NLMK

ELECTRICAL STEEL

PRODUCT CATALOGUE
2024

ONLINE CATALOGUE: NGOES

ONLINE CATALOGUE: GOES

CONTENTS

CONTENTS

SECTION 1

REFERENCE STANDARDS

EN 10106
Cold rolled non-oriented electrical steel strip and sheet delivered in the fully processed state (annealed)

EN 10303
Thin magnetic steel strip and sheet for use at medium frequencies

EN 10107
Grain-oriented electrical steel strip and sheet delivered in the fully processed state

EN 10342
Magnetic materials — Classification of surface insulations of electrical steel sheet, strip and laminations

GOST 33212
Non-grain oriented electrical steel strip

GOST 32482
Cold-rolled grain-oriented electrical steel sheet for transformers

GOST 21427.2
Cold-rolled isotropic electrical-sheet steel

STO 05757665-008
NLMK Corporate Standard, Cold-rolled grain-oriented (anisotropic) electrical steel sheets

NON-GRAIN-ORIENTED STEEL

SECTION 2

NGO STEEL APPLICATIONS

Industrial

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Industrial electric motors	Electric motors from 5 to 100 kW	Air blower motor	M470-50A	Д470-50A	2.3	10
	Electric motors from 100 to 500 kW	Overhead crane motor	M400-50A	Д400-50A	2.4	11
	Electric motors from 500 to 1,000 kW	Hoist tower motor	M350-50A	Д350-50A	2.5	12
	Electric motors over 1 MW	Cement mill motor	M330-50A	Д330-50A	2.6	13
Transformers	Transformers from 2 to 40 kVA	Welding machine transformer	M470-50A	Д470-50A	2.19	26
	Transformers from 40 to 630 kVA	On-site substation transformer	M400-50A	Д400-50A	2.20	27

Power generation

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Generators	Electric generators from 1 to 5 kW	Back-up gasoline generator for detached residential housing	M530-50A	Д530-50A	2.9	16
	Electric generators from 5 to 100 kW	Gasoline engine–generator set	M470-50A	Д470-50A	2.10	17
	Electric generators from 100 to 500 kW	Diesel engine–generator set	M400-50A	Д400-50A	2.11	18
	Electric generators from 500 to 1,000 kW	Generator in a small hydraulic power plant	M350-50A	Д350-50A	2.12	19
	Electric generators from 1 to 5 MW	Wind power plant generator	M330-50A	Д330-50A	2.13	20
	Electric generators from 5 to 30 MW	Gas-turbine power plant turbine generator	M310-50A	Д310-50A	2.14	21
	Electric generators from 30 to 100 MW	Hydraulic generator in an hydraulic power plant	M290-50A	Д290-50A	2.15	22
	Electric generators from 100 to 300 MW	Turbine generator in a heat power plant	M270-50A	Д270-50A	2.16	23
	Electric generators over 300 MW	Turbine generator in a nuclear power plant	M250-50A	Д250-50A	2.17	24

Household appliances

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Small appliances	Electric motors under 1 kW	Coffee maker motor	M600-50A	Д600-50A	2.1	8
	Electric motors from 1 to 5 kW	Vacuum cleaner motor	M530-50A	Д530-50A	2.2	9
	Transformers under 2 kVA	Microwave oven transformer	M600-50A	Д600-50A	2.18	25
Large appliances	Electric motors under 1 kW	Refrigerator compressor motor	M600-50A	Д600-50A	2.1	8
	Electric motors from 1 to 5 kW	Washing machine motor	M530-50A	Д530-50A	2.2	9
	Relay switches	Tumble dryer relay	M400-50A	Д400-50A	2.22	29
	Transformers from 2 to 40 kVA	Stovetop transformer	M470-50A	Д470-50A	2.19	26
Office appliances	Electric motors under 1 kW	Shredder motor	M600-50A	Д600-50A	2.1	8
	Transformers under 2 kVA	Photocopy machine transformer	M600-50A	Д600-50A	2.18	25

Construction

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Lighting	Relay switches	Illumination control	M400-50A	Д400-50A	2.22	29
HVAC	Electric motors from 5 to 100 kW	Ventilation compressor motor	M470-50A	Д470-50A	2.3	10
Other construction equipment	Electric motors under 1 kW	Smoke exhaust vent valve motor	M600-50A	Д600-50A	2.1	8
	Electric motors from 5 to 100 kW	Tower crane motor	M470-50A	Д470-50A	2.3	10

Transport

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Public transport	Electric motors from 100 to 500 kW	Tram motor	M400-50A	Д400-50A	2.4	11
Heavy-duty wheeled and crawler vehicles	Electric motors from 100 to 500 kW	Open-pit excavator motor	M400-50A	Д400-50A	2.4	11
	Electric motors from 500 to 1,000 kW	Mining dump truck motor	M350-50A	Д350-50A	2.5	12
	Electric generators from 1 to 5 MW	Mining dump truck power generator	M330-50A	Д330-50A	2.13	20
Marine transport	Electric motors from 100 to 500 kW	Secondary motor in the propulsion system	M400-50A	Д400-50A	2.4	11
	Electric motors from 500 to 1,000 kW	Manoeuvring system motor	M350-50A	Д350-50A	2.5	12
	Electric motors over 1 MW	Icebreaker propeller motor	M330-50A	Д330-50A	2.6	13
	Electric generators from 5 to 30 MW	Transportation vessel power generator	M310-50A	Д310-50A	2.14	21
	Electric generators from 30 to 100 MW	Nuclear-powered icebreaker generator	M290-50A	Д290-50A	2.15	22
Rail transport	Electric motors from 1 to 5 kW	Train air conditioning system motor	M530-50A	Д530-50A	2.2	9
	Electric motors from 100 to 500 kW	Suburban commuter train motor	M400-50A	Д400-50A	2.4	11
	Electric motors from 500 to 1,000 kW	Shunting locomotive auxiliary motor	M350-50A	Д350-50A	2.5	12
	Electric motors over 1 MW	Mainline electric locomotive motor	M330-50A	Д330-50A	2.6	13
	Induction coils	Induction coils for magnetically levitated trains	M600-50A	Д600-50A	2.21	28

Automotive industry

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Vehicle propulsion units	Electric generators under 1 kW	Starter-generator	M600-50A	Д600-50A	2.8	15
	High-frequency EV motors from 50 to 100 kW	EV motors	NO25-14*	–	2.7	14
Auxiliary equipment	Electric motors under 1 kW	Window lift regulator motor	M600-50A	Д600-50A	2.1	8

* As per EN 10303

SECTION 2.1

Electric motors under 1 kW

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A	**0.50**	EN 10106	8.00	±10	1.60	1.70	1.78
Д800-50A		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A	**0.50**	EN 10106	9.40	±8	1.62	1.72	1.81
Д940-50A		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

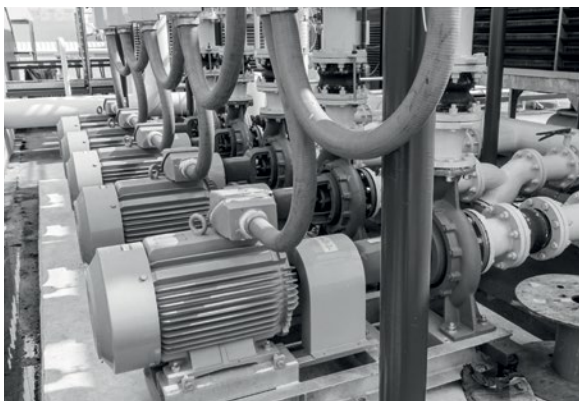
Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.2

Electric motors from 1 to 5 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A	**0.50**	EN 10106	8.00	±10	1.60	1.70	1.78
Д800-50A		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.3

Electric motors from 5 to 100 kW

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	**0.65**	EN 10106	5.30	±12	1.54	1.64	1.74
Д530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.4

Electric motors from 100 to 500 kW

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	**0.65**	EN 10106	5.30	±12	1.54	1.64	1.74
Д530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50AP		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.5

Electric motors from 500 to 1,000 kW

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M350-50A	**0.50**	EN 10106	3.50	±12	1.50	1.60	1.70
Д350-50A		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д350-50AP		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50AP		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

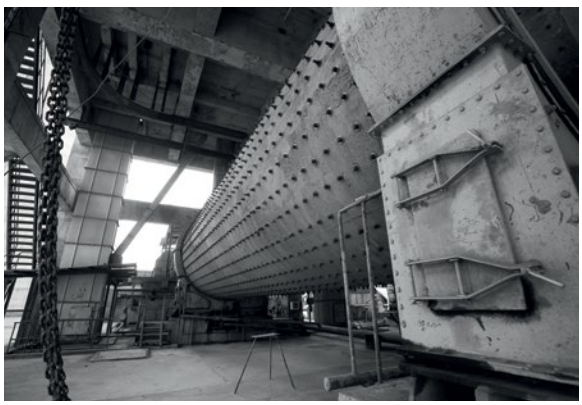
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.6

Electric motors over 1 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M330-50A	**0.50**	EN 10106	3.30	±14	1.49	1.60	1.70
Д330-50A		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A	**0.50**	EN 10106	3.50	±12	1.50	1.60	1.70
Д350-50A		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M400-65A	**0.65**	EN 10106	4.00	±14	1.52	1.62	1.72
Д400-65A		GOST 33212	4.00	±14	1.52	–	–
		typical properties	3.29	8	1.56	1.66	1.78
–	**0.50**	EN 10106***	–	–	–	–	–
Д330-50АР		GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д350-50АР		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50АР		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

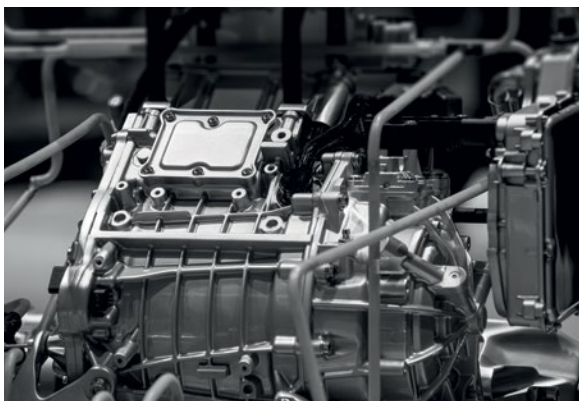
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.7

High-frequency EV motors from 50 to 100 kW



GRADES PRODUCED BY NLMK

Grade	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.0/400}$, W/kg, max	Magnetic induction			Yield strength, σ_T, N/mm²
				B_{2500}, T, min	B_{5000}, T, min	B_{10000}, T, min	
NO25-14* **	0.25	guaranteed	13.0	1.55	1.65	1.77	400
		typical properties	12.7	1.56	1.66	1.78	410
NO25-14	0.25	EN 10303	14.0	1.48	1.59	1.69	390
		typical properties	13.7	1.52	1.62	1.72	410
NO27-15**	0.27	guaranteed	15.0	1.55	1.65	1.76	370
		typical properties	14.5	1.56	1.66	1.77	410
NO27-15	0.27	EN 10303	15.0	1.48	1.59	1.69	370
		typical properties	14.5	1.54	1.63	1.75	410
NO30-16**	0.30	guaranteed	16.0	1.55	1.65	1.76	420
		typical properties	15.5	1.57	1.66	1.77	410
NO30-19	0.30	EN 10303	19.0	1.49	1.60	1.70	320
		typical properties	16.0	1.54	1.64	1.75	410
NO35-19***	0.35	guaranteed	17.5	1.55	1.65	1.75	400
		typical properties	17.0	1.57	1.66	1.76	410
NO35-19	0.35	EN 10303	19.0	1.49	1.60	1.70	370
		typical properties	17.2	1.54	1.64	1.75	410

