	755 (80)	14	32	3.9 (4.0)	150
	Discs	SC65	20	T	638-785 (65-80)	785 (80)	13	30	3.9 (4.0)	150
			550	T	≥392 (40)	-	-	-	-	-
	Tailed discs	SC65	20	L T	638-785 (65-80)	785 (80)	13	30	3.9 (4.0)	150
			550	L T	≥392 (40)	-	-	-	-	-

APPROVED by
First Deputy Minister of Power Engineering
Signed V.M. Velichko
Jun 6, 1983

Effective date
Jun 01, 1983

Group V 21

AMENDMENT No. 3 to

OST 108.961.05-80
"BLANKS OF ROTORS AND DISCS OF STATIONARY GAS TURBINES AND COMPRESSORS. SPECIFICATION"

---

1. Clause 6.4 be restated as follows: "Rotor and disc blanks shall be transported by any vehicle, without special package. If carried on an open rolling-stock, transportation shall follow the "Cargo transportation rules" and Specification of cargo loading and securing, as approved by the USSR Ministry of Railways.

Each cargo item to be transported shall bear a shipping mark as per GOST 14192-77, specifying basic, supplementary, and reference records".

2. Add the following line to the annex:

GOST 14192-77 Cargo marking.

Technical Department of the Ministry of Power Engineering

Head of Department *signed* V.P. Goloviznin

Head of research, development and standardization department	*signed*		A.V. Shtapauk
Head of metallurgy and welding department	*signed*		S.P. Ananchenko
CNIITMash Research and Production Association for Machine Building Technology			
CEO	*signed*	*May 23, 83*	E.T. Dolbenko
Head of industry department for regulatory documentation on metal and blanks	*signed*	*May 23, 83*	R.A. Solovyov
Principal investigator	*signed*	*May 23, 83*	I.I. Ivanov
Production association “Lenin Nevsky Plant”			
Chief Technology Officer	Letter No.1791-10/132 dated May 19, 83		G.V. Bufalov
Production association for turbine construction “Leningrad metal plant”			
Chief Technology Officer	Letter No.620-89 dated Jun 24, 83		A.P. Ogurtsov
Polzunov Research and Production Association for research and design of power plant equipment			
Deputy CEO	Letter No.15-6/7038 dated May 20, 83		M.K. Terentyev
Office for expert review of standards of the Cargo Directorate of the USSR Ministry of Railways			
Deputy head	Letter No.2233-03/2192 dated Apr 14, 83		G.N. Sokolov

AMENDMENT No. 3 to OST 108.961.05-80
"BLANKS OF ROTORS AND DISCS OF STATIONARY GAS TURBINES AND COMPRESSORS. SPECIFICATION"

APPROVED and ENACTED by directive of the Ministry of power engineering dated Oct 02, 84 No. SCh-002/7457.

1. In table 3, the line for steel grade 20X3MVFA (EI-415A) be restated as follows:

Steel grade	Intended use	Strength class	Test temperature, ºC	Position of specimen	Conventional 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)	Bending angle, degrees
						min.				
20X3MVFA (EI 415A)	Rotors	SC60	20	L	589-736 (60-75)	736 (75)	13	40	4.9 (5.0)	150
				T	589-736 (60-75)	716 (73)	11	32	3.9 (4.0)	120
			400	T	539 (55)	-	-	-	-	-
		SC65	20	T	615-765 (63-78)	736 (75)	11	32	3.9 (4.0)	-
			400	T	549 (56)	-	-	-	-	-
	Discs	SC70	20	T	647-795 (67-81)	785 (80)	13	40	4.9 (5.0)	120
			550	T	392 (40)	-	-	-	-	-

AMENDMENT No. 5 to

OST 108.961.05-80
"BLANKS OF ROTORS AND DISCS OF STATIONARY GAS TURBINES AND COMPRESSORS. SPECIFICATION"

Enacted by directive of the Ministry of power engineering dated May 20, 1986 No. SCh-002/1-4175 from Jan 01, 87.

On the first page of the standard, the validity end date "till Jan 01, 87" be replaced with "till Jan 01, 92".

In the bottom edge of the first page, the "Verified in 1986" note be inserted.

Table 3. Add note 6: "6. When testing mechanical properties of the metal of axial compressor blanks, if so specified in the drawings, the manufacturer shall determine the shear area fraction in specimens tested for impact bending, which, expressed as a percentage, shall be included in the blank's datasheet".

Section 2. Add clause 2.22: "2.22. Manufacturing and storage of blanks, loading/unloading and transportation shall meet the requirements of GOST 12.3.002-75, GOST 12.3.009-76, and GOST 12.3.020-80".

Clause 4.3. References to: GOST 7565-73 be replaced with GOST 7565-81, GOST 12349-66 – with GOST 12349-83, GOST 18895-73 – with GOST 18895-81.

Clause 4.5. References to: GOST 1497-73 be replaced with GOST 1497-84, GOST 9651-73 – with GOST 9651-84.

Clause 4.3. Reference to: GOST 14019-68 be replaced with GOST 14019-80.

Sub-paragraph 4.12.6. Be restated as follows: “Ultrasonic control of disc and rotor blanks shall be conducted to OST 108.958.03-83.”

