



PRODUCT CATALOGUE

GRAIN-ORIENTED ELECTRICAL STEEL

ELECTRICAL MACHINES

TRANSFORMERS

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ABOUT NLMK GROUP

NLMK Group is a vertically-integrated company, the largest steelmaker in Russia and one of the leading global suppliers of high-quality steel products.

NLMK Group produces hot-rolled, cold-rolled, galvanized and pre-painted rolled products, electrical steel (grain oriented and non-grain oriented), a wide range of plates, long products and metal ware. NLMK Group's steel products are used in various industries, from construction and automotive industry to power-generating equipment, electrical machines and transformers.

NLMK Group's key production assets are located in Russia, Europe and the United States. Steel production capacity exceeds 17 million tonnes per year. The products are supplied to more than 70 countries around the world.

NLMK Group produces electrical steel at two sites in Russia: Novolipetsk Steel (Lipetsk) and VIZ-Steel (Ekaterinburg).

Long experience in production of GO electrical steel, large-scale equipment and process upgrading program ensure product of high quality.

NLMK's electrical steel allows to meet state-of-the-art requirements to energy efficiency in transformer equipment and to contribute to minimization of manmade impact to the environment.

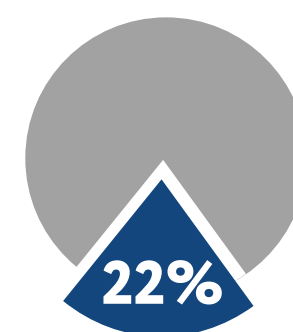


NLMK'S ENVIRONMENTAL POLICY

NLMK Group has invested over \$1 billion into environmental projects over the last decade. During this period NLMK's output has almost doubled and the company has become the largest steel producer in Russia.

Today NLMK accounts for 22% of all Russian steel. Against the background of increased production volumes, NLMK Group's continual focus on reducing its environmental footprint and on implementing the most advanced technologies allowed the company to more than halve its air emissions approaching the levels of the best available technologies (BAT). NLMK has completely ceased wastewater discharge and industrial waste accumulation.

In 2014 NLMK Group launched a new stage in its Environmental Programme 2020. It is aimed at further minimizing of environmental impact and at achieving the best available environment standards in global steel production.



of Russian steel is produced by NLMK Group



invested in environmental technologies



reducing emissions against output growth

**EFFICIENT PRODUCTION PROCESS
WITH A MINIMAL ENVIRONMENTAL
IMPACT**

CERTIFICATION

Within NLMK Group's companies there were implemented quality management, industrial safety, energy management and environmental management systems. Compliance of these systems with international standards is subject to regular audits by accredited companies and confirmed by certificates.





APPLICATIONS

List of main electrical equipment where GO electrical steel is used:

- power transformers;
- distribution transformers;
- measuring transformers;
- shunt reactors;
- generators;
- high-voltage and low-voltage gears;
- electronics.