Recommended by NLMK

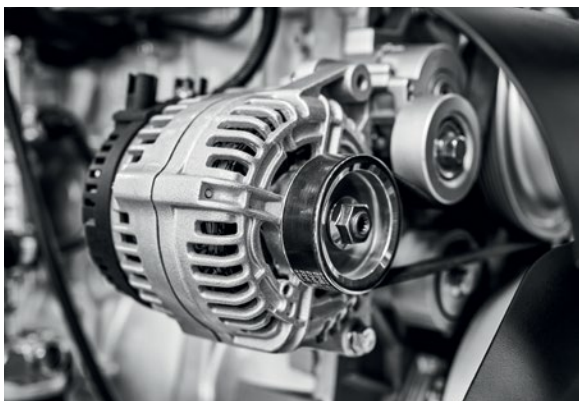
* Parameters under EN are guaranteed values

** Advanced induction grades

*** Advanced induction and lower loss grades

SECTION 2.8

Electric generators under 1 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A	**0.50**	EN 10106	8.00	±10	1.60	1.70	1.78
Д800-50A		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A	**0.50**	EN 10106	9.40	±8	1.62	1.72	1.81
Д940-50A		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.9

Electric generators from 1 to 5 kW

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A	**0.50**	EN 10106	8.00	±10	1.60	1.70	1.78
Д800-50A		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.10

Electric generators from 5 to 100 kW

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	**0.65**	EN 10106	5.30	±12	1.54	1.64	1.74
Д530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82

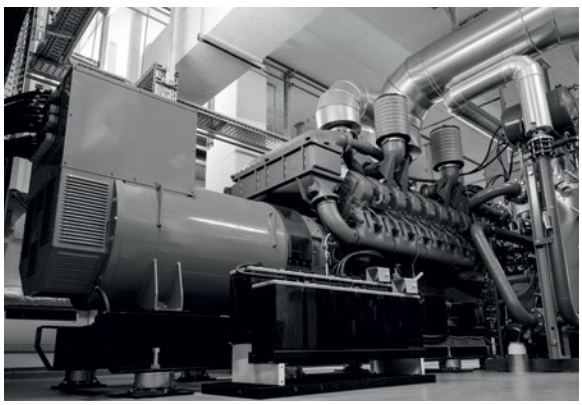
Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.11

Electric generators from 100 to 500 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	**0.65**	EN 10106	5.30	±12	1.54	1.64	1.74
Д530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50AP		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

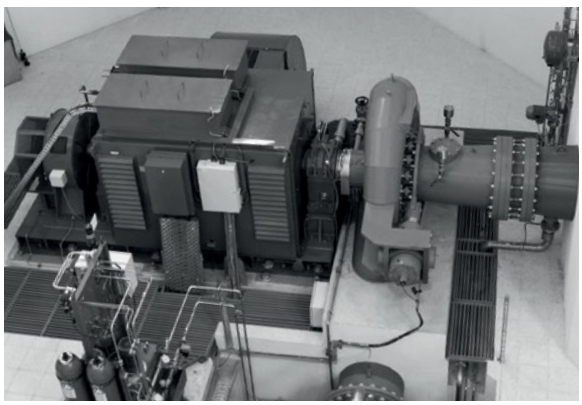
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.12

Electric generators from 500 to 1,000 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M350-50A	**0.50**	EN 10106	3.50	±12	1.50	1.60	1.70
Д350-50A		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д350-50АР		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50АР		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.13

Electric generators from 1 to 5 MW

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M330-50A	**0.50**	EN 10106	3.30	±14	1.49	1.60	1.70
Д330-50A		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A	**0.50**	EN 10106	3.50	±12	1.50	1.60	1.70
Д350-50A		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M400-65A	**0.65**	EN 10106	4.00	±14	1.52	1.62	1.72
Д400-65A		GOST 33212	4.00	±14	1.52	–	–
		typical properties	3.29	8	1.56	1.66	1.78
–	**0.50**	EN 10106***	–	–	–	–	–
Д330-50AP		GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д350-50AP		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50AP		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

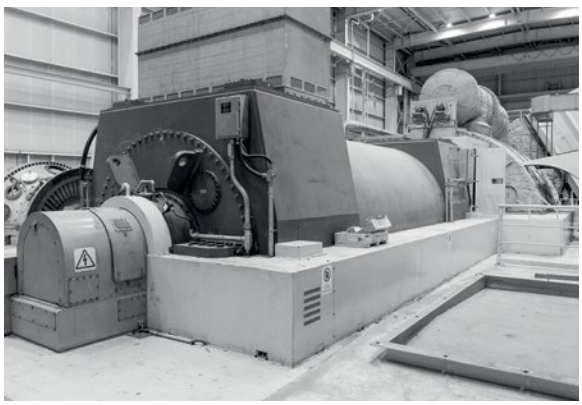
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.14

Electric generators from 5 to 30 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M310-50A	**0.50**	EN 10106	3.10	±14	1.49	1.60	1.70
Д310-50A		GOST 33212	3.10	±14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
M330-50A	**0.50**	EN 10106	3.30	±14	1.49	1.60	1.70
Д330-50A		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A	**0.50**	EN 10106	3.50	±12	1.50	1.60	1.70
Д350-50A		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
–	**0.50**	EN 10106***	–	–	–	–	–
Д310-50AP		GOST 33212	3.10	±14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д330-50AP		GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д350-50AP		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50AP		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82
M330-35A	**0.35**	EN 10106	3.30	±17	1.49	1.60	1.70
Д330-35A		GOST 33212	3.30	±17	1.49	–	–
		typical properties	2.98	9	1.48	1.58	1.71

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.15

Electric generators from 30 to 100 MW

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M290-50A	**0.50**	EN 10106	2.90	±17	1.49	1.60	1.70
Д290-50A		GOST 33212	2.90	±17	1.49	–	–
		typical properties	2.75	10	1.54	1.63	1.75
M310-50A	**0.50**	EN 10106	3.10	±14	1.49	1.60	1.70
Д310-50A		GOST 33212	3.10	±14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
M330-50A	**0.50**	EN 10106	3.30	±14	1.49	1.60	1.70
Д330-50A		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A	**0.50**	EN 10106	3.50	±12	1.50	1.60	1.70
Д350-50A		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
–	**0.50**	EN 10106***	–	–	–	–	–
Д310-50AP		GOST 33212	3.10	±14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д330-50AP		GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д350-50AP		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
M330-35A	**0.35**	EN 10106	3.30	±17	1.49	1.60	1.70
Д330-35A		GOST 33212	3.30	±17	1.49	–	–
		typical properties	2.98	9	1.48	1.58	1.71

Recommended by NLMK

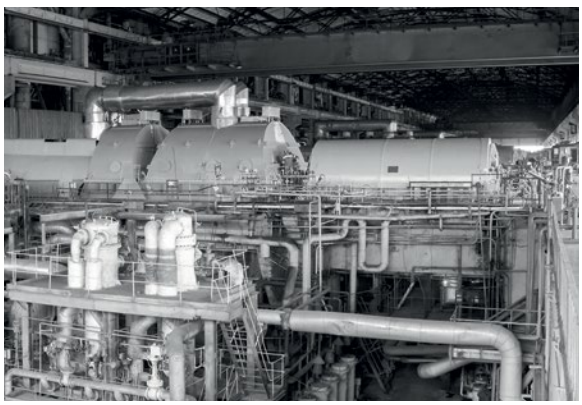
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.16

Electric generators from 100 to 300 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M270-50A	**0.50**	EN 10106	2.70	±17	1.49	1.60	1.70
Д270-50A		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.58	11	1.55	1.64	1.77
M290-50A	**0.50**	EN 10106	2.90	±17	1.49	1.60	1.70
Д290-50A		GOST 33212	2.90	±17	1.49	–	–
		typical properties	2.75	10	1.54	1.63	1.75
M310-50A	**0.50**	EN 10106	3.10	±14	1.49	1.60	1.70
Д310-50A		GOST 33212	3.10	±14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
M330-50A	**0.50**	EN 10106	3.30	±14	1.49	1.60	1.70
Д330-50A		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
–	**0.50**	EN 10106***	–	–	–	–	–
Д310-50АР		GOST 33212	3.10	±14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
–	**0.50**	EN 10106***	–	–	–	–	–
Д330-50АР		GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
M270-35A	**0.35**	EN 10106	2.70	±17	1.49	1.60	1.70
Д270-35A		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.62	10	1.54	1.63	1.75

Recommended by NLMK

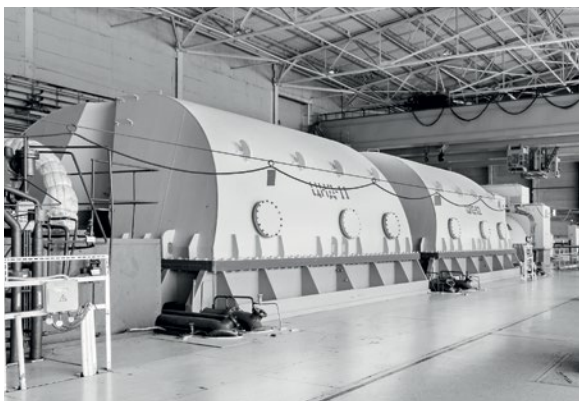
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.17

Electric generators over 300 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M250-50A	**0.50**	EN 10106	2.50	±17	1.49	1.60	1.70
Д250-50A		GOST 33212	2.50	±17	1.49	–	–
		typical properties	2.46	11	1.56	1.65	1.77
M270-50A	**0.50**	EN 10106	2.70	±17	1.49	1.60	1.70
Д270-50A		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.58	11	1.55	1.64	1.77
M290-50A	**0.50**	EN 10106	2.90	±17	1.49	1.60	1.70
Д290-50A		GOST 33212	2.90	±17	1.49	–	–
		typical properties	2.75	10	1.54	1.63	1.75
M310-50A	**0.50**	EN 10106	3.10	±14	1.49	1.60	1.70
Д310-50A		GOST 33212	3.10	±14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
–	**0.50**	EN 10106***	–	–	–	–	–
Д310-50АР		GOST 33212	3.10	±14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
M250-35A	**0.35**	EN 10106	2.50	±17	1.49	1.60	1.70
Д250-35A		GOST 33212	2.50	±17	1.49	–	–
		typical properties	2.45	11	1.54	1.64	1.76
M270-35A	**0.35**	EN 10106	2.70	±17	1.49	1.60	1.70
Д270-35A		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.62	10	1.54	1.63	1.75

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.18

Transformers under 2 kVA

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A	**0.50**	EN 10106	8.00	±10	1.60	1.70	1.78
Д800-50A		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A	**0.50**	EN 10106	9.40	±8	1.62	1.72	1.81
Д940-50A		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.19

Transformers from 2 to 40 kVA

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	**0.65**	EN 10106	5.30	±12	1.54	1.64	1.74
Д530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.20

Transformers from 40 to 630 kVA

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	**0.65**	EN 10106	5.30	±12	1.54	1.64	1.74
Д530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50AP		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.21