Clause 4.14. Reference to: RTM 24.021.02 be replaced with RTM 108.021.02-85.

The list of documents referred to in the standard shall be restated as follows:

“LIST OF DOCUMENTS REFERRED TO IN THIS STANDARD

Document designation	Document name	Standard clause No.
GOST 12.3.002-75	OSSS. Production processes. General safety requirements.	2.22.
GOST 12.3.009-75	OSSS. Handling operations. General safety requirements.	2.22.
GOST 12.3.020-80	OSSS. In-house cargo transfer processes. General safety requirements.	2.22.
GOST 1497-84	Metals. Tensile test methods	4.5.
GOST 7565-81	Cast irons, steels and alloys. Sampling methodology for chemical composition determination	4.3.
GOST 9012-59	Metals. Test methods. Brinell hardness test	4.7.
GOST 9454-78	Metals. Impact bending test method at low, room and high temperatures.	4.5.
GOST 9651-84	Metals. Tensile test methods at high temperatures.	4.5.

Document designation	Document name	Standard clause No.
GOST 12344-78	Alloy and high-alloy steels. Carbon determination methods	4.3.
GOST 12345-80	Alloy and high-alloy steels. Sulfur determination methods	4.3.
GOST 12346-78	Alloy and high-alloy steels. Silicon determination methods	4.3.
GOST 123477-77	Alloy and high-alloy steels. Phosphor determination methods	4.3.
GOST 12348-78	Alloy and high-alloy steels. Manganese determination methods	4.3.
GOST 12349-83	Alloy and high-alloy steels. Tungsten determination methods	4.3.
GOST 12350-78	Alloy and high-alloy steels. Chrome determination methods	4.3.
GOST 12351-81	Alloy and high-alloy steels. Vanadium determination methods	4.3.
GOST 12352-81	Alloy and high-alloy steels. Nickel determination methods	4.3.
GOST 12354-81	Alloy and high-alloy steels. Molybdenum determination methods	4.3.
GOST 12355-78	Alloy and high-alloy steels. Copper determination methods	4.3.
GOST 12356-81	Alloy and high-alloy steels. Titanium determination methods	4.3.
GOST 12357-66	Alloy and high-alloy steels. Aluminum determination methods	4.3.
GOST 12361-66	Alloy and high-alloy steels. Niobium determination methods	4.3.
GOST 14019-80	Metals and alloys. Bending test methods	4.5.
GOST 14192-77	Cargo marking	6.4.
GOST 18895-73	Steels. Photoelectric spectral analysis method	4.3.

Document designation	Document name	Standard clause No.
GOST 20560-81	Alloy and high-alloy steels. General requirements to analysis methods	4.3.
OST 108.958.03-83	Steel forgings for power engineering equipment. Ultrasonic control procedure	4.12.6.
RTM 108.021.20-85	Steam and gas turbines. Hot testing of shafts, shafts with discs, and rotors	4.14.
	Cargo carriage rules of the USSR Ministry of Railways	6.4.
	Specification for cargo loading and securing of the USSR Ministry of Railways	6.4.

Head of Technical Directorate of the
Ministry of power engineering *signed Apr 29, 86* V.P. Goloviznin

Deputy CEO of Research and Production
Association for Machine Building Technology
(NPO CNIITMASH) *signed Apr 17, 87* I.R. Kryanin

Head of metrology and standardization department *signed* V.P. Grigoriev

Head of industry department for regulatory
documentation on metal and blanks *signed* R.A. Solovyov

Project lead:
Senior researcher *signed* V.L. Sokolov

VALIDATED

Chief technology officer of “Lenin Nevsky Plant” production association
Ref. No. 1794-102 dated April 09, 1986 K.B. Sarantsev

Chief technology officer of “Leningrad Metal Plant” production association
Ref. No. 613/63 dated April 11, 1986 V.K. Glukhikh

Deputy CEO of research and production association for research and design of power engineering equipment (NPO CKTI)
Ref. No. 12/5227 dated April 08, 1986 P.V. Khrabrov

Order 154 Print run: 100

Electrography group of NPO CNIITMASH. Sharikopodshipnikovskaya, 4

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Mar 29, 2002 No. 16-23/3-566 MK
to No. 610/6-173 dated Mar 11, 2002 *To Y.N. Vasiliev* *signed Apr 3, 02*
Dementieva

Re: OST 108.961.105-80

In response to your request, we inform you than amendment No. 6 to OST 108.961.05-80 "Blanks of rotors and discs of stationary gas turbines and compressors. Specification" concerns solely a change in the term of the OST's validity, and contains one phrase: "The validity of the standard be extended till Jan 01, 97".

Further, by letter No. 20/2-591 dated Sep 13, 95, the Committee for machine building of the Russian Federation cancelled the limitation of the term of validity of this standard.

Deputy CEO *signed* A.S. Zubchenko

To Babinskaya T.V. for guidance. *signed Apr 4, 02*

Prepared by: Lomakin P.A., tel. 2758775

Stamp: UKiS * Izhora Plants JSC * Common registry * Incoming No. 11/2458 Apr 02, 2002

Incoming No. 610/371 Apr 03, 02.