GO ELECTRICAL STEEL PROCESS FLOW

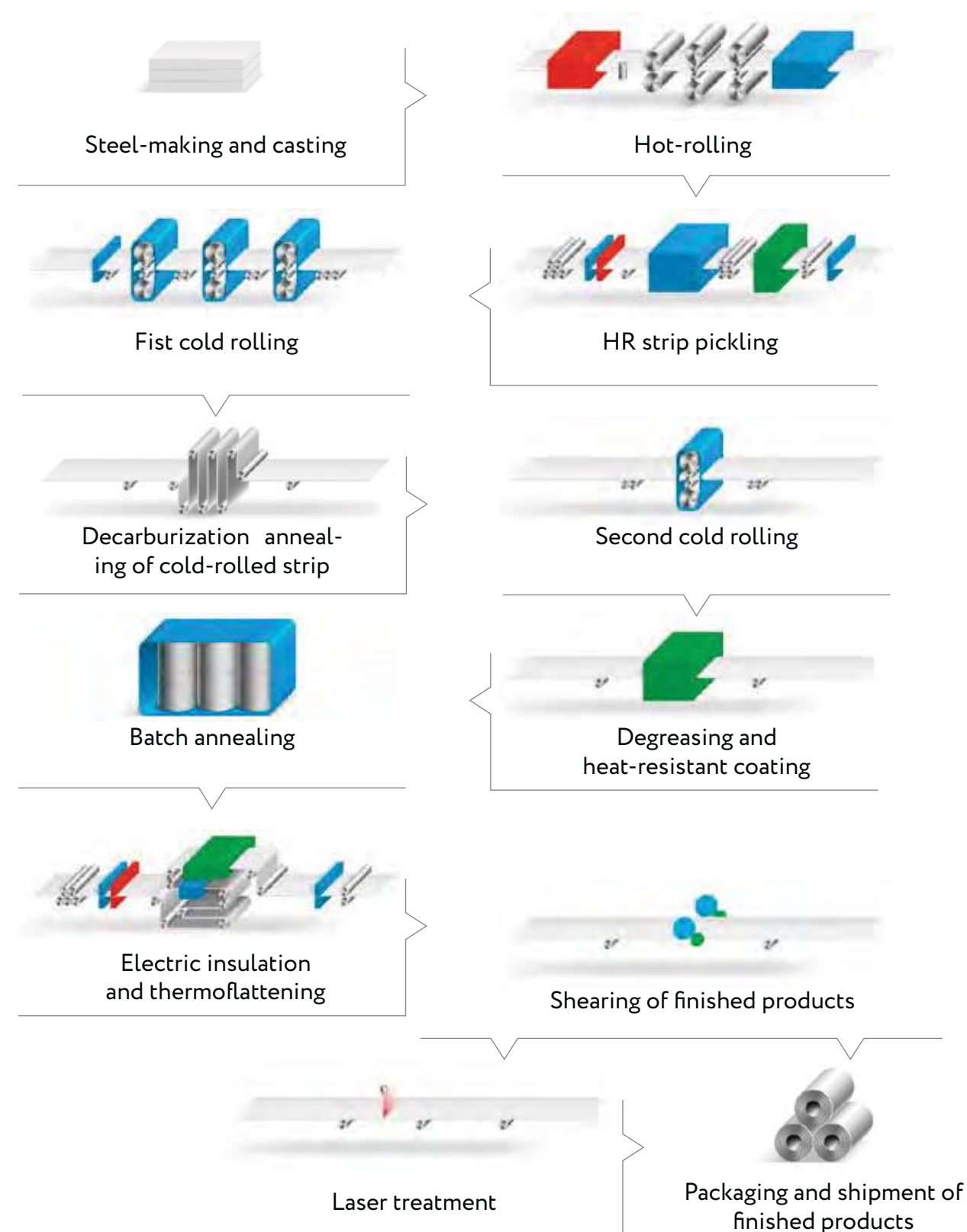
GO steel production process includes steelmaking in BOF, continuous casting, hot-rolling, pickling, two-stage cold-rolling with intermediate decarburization annealing, high-temperature annealing, application of heat-resistant and electrical insulation coatings, laser treatment for optimization of domain structure as well as slitting and packaging.

Laser treatment helps to improve GO steel magnetic properties.

NLMK Group guarantees high quality of produced GO electrical steel due to strict control of production process, quality of materials used and final products.



PRODUCTION SCHEME



DIMENSIONAL PRODUCT MIX

Cold-rolled grain-oriented electrical steel is supplied in line with the requirements of corporate, domestic, foreign standards and technical specifications.

Thickness – 0.15; 0.20; 0.23; 0.27; 0.30; 0.35; 0.50 mm.

Width:

- coils - up to 1020 mm;
- slit strip - from 80 to 500 mm;
- 0.15 mm slit strip – from 16 to 80 mm.

Coil ID – 500 mm, for 0.15 mm slit strip - 270 mm.

Coil weight - up to 5 mt. Upon agreement with the customer, coil weight may be increased.

The weight of one piece in a narrow strip coil shall not be less than the weight calculated as 0.5 kg per 1 mm of narrow strip width.

TOLERANCE REQUIREMENTS ACCORDING TO STO 05757665-008

Nominal thickness, mm	0,23; 0,27; 0,30	0,35; 0,50
Max. thickness deviation, mm	±0,02	±0,03
Max. weld thickness deviation, mm	0,02	
Transverse thickness deviation*, max., mm	0,02	
Longitudinal thickness deviation per 1,500 mm of length, max., mm	0,02	
Burr height, max., mm	0,020	

Nominal width, mm	L ≤ 250	250 < L ≤ 500	L > 500
Maximum width deviation, mm	+0,8	+1,2	+0,5%
Wave factor, %, max.	1,5		
Wave height, max., mm	3,0		
Camber per 1,500 mm of length*, max., mm	1,0		
Number of bends	≥ 5		
Residual stresses (maximum gap along the cutting line)***, mm	≤ 1,0		

Flat products with other product mix requirements can be produced according to special order upon additional agreement.