Induction coils

GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A	**0.50**	EN 10106	8.00	±10	1.60	1.70	1.78
Д800-50A		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A	**0.50**	EN 10106	9.40	±8	1.62	1.72	1.81
Д940-50A		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

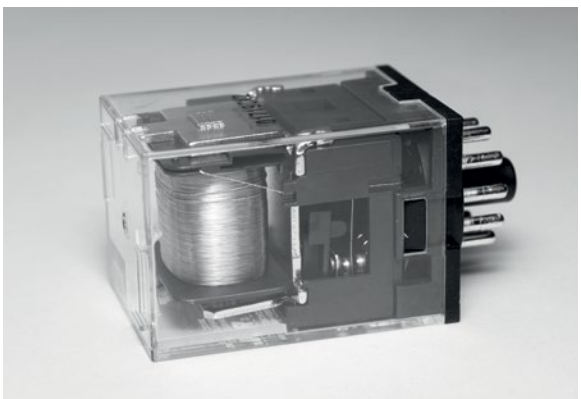
Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.22

Relay switches



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	**0.65**	EN 10106	5.30	±12	1.54	1.64	1.74
Д530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82
–	**0.50**	EN 10106***	–	–	–	–	–
Д400-50AP		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 3

NGO STEEL ELECTRIC INSULATION COATING

Type under EN 10342	Type under GOST 33212	Grade under GOST 21427	Thickness, μm	Resistance factor, Om × cm², min*	Thermal resistance	Freon resistance	Stampability	Weldability
EN-5-N EN-5-P	ТШ	ТШ1	≤1.0	1	450°C, 2 hrs in air	good	good	good
			0.5-1.5	5	750°C, 2.5 hrs in protective atmosphere	good	good	good
EC-3	НШ	НШ1	0.5-1.5	1.5	200°C, 24 hrs in air	good	excellent	adequate
EC-6	НШ	НШ40	4.0-7.0	40	200°C, 24 hrs in air	good	good	adequate

* Average of two sides

SECTION 4

NGO STEEL DIMENSIONAL MIX

- **Thickness:** 0.25; 0.27; 0.30; 0.35; 0.50; 0.65 mm
- **Width:**
  coils from 500 to 1,200 mm,
  bands from 90 to 500 mm
- **Coil internal diameter:** 500 mm
- **Coil weight:** from 3 to 15 t

TOLERANCES

	EN 10303				EN 10106			GOST 33212			
Nominal thickness, mm	**0.25**	**0.27**	**0.30**	**0.35**	**0.35**	**0.50**	**0.65**	**0.27**	**0.35**	**0.50**	**0.65**
Steel thickness deviation, %, max	–	–	–	–	±8	±8	±6	–	–	–	–
Steel thickness deviation, mm, max	±0.025	±0.027	±0.030	±0.030	–	–	–	±0.020	±0.030	±0.040	±0.040
Transverse thickness variation, mm	≤0.020	≤0.020	≤0.020	≤0.020	≤0.020	≤0.020	≤0.030	≤0.020	≤0.020	≤0.020	≤0.030
Longitudinal thickness variation, %, max	≤10	≤10	≤8	≤8	≤8	≤8	≤6	–	–	–	–
Longitudinal thickness variation, mm, max	–	–	–	–	–	–	–	≤0.020	≤0.030	≤0.040	≤0.040
Distortion factor, %, per 1 metre*	–				≤2.0			≤1.5			
Camber, mm, per 1 metre											
rolled steel width >150 mm	≤1.0				≤0.5			≤0.5			
rolled steel width 30–150 mm	–				≤1.0			–			
Residual curvature, mm	–				≤35			≤35			
Internal stress, mm, per 1 metre	–				≤2			≤2			
Burr height, mm, max	≤0.030				–			≤0.020			

	EN 10303			EN 10106/ GOST 33212				
Nominal width, mm	<150	150</<500	500</<1250	≤150	150</≤300	300</≤600	600</≤1000	1000</≤1250
Maximum width deviation*, mm	0/+0.4	0/+0.6	0/+1.5	0/+0.2	0/+0.3	0/+0.5	0/+1.0	0/+1.5

* rolled steel width >100 mm
** rolled steel width >150 mm

SECTION 5

NGO STEEL GRADES PRODUCED BY NLMK

STANDARD GRADES UNDER EN 10106 AND GOST 33212

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M250-35A	**0.35**	EN 10106	2.50	±17	1.49	1.60	1.70
Д250-35A		GOST 33212	2.50	±17	1.49	–	–
		typical properties	2.45	11	1.54	1.64	1.76
M270-35A	**0.35**	EN 10106	2.70	±17	1.49	1.60	1.70
Д270-35A		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.62	10	1.54	1.63	1.75
M250-50A	**0.50**	EN 10106	2.50	±17	1.49	1.60	1.70
Д250-50A		GOST 33212	2.50	±17	1.49	-	-
		typical properties	2.46	11	1.56	1.65	1.77
M270-50A	**0.50**	EN 10106	2.70	±17	1.49	1.60	1.70
Д270-50A		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.58	11	1.55	1.64	1.77
M290-50A	**0.50**	EN 10106	2.90	±17	1.49	1.60	1.70
Д290-50A		GOST 33212	2.90	±17	1.49	–	–
		typical properties	2.75	10	1.54	1.63	1.75
M310-50A	**0.50**	EN 10106	3.10	±14	1.49	1.60	1.70
Д310-50A		GOST 33212	3.10	±14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
M330-50A	**0.50**	EN 10106	3.30	±14	1.49	1.60	1.70
Д330-50A		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A	**0.50**	EN 10106	3.50	±12	1.50	1.60	1.70
Д350-50A		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A	**0.50**	EN 10106	4.00	±12	1.53	1.63	1.73
Д400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	**0.50**	EN 10106	4.70	±10	1.54	1.64	1.74
Д470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	**0.50**	EN 10106	5.30	±10	1.56	1.65	1.75
Д530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A	**0.50**	EN 10106	6.00	±10	1.57	1.66	1.76
Д600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	**0.50**	EN 10106	7.00	±10	1.60	1.69	1.77
Д700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A	**0.50**	EN 10106	8.00	±10	1.60	1.70	1.78
Д800-50A		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A	**0.50**	EN 10106	9.40	±8	1.62	1.72	1.81
Д940-50A		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

STANDARD GRADES UNDER EN 10106 AND GOST 33212

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
M400-65A	**0.65**	EN 10106	4.00	±14	1.52	1.62	1.72
Д400-65A		GOST 33212	4.00	±14	1.52	–	–
		typical properties	3.29	8	1.56	1.66	1.78
M470-65A	**0.65**	EN 10106	4.70	±12	1.53	1.63	1.73
Д470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	**0.65**	EN 10106	5.30	±12	1.54	1.64	1.74
Д530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82

HIGH-PERMEABILITY GRADES UNDER GOST 33212

Used in electric motors with high torque and power generators with stricter requirements to size. The desired properties are achieved through improved magnetic induction.

Grade	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Magnetic induction		
					B_{2500}, T, min	B_{5000}, T, min**	B_{10000}, T, min**
Д310-50АР	**0.50**	GOST 33212	3.10	±14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
Д330-50АР	**0.50**	GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
Д350-50АР	**0.50**	GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
Д400-50АР	**0.50**	GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

HIGH-FREQUENCY GRADES UNDER EN 10303

Used in EV motors that operate at or above 400 Hz. The steel is purposefully designed to achieve optimal losses at those specific frequencies.

Grade	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,0/400}$, W/kg, max	Magnetic induction			Yield strength, σ_T, N/mm²
				B_{2500}, T, min	B_{5000}, T, min	B_{10000}, T, min	
NO25-14****	**0.25**	guaranteed	13.0	1.55	1.65	1.77	400
		typical properties	12.7	1.56	1.66	1.78	410
NO25-14	**0.25**	EN 10303	14.0	1.48	1.59	1.69	390
		typical properties	13.7	1.52	1.62	1.72	410
NO27-15***	**0.27**	guaranteed	15.0	1.55	1.65	1.76	370
		typical properties	14.5	1.56	1.66	1.77	410
NO27-15	**0.27**	EN 10303	15.0	1.48	1.59	1.69	370
		typical properties	14.5	1.54	1.63	1.75	410
NO30-16***	**0.30**	guaranteed	16.0	1.55	1.65	1.76	420
		typical properties	15.5	1.57	1.66	1.77	410
NO30-19	**0.30**	EN 10303	19.0	1.49	1.60	1.70	320
		typical properties	16.0	1.54	1.64	1.75	410
NO35-19****	**0.35**	guaranteed	17.5	1.55	1.65	1.75	400
		typical properties	17.0	1.57	1.66	1.76	410
NO35-19	**0.35**	EN 10303	19.0	1.49	1.60	1.70	370
		typical properties	17.2	1.54	1.64	1.75	410

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Advanced induction grades

****Advanced induction and lower loss grades

GUARANTEED PROPERTIES UNDER GOST 21427

Nominal thickness, mm	Grade	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Magnetic induction, B_{5000}, T, min	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Anisotropy of magnetic induction, ΔB_{5000}, T, max	Stacking factor*, min	Bends, min
0.35	**2413**	2.5	1.50	±18	0.16	0.95	2
	2412	2.7	1.50	±18	0.16	0.95	2
	2411	3.0	1.50	±18	0.16	0.95	2
0.50	**2414**	2.7	1.49	±18	0.16	0.96 (0.95)	1
	2413	2.9	1.50	±18	0.16	0.96 (0.95)	1
	2412	3.1	1.50	±18	0.16	0.96 (0.95)	1
	2411	3.6	1.49	±18	0.16	0.96 (0.95)	1
	2312	3.8	1.58	±14	0.16	0.96 (0.95)	2
	2216	4.0	1.60	±12	0.13	0.96 (0.95)	3
	2215	4.5	1.64	±12	0.13	0.96 (0.95)	3
	2214	4.8	1.62	±12	0.13	0.96 (0.95)	3
	2213	5.0	1.65	±12	0.13	0.96 (0.95)	3
	2212	5.0	1.60	±12	0.13	0.96 (0.95)	3
	2211	5.5	1.56	±12	0.13	0.96 (0.95)	3
0.50	**2112**	6.0	1.62	±12	0.13	0.96 (0.95)	–
	2111	7.0	1.60	±12	0.13	0.96 (0.95)	–
	2013	6.5	1.65	±10	0.13	0.96 (0.95)	–
	2012	7.0	1.62	±10	0.13	0.96 (0.95)	–
	2011	8.0	1.60	±10	0.13	0.96 (0.95)	–

* For coated steel: Group A (Group B)

GUARANTEED MECHANICAL PROPERTIES UNDER GOST 21427

Grade	Ultimate tensile strength, σ_B, N/mm²	Relative elongation, δ_4, %	Hardness, HV_5
2411–2414	370–600	15–30	140–210
2312	330–470	20–35	120–160
2216–2211	300–450	20–35	120–145
2111–2112	300–450	20–35	110–145
2011–2013	290–490	15–35	120–160

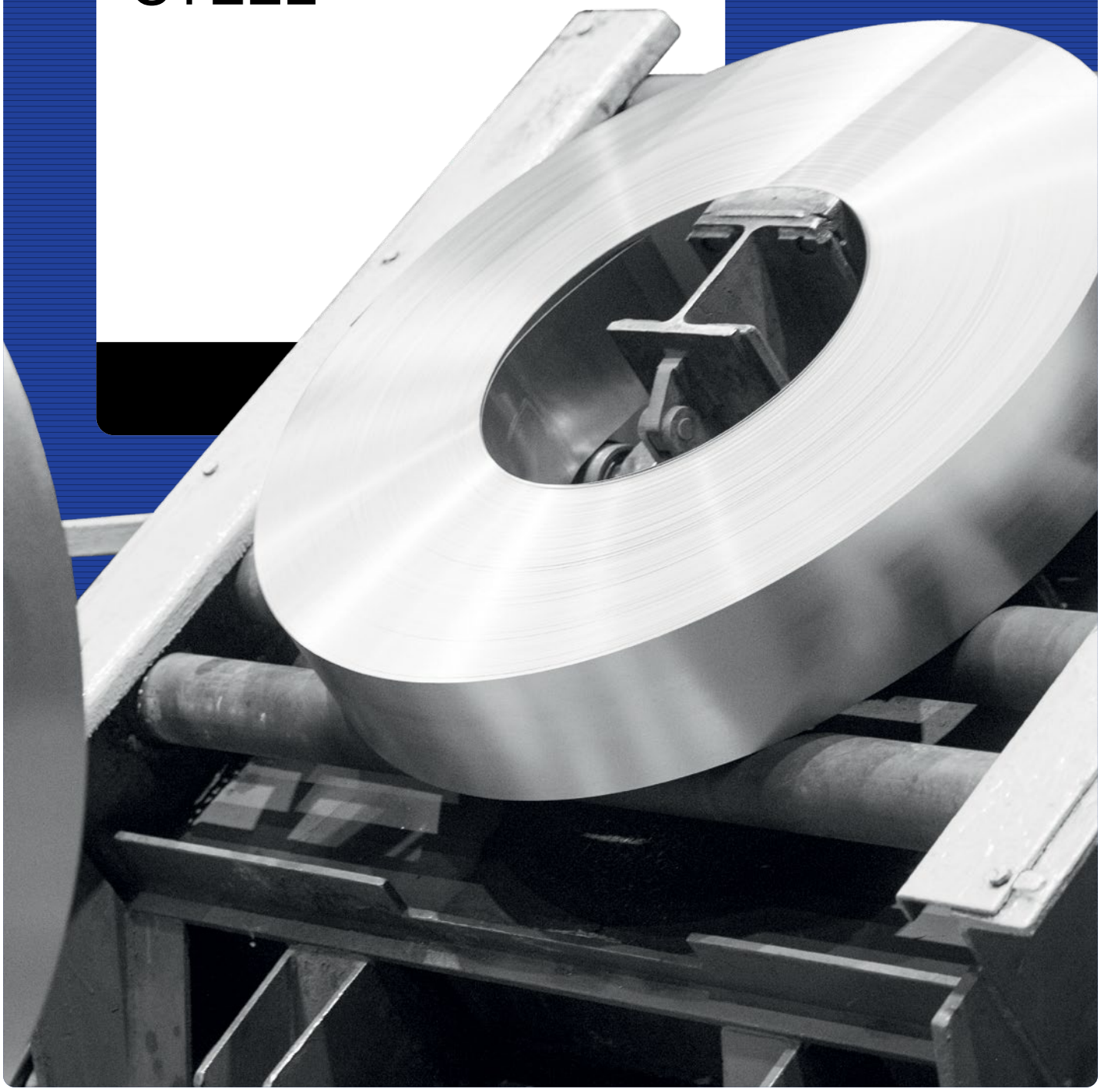
TYPICAL MAGNETIC AND MECHANICAL PROPERTIES UNDER GOST 21427

Nominal thickness, mm	Grade	Specific magnetic losses, $P_{1,0/50}$, W/kg	Specific magnetic losses, $P_{1,5/50}$, W/kg	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %	Magnetic induction, B_{2500}, t	Magnetic induction, B_{5000}, t	Magnetic induction, B_{10000}, t	Yield strength, σ_T, N/mm²	Ultimate tensile strength, σ_B, N/mm²	Relative elongation, δ_4, %	Hardness, HV_5
0.35	**2412**	0.97	2.29	9	1.54	1.64	1.76	403	516	16	200
0.50	**2412**	1.24	2.97	8	1.52	1.61	1.74	390	514	20	203
	2411	1.3	3.04	8	1.52	1.61	1.74	384	506	19	201
	2312	1.59	3.66	8	1.6	1.69	1.81	246	407	29	137
	2212	1.83	4.11	6	1.63	1.71	1.82	226	390	31	127
	2112	2.13	4.73	4	1.65	1.73	1.85	274	404	30	127
	2012	2.58	5.61	4	1.64	1.7	1.855	283	404	31	128

ALIGNMENT OF FULLY PROCESSED NGO STEELS ACROSS DIFFERENT STANDARDS

	Europe				Russia						USA		India		
	EN 10106				GOST 33212			GOST 21427			ASTM A677		IS 648		
Nominal thickness, mm	Grade	$P_{1,5/50}$, W/kg	B_{2500}, T	B_{5000}, T	Grade	$P_{1,5/50}$, W/kg	B_{2500}, T	Grade	$P_{1,5/50}$, W/kg	B_{2500}, T	Grade	$P_{1,5/50}$, W/kg	Grade	$P_{1,5/50}$, W/kg	B_{2500}, T
0.35	M250-35A	2.50	1.49	1.60	Д250-35А	2.50	1.49	2413	2.50	1.50	36F145	2.53	35C250	2.50	1.49
	M270-35A	2.70	1.49	1.60	Д270-35А	2.70	1.49	2412	2.70	1.50	36F155	2.70	35C270	2.70	1.49
	–	–	–	–	–	–	–	–	–	–	36F165	2.88	–	–	–
	–	–	–	–	–	–	–	–	–	–	36F175	3.05	–	–	–
	M330-35A	3.30	1.49	1.60	Д330-35А	3.30	1.49	–	–	–	36F185	3.22	35C330	3.30	1.49
	–	–	–	–	–	–	–	–	–	–	–	–	35C360	3.60	1.49
0.50	M250-50A	2.50	1.49	1.60	Д250-50А	2.50	1.49	–	–	–	–	–	50C250	2.50	1.49
	M270-50A	2.70	1.49	1.60	Д270-50А	2.70	1.49	2414	2.70	1.49	–	–	50C270	2.70	1.49
	M290-50A	2.90	1.49	1.60	Д290-50А	2.90	1.49	2413	2.90	1.50	47F165	2.88	50C290	2.90	1.49
	M310-50A	3.10	1.49	1.60	Д310-50А	3.10	1.49	2412	3.10	1.50	–	–	50C310	3.10	1.49
	–	–	–	–	–	–	–	–	–	–	47F180	3.14	–	–	–
	M330-50A	3.30	1.49	1.60	Д330-50А	3.30	1.49	–	–	–	47F190	3.31	50C330	3.30	1.49
	M350-50A	3.50	1.50	1.60	Д350-50А	3.50	1.50	–	–	–	47F200	3.48	50C350	3.50	1.50
	–	–	–	–	–	–	–	2411	3.60	1.49	47F210	3.66	–	–	–
	–	–	–	–	–	–	–	2312	3.80	1.58	–	–	–	–	–
	M400-50A	4.00	1.53	1.63	Д400-50А	4.00	1.53	2216	4.00	1.60	47F240	4.18	50C400	4.00	1.53
	–	–	–	–	–	–	–	2215	4.50	1.64	–	–	–	–	–
	M470-50A	4.70	1.54	1.64	Д470-50А	4.70	1.54	–	–	–	–	–	50C470	4.70	1.54
	–	–	–	–	–	–	–	2214	4.80	1.62	47F280	4.87	–	–	–
	–	–	–	–	–	–	–	2213	5.00	1.65	–	–	–	–	–
	–	–	–	–	–	–	–	2212	5.00	1.60	–	–	–	–	–
	M530-50A	5.30	1.56	1.65	Д530-50А	5.30	1.56	–	–	–	–	–	50C530	5.30	1.56
	–	–	–	–	–	–	–	2211	5.50	1.56	–	–	–	–	–
	M600-50A	6.00	1.57	1.66	Д600-50А	6.00	1.57	2112	6.00	1.62	–	–	50C600	6.00	1.57
	M700-50A	7.00	1.60	1.69	Д700-50А	7.00	1.60	2111	7.00	1.60	47F400	6.97	50C700	7.00	1.60
	–	–	–	–	–	–	–	2013	6.50	1.65	–	–	–	–	–
	–	–	–	–	–	–	–	2012	7.00	1.62	–	–	–	–	–
	M800-50A	8.00	1.60	1.70	Д800-50А	8.00	1.60	2011	8.00	1.60	47F450	7.84	50C800	8.00	1.60
	–	–	–	–	–	–	–	–	–	–	–	–	50C900	9.00	1.61
	M940-50A	9.40	1.62	1.72	Д940-50А	9.40	1.62	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–	–	–	–	50C1000	10.00	1.62
0.65	M400-65A	4.00	1.52	1.62	Д400-65А	4.00	1.52	–	–	–	64F235	4.09	65C400	4.00	1.52
	M470-65A	4.70	1.53	1.63	Д470-65А	4.70	1.53	–	–	–	–	–	65C470	4.70	1.53
	M530-65A	5.30	1.54	1.64	Д530-65А	5.30	1.54	–	–	–	–	–	65C530	5.30	1.54

GRAIN-ORIENTED STEEL



SECTION 6

GRAIN-ORIENTED STEEL APPLICATIONS

Electricity generation

Group	Equipment / Device	Use cases	Recommended grades		Section No.	Page No.
			EN 10107	GOST 32482		
Transformers for power stations	Transformers from 1 to 40 MVA	Transformers for wind power plants	M95-27Pb	T95-27D	6.6	44
	Transformers from 40 to 250 MVA	Transformers for gas-turbine power plants	M90-23Pb	NV23S-90L*	6.7	45
	Transformers over 250 MVA	Transformers for nuclear power plants	M85-23Pb	NV23S-85L*/**	6.8	46

Electric power transmission

Group	Equipment / Device	Use cases	Recommended grades		Section No.	Page No.
			EN 10107	GOST 32482		
Metering transformers for transmission substations	Metering transformers	Current transformers for relay protection and metering systems	M110-30P	T111-30S	6.9	47
Transformers for transmission substations	Transformers from 1 to 40 MVA	Transformers for substations rated for voltage up to 110 kV	M95-27Pb	T95-27D	6.6	44
	Transformers from 40 to 250 MVA	Transformers for substations rated for voltage up to 500 kV	M90-23Pb	NV23S-90L*/**	6.7	45
	Transformers over 250 MVA	Autotransformers for grid interconnections	M85-23Pb	NV23S-85L*/**	6.8	46
Line reactors for transmission substations	Line reactors	Controlled shunt reactors for transformer substations	M85-23Pb	NV23S-85L*/**	6.10	48

Electrical power distribution

Group	Equipment / Device	Use cases	Recommended grades		Section No.	Page No.
			EN 10107	GOST 32482		
Transformers for distribution substations and end users	Transformers under 2 kVA	Transformers for high pressure water jets	M130-30S	T130-30S	6.1	39
	Transformers from 2 to 10 kVA	Voltage stabilizing transformers	M120-30S	T120-30S	6.2	40
	Transformers from 10 to 40 kVA	Transformers for power-system automation circuits	M110-30P	T111-30S	6.3	41
	Transformers from 40 to 630 kVA	Transformers for thyristor converters in electrical drives	M105-30P	T105-30D	6.4	42
	Transformers from 630 to 1,000 kVA	Transformers for industrial on-site substations	M100-30Pb	T100-30D**	6.5	43
Line reactors for distribution substations	Line reactors	Shell-type current limiting reactors against short circuits	M85-23Pb	NV23S-85L*/**	6.10	48

* Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

Transport

Group	Equipment / Device	Use cases	Recommended grades		Section No.	Page No.
			EN 10107	GOST 32482		
Electric public transit	Transformers from 40 to 630 kVA	Transformers for trackside propulsion substations in subway networks	M105-30P	T105-30D	6.4	42
	Transformers from 630 to 1,000 kVA	Transformers for master propulsion substations in subway networks	M100-30Pb	T100-30D**	6.5	43
Cars, heavy-duty wheeled and crawler vehicles	Transformers under 2 kVA	Transformers for EV on-board control systems	M130-30S	T130-30S	6.1	39
	Transformers from 2 to 10 kVA	Transformers for EV charging stations	M120-30S	T120-30S	6.2	40
	Transformers from 40 to 630 kVA	Transformers for excavator electric systems	M105-30P	T105-30D	6.4	42
Marine transport	Transformers from 10 to 40 kVA	Transformers for lighting systems	M110-30P	T111-30S	6.3	41
	Transformers from 40 to 630 kVA	Transformers for HVAC	M105-30P	T105-30D	6.4	42
	Transformers from 630 to 1,000 kVA	Transformers for steering systems	M100-30Pb	T100-30D**	6.5	43
	Transformers from 1 to 40 MVA	Transformers for main drivetrain	M95-27Pb	T95-27D	6.6	44
Rail transport	Transformers from 630 to 1,000 kVA	Transformers for trackside propulsion substations in mainline networks	M100-30Pb	T100-30D**	6.5	43
	Transformers from 1 to 40 MVA	Transformers for master propulsion substations in mainline networks	M95-27Pb	T95-27D	6.6	44

* Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

SECTION 6.1

Transformers under 2 kVA

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M130-30S	**0.30**	EN 10107	1.30	1.78
T130-30S		GOST 32482	1.30	1.84
		typical properties	1.26	1.85

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

SECTION 6.2

Transformers from 2 to 10 kVA

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M120-30S	**0.30**	EN 10107	1.20	1.78
T120-30S		GOST 32482	1.20	1.86
		typical properties	1.12	1.87
M120-27S	**0.27**	EN 10107	1.20	1.78
T120-27S		GOST 32482	1.20	1.84
		typical properties	1.13	1.86
M130-30S	**0.30**	EN 10107	1.30	1.78
T130-30S		GOST 32482	1.30	1.84
		typical properties	1.26	1.85

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

SECTION 6.3

Transformers from 10 to 40 kVA

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M110-30P	**0.30**	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.09	1.88
M110-23S	**0.23**	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
M110-27P	**0.27**	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M120-27S	**0.27**	EN 10107	1.20	1.78
T120-27S		GOST 32482	1.20	1.84
		typical properties	1.13	1.86
M120-30S	**0.30**	EN 10107	1.20	1.78
T120-30S		GOST 32482	1.20	1.86
		typical properties	1.12	1.87
M130-30S	**0.30**	EN 10107	1.30	1.78
T130-30S		GOST 32482	1.30	1.84
		typical properties	1.26	1.85

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

SECTION 6.4

Transformers from 40 to 630 kVA

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M105-30P	**0.30**	EN 10107	1.05	1.88
T105-30D		GOST 32482	1.05	1.87
		typical properties	1.04	1.87
–	**0.27**	EN 10107**	–	–
T105-27S		GOST 32482	1.05	1.87
		typical properties	1.02	1.88
M110-23S	**0.23**	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
M110-27P	**0.27**	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M110-30P	**0.30**	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.07	1.87

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified by EN 10107

SECTION 6.5

Transformers from 630 to 1,000 kVA

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M100-30Pb	**0.30**	EN 10107	1.00	1.88
T100-30D**		GOST 32482	1.00	1.87
		typical properties	–	–
M100-23P	**0.23**	EN 10107	1.00	1.88
T100-23D		GOST 32482	1.00	1.86
		typical properties	0.98	1.88
M100-27P	**0.27**	EN 10107	1.00	1.88
T100-27D		GOST 32482	1.00	1.86
		typical properties	0.99	1.88
–	**0.27**	EN 10107***	–	–
T105-27S		GOST 32482	1.05	1.87
		typical properties	1.02	1.88
M105-30P	**0.30**	EN 10107	1.05	1.88
T105-30D		GOST 32482	1.05	1.87
		typical properties	1.04	1.87
M110-23S	**0.23**	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
M110-27P	**0.27**	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M110-30P	**0.30**	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.07	1.87

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Not specified by EN 10107

SECTION 6.6

Transformers from 1 to 40 MVA

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M95-27Pb	**0.27**	EN 10107	0.95	1.88
T95-27D		GOST 32482	0.95	1.87
		typical properties	0.95	1.88
M95-23P	**0.23**	EN 10107	0.95	1.88
T95-23D		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M100-23P	**0.23**	EN 10107	1.00	1.88
T100-23D		GOST 32482	1.00	1.86
		typical properties	0.98	1.88
M100-27P	**0.27**	EN 10107	1.00	1.88
T100-27D		GOST 32482	1.00	1.86
		typical properties	0.99	1.88
M100-30Pb	**0.30**	EN 10107	1.00	1.88
T100-30D**		GOST 32482	1.00	1.87
		typical properties	–	–
–	**0.27**	EN 10107***	–	–
T105-27S		GOST 32482	1.05	1.87
		typical properties	1.02	1.88
M105-30P	**0.30**	EN 10107	1.05	1.88
T105-30D		GOST 32482	1.05	1.87
		typical properties	1.04	1.87

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Not specified by EN 10107

SECTION 6.7

Transformers from 40 to 250 MVA

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482***	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M90-23Pb	**0.23**	EN 10107	0.90	1.88
NV23S-90L		STO 05757665-008***	0.90	1.88
		typical properties	0.89	1.88
M95-23P	**0.23**	EN 10107	0.95	1.88
T95-23D		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M95-27Pb	**0.27**	EN 10107	0.95	1.88
T95-27D		GOST 32482	0.95	1.87
		typical properties	0.94	1.88
M100-23P	**0.23**	EN 10107	1.00	1.88
T100-23D		GOST 32482	1.00	1.86
		typical properties	0.98	1.88
M100-27P	**0.27**	EN 10107	1.00	1.88
T100-27D		GOST 32482	1.00	1.86
		typical properties	0.99	1.88
M100-30Pb	**0.30**	EN 10107	1.00	1.88
T100-30D**		GOST 32482	1.00	1.87
		typical properties	–	–

Recommended by NLMK

* Parameters under EN, STO and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

SECTION 6.8

Transformers over 250 MVA

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482***	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M85-23Pb	**0.23**	EN 10107	0.85	1.88
NV23S-85L**		STO 05757665-008***	0.85	1.88
		typical properties	0.84	1.88
M90-23Pb	**0.23**	EN 10107	0.90	1.88
NV23S-90L		STO 05757665-008***	0.90	1.88
		typical properties	0.89	1.88
M95-23P	**0.23**	EN 10107	0.95	1.88
T95-23D		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M95-27Pb	**0.27**	EN 10107	0.95	1.88
T95-27D		GOST 32482	0.95	1.87
		typical properties	0.945	1.88

Recommended by NLMK

* Parameters under EN, STO and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

SECTION 6.9

Metering transformer

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M110-30P	**0.30**	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.07	1.87
M110-23S	**0.23**	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
M110-27P	**0.27**	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M120-27S	**0.27**	EN 10107	1.20	1.78
T120-27S		GOST 32482	1.20	1.84
		typical properties	1.13	1.86
M120-30S	**0.30**	EN 10107	1.20	1.78
T120-30S		GOST 32482	1.20	1.86
		typical properties	1.12	1.87

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

SECTION 6.10

Line reactors

GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482***	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M85-23Pb	**0.23**	EN 10107	0.85	1.88
NV23S-85L**		STO 05757665-008***	0.85	1.88
		typical properties	0.84	1.88
M90-23Pb	**0.23**	EN 10107	0.90	1.88
NV23S-90L		STO 05757665-008***	0.90	1.88
		typical properties	0.89	1.88
M95-23P	**0.23**	EN 10107	0.95	1.88
T95-23D		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M95-27Pb	**0.27**	EN 10107	0.95	1.88
T95-27D		GOST 32482	0.95	1.87
		typical properties	0.945	1.88

Recommended by NLMK

* Parameters under EN, STO and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

SECTION 7

GO STEEL ELECTRIC INSULATION COATING

Supplied as coils, bands or sheets with heat-resistant insulation coating “ЭТ” under GOST 32482-2013 (equivalent to the electrical insulation coating under EN 10342).

Coating type	Base	Colour	Resistance factor, Om×cm²	Thermal resistance
ЭТ	Silicates, phosphates, chromates	Grey or brown grey	≥20	(840±10) °C, 3 h, in neutral atmosphere

SECTION 8

GO STEEL DIMENSIONAL MIX

- **Thickness:** 0.23; 0.27; 0.30 mm
- **Width:**
  bands — 20 to 499 mm
  sheets — 914 to 960 mm;
  coils — 650 to 1020 mm
- **Coil internal diameter:** 500 mm
- **Coil weight:** 3 to 5 tonnes

TOLERANCES

	EN 10107			GOST 32482		
Nominal thickness, mm	**0.23**	**0.27**	**0.30**	**0.23**	**0.27**	**0.30**
Max steel thickness deviation, mm	±0.025	±0.03	±0.03	±0.02	±0.02	±0.02
Max weld thickness deviation, mm	≤0.05	≤0.05	≤0.05	≤0.02	≤0.02	≤0.02
Transverse thickness variation*, mm	≤0.02	≤0.02	≤0.02	≤0.02	≤0.02	≤0.02
Longitudinal thickness variation per 1,500 mm of length, mm	≤0.03	≤0.03	≤0.03	≤0.02	≤0.02	≤0.02
Burrs, mm	≤0.025	≤0.025	≤0.025	≤0.015	≤0.015	≤0.015
Min stacking factor	0.945	0.950	0.955	0.945	0.950	0.955
Non-flatness height to length ratio, %	≤1.5			≤1.5		
Camber per 1,500 mm (EN) / 1,000 mm (GOST) of length*, mm	≤0.05			≤0.05		
Residual stresses (cutting line gap)**, mm	-			≤1.0		
No. of folds	≥1			≥1		

	EN 10107				GOST 32482			
Nominal width, mm	**≤150**	**150<⁄≤400**	**400<⁄≤750**	**>750**	**≤150**	**150<⁄≤400**	**400<⁄≤750**	**>750**
Maximum width deviations, mm	0<⁄≤-0.02	0<⁄≤-0.03	0<⁄≤-0.05	0<⁄≤-0.06	0<⁄≤-0.02	0<⁄≤-0.03	0<⁄≤-0.05	0<⁄≤-0.06

* For widths over 150 mm

** For widths over 500 mm

Steel produced to other specifications is available by custom order, subject to additional approval.