* For width over 150 mm.

** For width over 500 mm.

MAGNETIC PROPERTIES

PRODUCT MIX AND MAGNETIC PROPERTIES OF GO ELECTRICAL STEEL UNDER STO 05757665-008

GOES grade	Nominal thickness, mm	Guaranteed specific core loss, W/kg, max.		Guaranteed magnetic polarization, T, minimum	Typical specific core loss, W/kg, average		Typical magnetic polarization, T, average
		P _{1,5/50}	P _{1,7/50}		P _{1,5/50}	P _{1,7/50}	
NV23S-095L	0,23	-	0,95	1,84	0,66	0,94	1,87
NV23P-095		-	0,95	1,88	0,66	0,94	1,88
NV23S-100L		-	1,00	1,84	0,68	0,98	1,86
NV23S-100		0,70	1,00	1,86	0,69	0,98	1,87
NV23S-110		0,73	1,10	1,85	0,72	1,05	1,87
NV23S-120		0,77	1,20	1,83	0,73	1,12	1,86
NV23S-127		0,80	1,27	1,82	-	-	-
NV27P-100	0,27	-	1,00	1,88	0,72	0,99	1,89
NV27S-100L		-	1,00	1,84	0,72	0,99	1,86
NV27P-103		-	1,03	1,88	-	1,02	1,88
NV27S-105L		-	1,05	1,84	0,73	1,03	1,86
NV27S-105		0,74	1,05	1,86	0,73	1,03	1,87
NV27S-110		0,75	1,10	1,86	0,74	1,08	1,88
NV27S-120		0,80	1,20	1,84	0,78	1,12	1,87
NV27S-130	0,30	0,85	1,30	1,83	0,84	1,23	1,85
NV27S-140		0,89	1,40	1,82	-	-	-
NV30P-100		-	1,00	1,88	-	-	-
NV30P-105		-	1,05	1,88	0,75	1,04	1,88
NV30S-110L		-	1,10	1,84	0,77	1,08	1,86
NV30S-110		0,78	1,10	1,86	0,77	1,08	1,87
NV30P-111		-	1,11	1,88	-	1,09	1,88
NV30S-120	0,35	0,80	1,20	1,86	0,80	1,14	1,87
NV30S-130		0,85	1,30	1,84	0,85	1,25	1,87
NV30S-140		0,89	1,40	1,78	-	-	-
NV35S-120	0,50	0,90	1,20	1,86	0,87	1,19	1,87
NV35S-130		0,95	1,30	1,83	0,91	1,25	1,87
NV35S-145		1,00	1,45	1,81	0,97	1,33	1,86
NV50S-150	0,50	1,50	-	1,88**	-	-	-
NV50S-200		2,00	-	1,85**	-	-	-

* L index – laser-treated strip (optimized domain structure).

Annealing (heating over 450°C) of this steel is not recommended in the process of its application

** for J₂₅₀₀ (B₂₅₀₀)

PRODUCT MIX AND MAGNETIC PROPERTIES OF GO ELECTRICAL STEEL UNDER GOST 32482, GOST R 53934

GOES grade	Nominal thickness, mm	Guaranteed specific core loss, W/kg, max.		Guaranteed magnetic polarization, T, minimum	Typical specific core loss, W/kg, average	Typical magnetic polarization, T, average
		$P_{1,5/50}$	$P_{1,7/50}$			
T95-23D	0,23	-	0,95	1,87	0,94	1,87
T100-23D		-	1,00	1,86	0,98	1,86
T105-23D		-	1,05	1,85	1,03	1,86
T110-23S		-	1,10	1,85	1,05	1,87
T120-23S		-	1,20	1,83	1,12	1,86
T127-23S		-	1,27	1,82	-	-
T103-27P	0,27	-	1,03	1,88	1,02	1,88
T100-27D		-	1,00	1,86	0,99	1,86
T105-27D		-	1,05	1,85	1,03	1,86
T105-27S		-	1,05	1,87	1,03	1,88
T110-27S		-	1,10	1,86	1,08	1,88
T120-27S		-	1,20	1,84	1,12	1,87
T130-27S		-	1,30	1,83	1,23	1,85
T140-27S		-	1,40	1,82	-	-
T100-30P	0,30	-	1,00	1,88	-	-
T105-30P		-	1,05	1,88	1,04	1,88
T111-30P		-	1,11	1,88	1,09	1,88
T105-30D		-	1,05	1,86	1,04	1,86
T110-30D		-	1,10	1,85	1,08	1,86
T111-30S		-	1,11	1,87	1,09	1,88
T120-30S		-	1,20	1,86	1,14	1,87
T130-30S		-	1,30	1,84	1,25	1,87
T140-30S	0,35	-	1,40	1,82	-	-
T120-35S		-	1,20	1,86	1,19	1,87
T130-35S		-	1,30	1,83	1,25	1,87
T145-35S		-	1,45	1,81	1,33	1,86
T150-50S	0,50	1,50	-	1,88**	1,37***	1,92
T175-50S		1,75	-	1,85**	-	-