SECTION 9

GO STEEL GRADES PRODUCED BY NLMK

STANDARD GRADES

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M110-23S	**0.23**	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
–	**0.27**	EN 10107**	–	–
T105-27S		GOST 32482	1.05	1.87
		typical properties	1.02	1.88
M110-27P	**0.27**	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M120-27S	**0.27**	EN 10107	1.20	1.78
T120-27S		GOST 32482	1.20	1.84
		typical properties	1.13	1.86
M105-30P	**0.30**	EN 10107	1.05	1.88
T105-30D		GOST 32482	1.05	1.87
		typical properties	1.04	1.87
M110-30P	**0.30**	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.07	1.87
M120-30S	**0.30**	EN 10107	1.20	1.78
T120-30S		GOST 32482	1.20	1.86
		typical properties	1.12	1.87
M130-30S	**0.30**	EN 10107	1.30	1.78
T130-30S		GOST 32482	1.30	1.84
		typical properties	1.26	1.85

* Parameters under EN and GOST are guaranteed values

** Not specified by EN 10107

HIGH-PERMEABILITY GRADES UNDER EN 10107, GOST 32482 AND STO 05757665-008

Grade EN 10107 GOST 32482***	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1,7/50}$, W/kg, max	Magnetic induction, B_{800}, T, min
M85-23Pb	**0.23**	EN 10107	0.85	1.88
NV23S-85L**		STO 05757665-008***	0.85	1.88
		typical properties	0.84	1.88
M90-23Pb	**0.23**	EN 10107	0.90	1.88
NV23S-90L		STO 05757665-008***	0.90	1.88
		typical properties	0.89	1.88
M95-23P	**0.23**	EN 10107	0.95	1.88
T95-23D		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M100-23P	**0.23**	EN 10107	1.00	1.88
T100-23D		GOST 32482	1.00	1.86
		typical properties	0.98	1.88
M95-27Pb	**0.27**	EN 10107	0.95	1.88
T95-27D		GOST 32482	0.95	1.87
		typical properties	0.945	1.88
M100-27P	**0.27**	EN 10107	1.00	1.88
T100-27D		GOST 32482	1.00	1.86
		typical properties	0.99	1.88
M100-30Pb	**0.30**	EN 10107	1.00	1.88
T100-30D**		GOST 32482	1.00	1.87
		typical properties	–	–

* Parameters under EN and GOST are guaranteed values

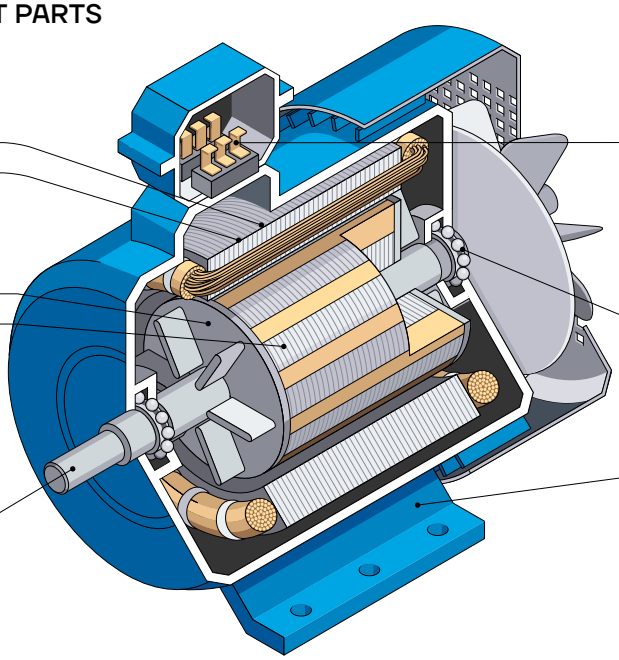
** Технология производства данных марок трансформаторной стали находится в стадии разработки, продукция производится в опытно-промышленных объемах

*** Марки в толщине 0,23 мм и с низкими магнитными потерями отсутствуют в GOST 32482, приведен аналог по стандарту НЛМК STO 05757665-008

APPENDIX 1

Example of NGO steel in electric motors

APPENDIX 1.1 COMPONENT PARTS



STATOR
- NON-GRAIN-ORIENTED STEEL
- Copper

ROTOR
- NON-GRAIN-ORIENTED STEEL
- Copper

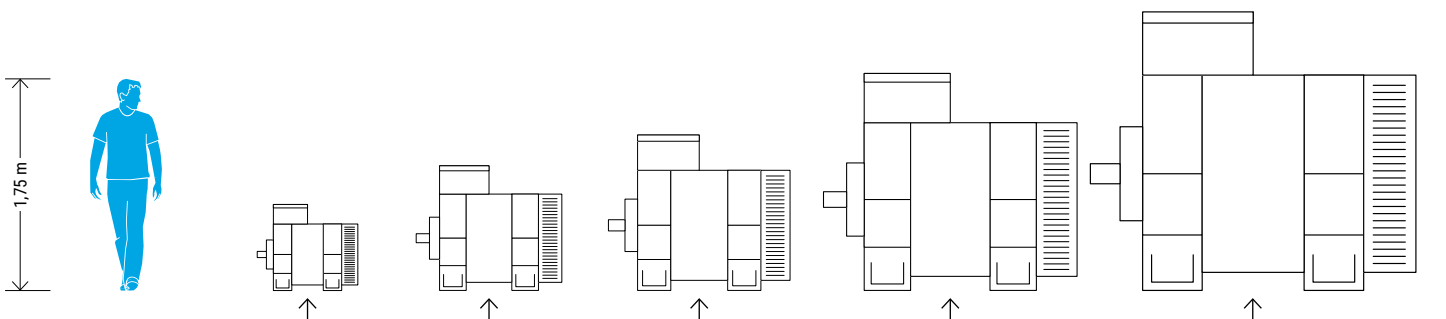
SHAFT
- Carbon steel

JUNCTION BOX
- Copper

BEARINGS
- Carbon steel

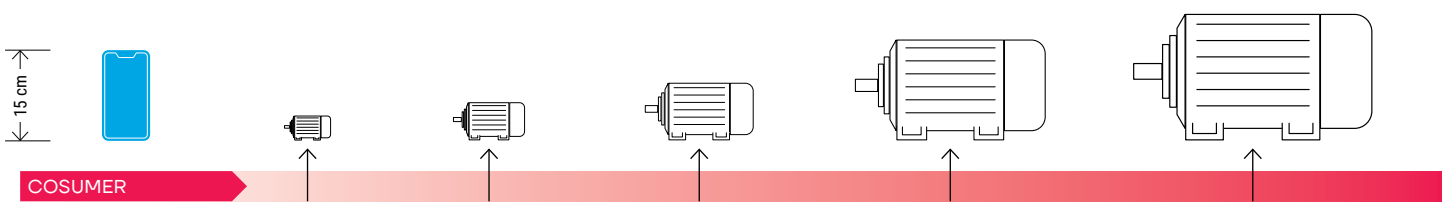
CASING
- Cast iron
- Aluminium

APPENDIX 1.2 POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



Power	10 kW	100 kW	500 kW	1000 kW	>7000 kW
Total weight	20 kg	300 kg	1 t	2 t	15 t
Share of NGO steel by weight	**50%**	**48%**	**45%**	**42%**	**40%**

APPENDIX 1.3 POWER RANGE. CONSUMER IMPLEMENTATIONS

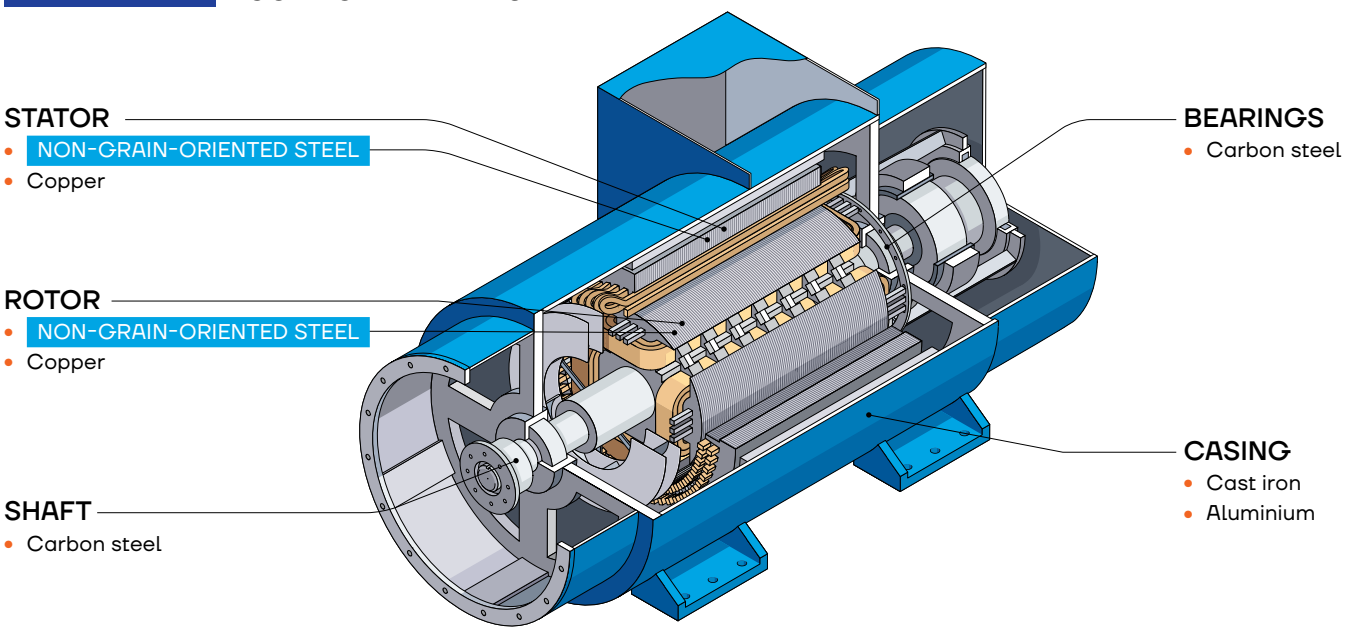


Power	до 1 W	0,1 kVA	50 W	0,5 kW	1 kW
Total weight	0,1 kg	0,1 kg	0,3 kg	3 kg	6 kg
Share of NGO steel by weight	**60%**	**55%**	**55%**	**52%**	**50%**

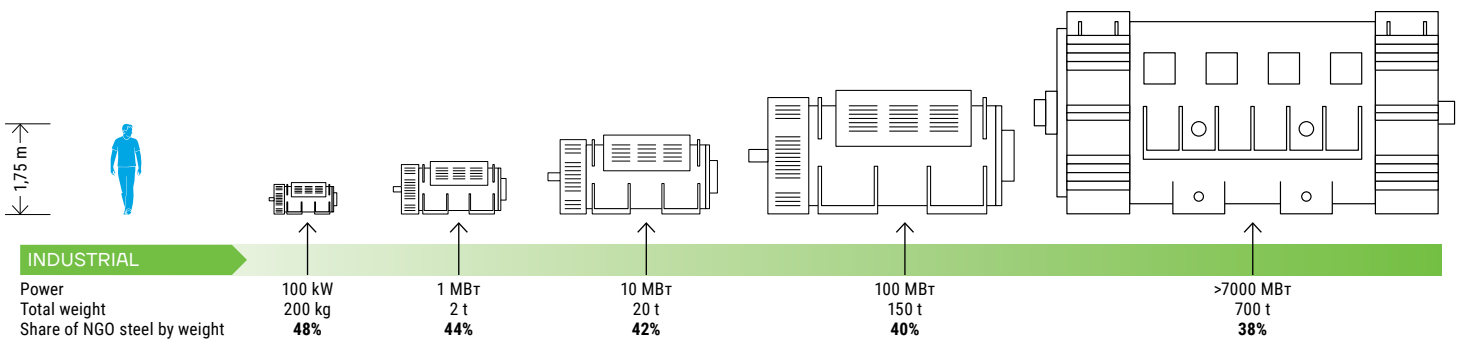
APPENDIX 2

Example of NGO steel in electric generators

APPENDIX 2.1 COMPONENT PARTS

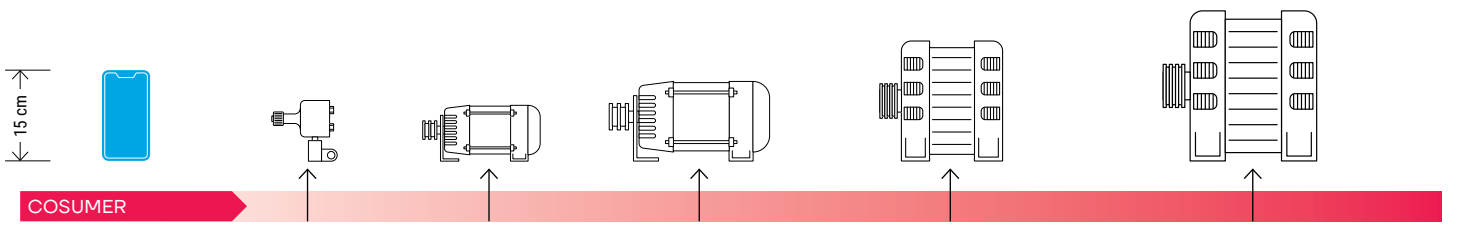


APPENDIX 2.2 POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



Power	100 kW	1 МВт	10 МВт	100 МВт	>7000 МВт
Total weight	200 kg	2 t	20 t	150 t	700 t
Share of NGO steel by weight	**48%**	**44%**	**42%**	**40%**	**38%**

APPENDIX 2.3 POWER RANGE. CONSUMER IMPLEMENTATIONS

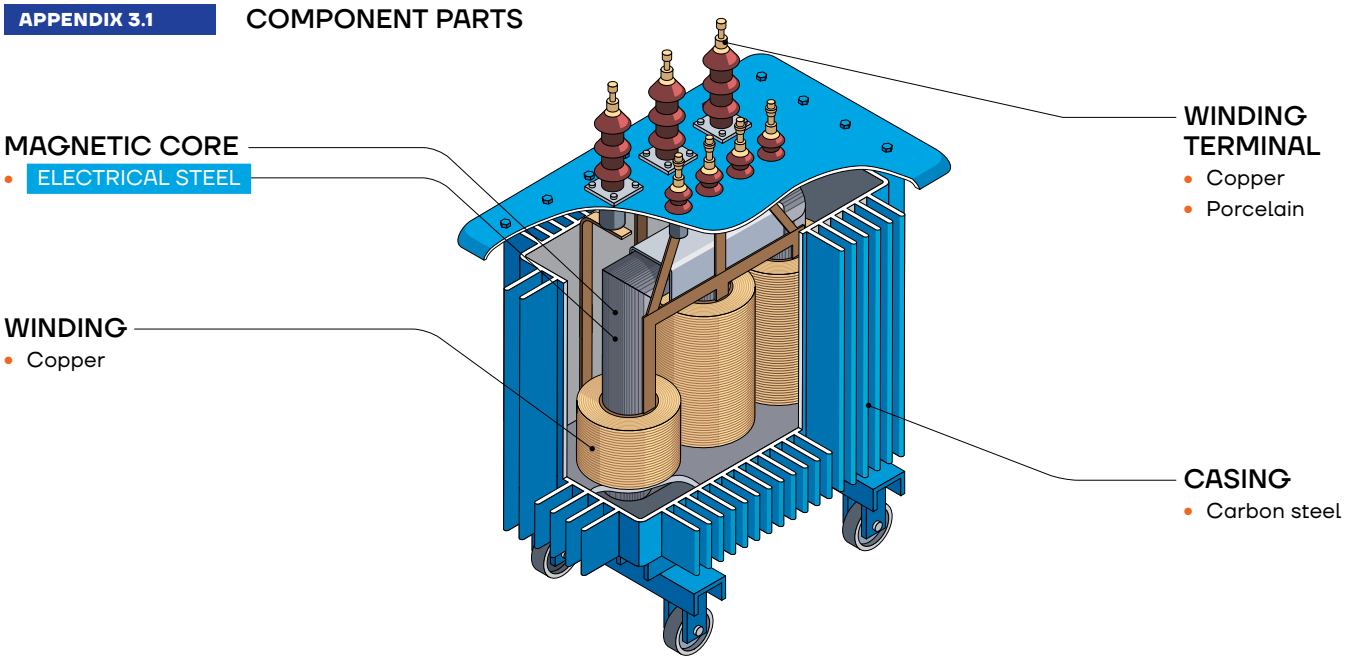


Power	до 3 W	50 W	500 W	1 kW	5 kW
Total weight	0,2 kg	0,3 kg	0,6 kg	6 kg	10 kg
Share of NGO steel by weight	**60%**	**55%**	**53%**	**50%**	**50%**