* S index – conventional grain oriented steel
P index – high permeability grain oriented steel
D index – grain oriented steel with optimized domain structure (e.g. with a laser surface treatment).

** for J_{2500} (B_{2500})

*** for $P_{1,5/50}$

Measurement of magnetic properties under IEC 60404, GOST 12119.

Reference formula: specific loss at 60 Hz = specific loss at 50 Hz x 1.316

PRODUCT MIX AND MAGNETIC PROPERTIES OF GO ELECTRICAL STEEL UNDER GOST 21427.4

Steel grade	Nominal thickness, mm	Specific magnetic loss, W/kg, max.		Magnetic induction, T, min., at magnetic field strength of, A/m					
		$P_{1,5/400}$	B_{40}	B_{80}	B_{200}	B_{400}	B_{1000}	B_{2500}	
3425	0,15	17,0	1,10	1,35	1,50	1,65	1,75	1,82	

Upon agreement with the customer, flat products may be supplied with special magnetic properties requirements.



CORRESPONDENCE OF GO ELECTRICAL STEEL GRADES UNDER NLMK'S CORPORATE STANDARD TO GRADES UNDER OTHER STANDARDS

STO 05757665-008				GOST 32482, GOST R 53934			EN 10107			IS 3024			ASTM A876					
Nominal thickness, mm	Grade	P _{1,7/50} [°] W/kg	B ₈₀₀ [°] T	Grade	P _{1,7/50} [°] W/kg	B ₈₀₀ [°] T	Grade	P _{1,7/50} [°] W/kg	B ₈₀₀ [°] T	Grade	P _{1,7/50} [°] W/kg	B ₈₀₀ [°] T	Grade	P _{1,7/50} [°] W/kg	P _{1,7/60} [°] W/kg			
0,23	Conventional steel							Conventional steel										
	NV23S-100	1,00	1,86	Not available				Not available			Not available			Not available				
	NV23S-110	1,10	1,85	T110-23S	1,10	1,85		M110-23S	1,10	1,78	23CG110	1,10	1,78	Not available				
	Not available			Not available				Not available			Not available			23H070	1,17	1,54		
	NV23S-120	1,20	1,83	T120-23S	1,20	1,83		M120-23S	1,20	1,78	23CG120	1,20	1,78	Not available				
	NV23S-127	1,27	1,82	T127-23S	1,27	1,82		M127-23S	1,27	1,75	23CG127	1,27	1,75					
	High permeability steel							High permeability steel										
	Not available			Not available				M85-23P	0,85	1,88	23HP85d	0,85	1,85	Not available				
							M90-23P	0,90	1,88	23HP90d	0,90	1,85						
	NV23P-095	0,95	1,88					M95-23P	0,95	1,88	23HP95d	0,95	1,85					
	Not available							M100-23P	1,00	1,85	23HP100d	1,00	1,85					
	Optimized domain structure (laser-treated) steel							Optimized domain structure (laser-treated) steel										
	Not available			Not available				Not available			Not available			23Q054	0,90	1,19		
	NV23S-095L	0,95	1,84	T95-23D	0,95	1,87	Not available											
	NV23S-100L	1,00	1,84	T100-23D	1,00	1,86												
Not available			T105-23D	1,05	1,85													
0,27	Conventional steel							Conventional steel										
	NV27S-105	1,05	1,86	T105-27S	1,05	1,87		Not available			Not available			Not available				
	NV27S-110	1,10	1,86	T110-27S	1,10	1,86												
	NV27S-120	1,20	1,84	T120-27S	1,20	1,84		M120-27S	1,20	1,78	27CG120	1,20	1,78					
	Not available			Not available				Not available			Not available			27H074	1,24	1,63		
	NV27S-130	1,30	1,83	T130-27S	1,30	1,83		M130-27S	1,30	1,78	27CG130	1,30	1,78	Not available				
	NV27S-140	1,40	1,82	T140-27S	1,40	1,82		M140-27S	1,40	1,75	27CG140	1,40	1,75					
	High permeability steel							High permeability steel										
	Not available			T90-27P	0,90	1,88		M90-27P	0,90	1,88	27HP90d	0,90	1,85	Not available				
				T95-27P	0,95	1,88		M95-27P	0,95	1,88	27HP95d	0,95	1,85					
	NV27P-100	1,00	1,88	T103-27P	1,03	1,88		M100-27P	1,00	1,88	27HP100	1,00	1,88					
	NV27P-103	1,03	1,88	T103-27P	1,03	1,88		Not available			Not available							
	Not available			Not available				M110-27P	1,10	1,88	27HP110	1,10	1,88	27P066				
				Not available				Not available			Not available							
	Optimized domain structure (laser-treated) steel							Optimized domain structure (laser-treated) steel										
	Not available			T95-27D	0,95	1,87		Not available			Not available			Not available				
				Not available										27Q057	0,96	1,26		
	NV27S-100L	1,00	1,84	T100-27D	1,00	1,86	Not available											
	NV27S-105L	1,05	1,84	T105-27D	1,05	1,85												