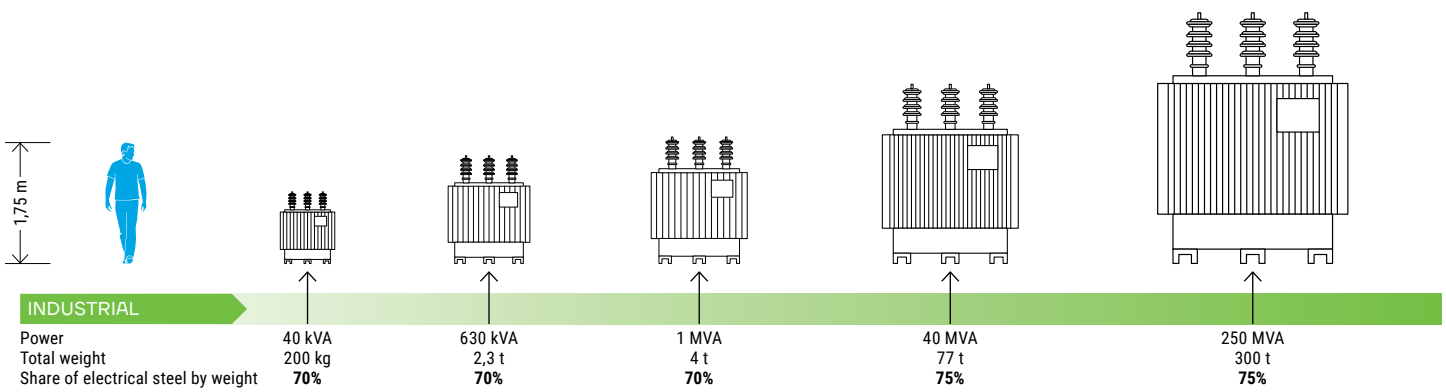
APPENDIX 3

Example of electrical steel in transformers

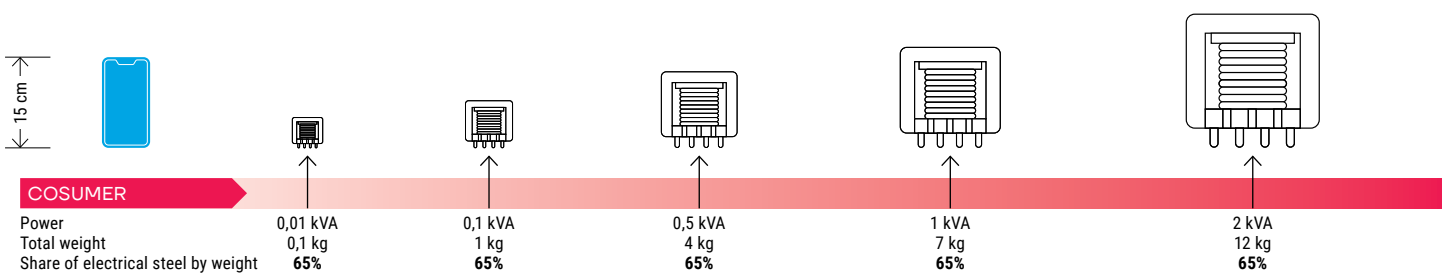
APPENDIX 3.1 COMPONENT PARTS



APPENDIX 3.2 POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



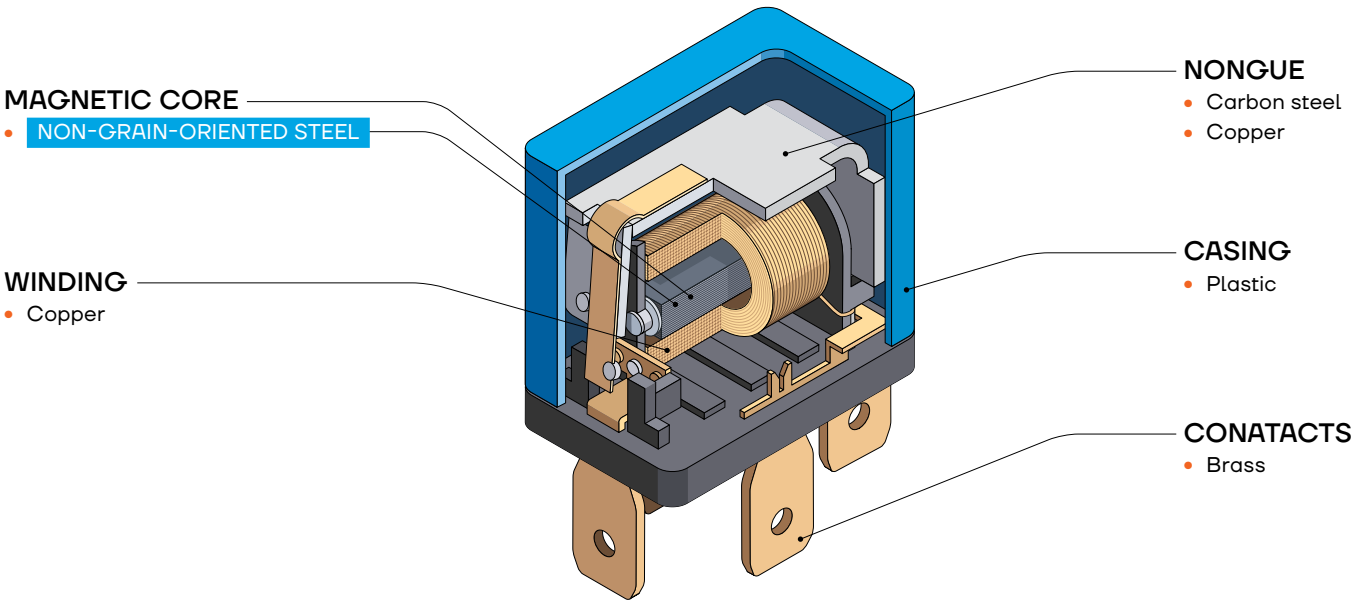
ПРИЛОЖЕНИЕ 3.3 POWER RANGE. CONSUMER IMPLEMENTATIONS



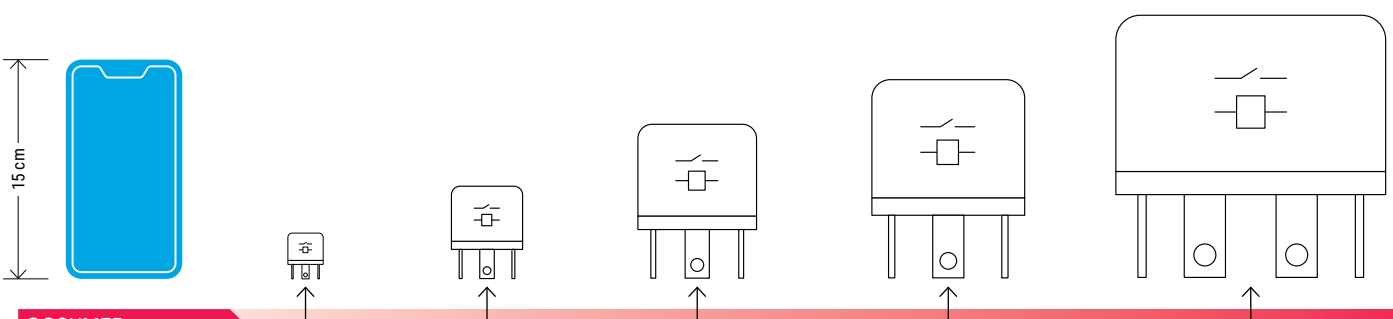
APPENDIX 4

Example of NGO steel in relay switches

APPENDIX 4.1 COMPONENT PARTS



APPENDIX 4.2 POWER RANGE. CONSUMER IMPLEMENTATIONS

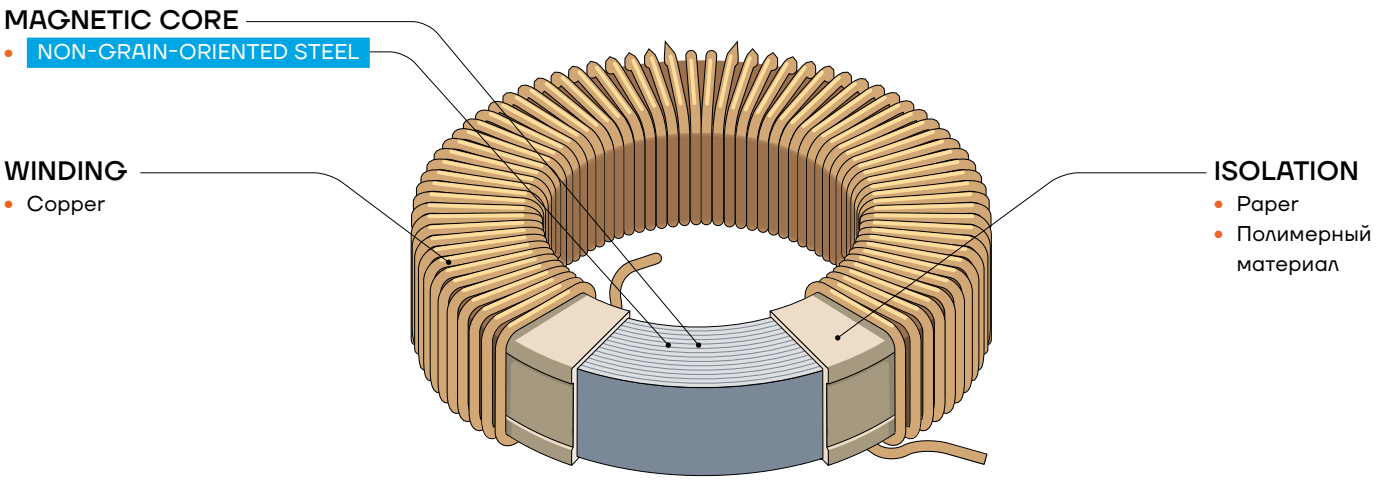


	Micro	Mini	Small	Medium	Large
Power	< 5 g	20 g	50 g	150 g	600 g
Total weight	**65%**	**65%**	**70%**	**70%**	**75%**
Share of NGO steel by weight					

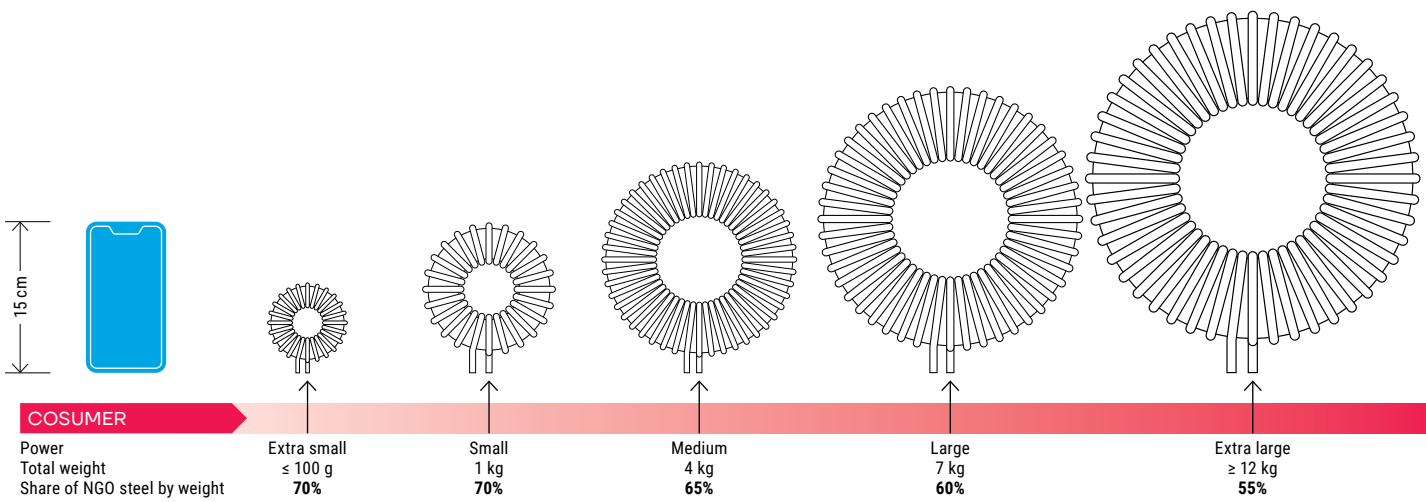
APPENDIX 5

Example of NGO steel in induction coils

APPENDIX 6.1 COMPONENT PARTS



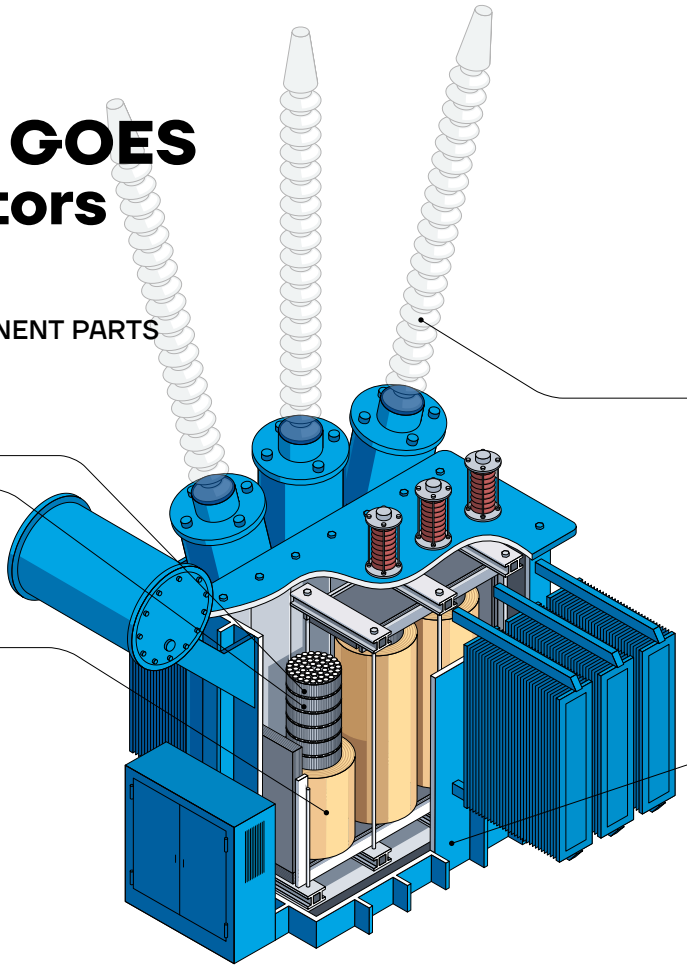
APPENDIX 6.2 POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



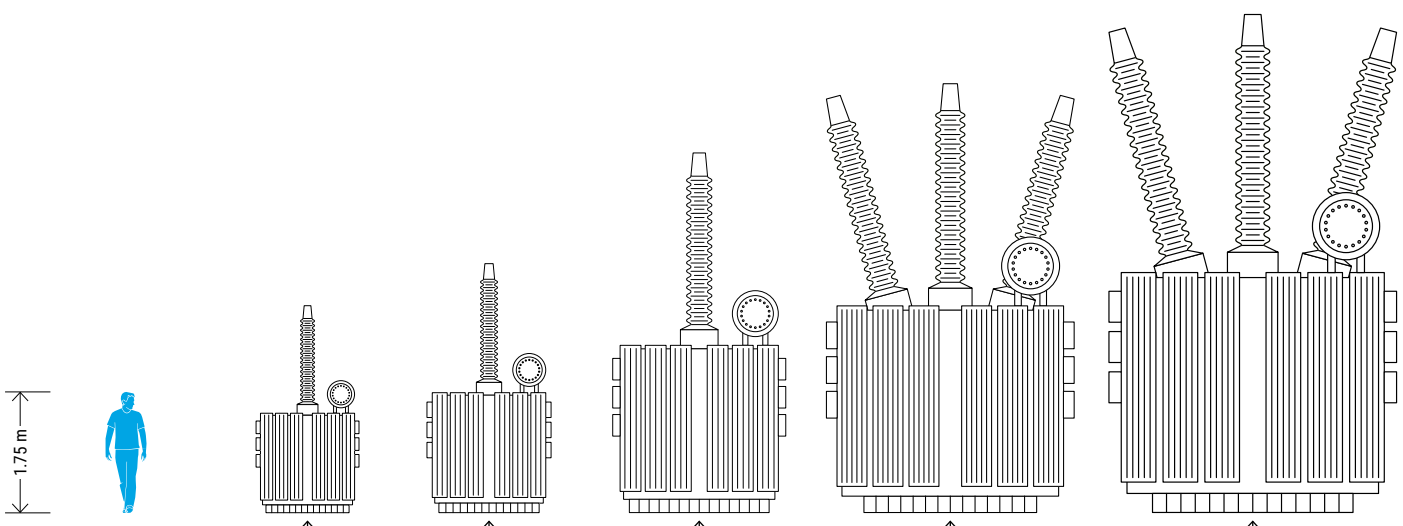
APPENDIX 6

Example of GOES in line reactors

APPENDIX 6.1 COMPONENT PARTS



APPENDIX 6.2 POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



Power	3 MVA	33 MVA	111 MVA	180 MVA	300 MVA
Total weight	3 t	10 t	125 t	145 t	210 t
Share of GO steel by weight	**70%**	**73%**	**73%**	**75%**	**75%**

sales@nlmk.com