STO 05757665-008				GOST 32482, GOST R 53934			EN 10107			IS 3024			ASTM A876			
Nominal thickness, mm	Grade	P _{1,7/50°} W/kg	B _{800°} T	Grade	P _{1,7/50°} W/kg	B _{800°} T	Grade	P _{1,7/50°} W/kg	B _{800°} T	Grade	P _{1,7/50°} W/kg	B _{800°} T	Grade	P _{1,7/50°} W/kg	P _{1,7/60°} W/kg	
0,30	Conventional steel							Conventional steel								
	NV30S-110	1,10	1,86	T111-30S	1,11	1,87		Not available			Not available			Not available		
	NV30S-120	1,20	1,86	T120-30S	1,20	1,86		M120-30S	1,20	1,78						
	NV30S-130	1,30	1,84	T130-30S	1,30	1,84		M130-30S	1,30	1,78	30CG130	1,30	1,78			
	Not available						Not available				Not available					
	NV30S-140	1,40	1,78	T140-30S	1,40	1,82		M140-30S	1,40	1,78	30CG140	1,40	1,78	Not available		
	Not available			Not available				M150-30S	1,50	1,75	30CG150	1,50	1,75			
	High permeability steel							High permeability steel								
	NV30P-100	1,00	1,88	T100-30P	1,00	1,88		M100-30P	1,00	1,88	Not available			Not available		
	NV30P-105	1,05	1,88	T105-30P	1,05	1,88		M105-30P	1,05	1,88	30HP105	1,05	1,88			
	NV30P-111	1,11	1,88	T111-30P	1,11	1,88		M110-30P	1,10	1,88	30HP110	1,10	1,88			
	Not available			Not available				Not available			30HP120	1,20	1,88			
	Optimized domain structure (laser-treated) steel							Optimized domain structure (laser-treated) steel								
	Not available			T100-30D	1,00	1,87		Not available			Not available			Not available		
				T105-30D	1,05	1,86										
	NV30S-110L	1,10	1,84	T110-30D	1,10	1,85										
0,35	Conventional steel							Conventional steel								
	NV35S-120	1,20	1,86	T120-35S	1,20	1,86		Not available			Not available			Not available		
	NV35S-130	1,30	1,83	T130-35S	1,30	1,83		M135-35S	1,35	1,78						
	-	-	-					M145-35S	1,45	1,78	35CG145	1,45	1,78			
	NV35S-145	1,45	1,81	T145-35S	1,45	1,81		M155-35S	1,55	1,78	35CG155	1,55	1,78			
	Not available			Not available				Not available			Not available					
								M165-35S	1,65	1,75	35CG165	1,65	1,75	Not available		
	High permeability steel							High permeability steel								
	Not available			Not available				M115-35P	1,15	1,88	35HP115	1,15	1,88	Not available		
								M125-35P	1,25	1,88	35HP125	1,25	1,88			
								Not available			35HP135	1,35	1,88			

PACKAGING

Packing of NLMK’s products provides protection of rolled product from damage during handling, transportation and impact from ambient environment.

Product packaging patterns are developed and applied on horizontal and vertical axes. There is a possibility to deliver rolled product in containers.

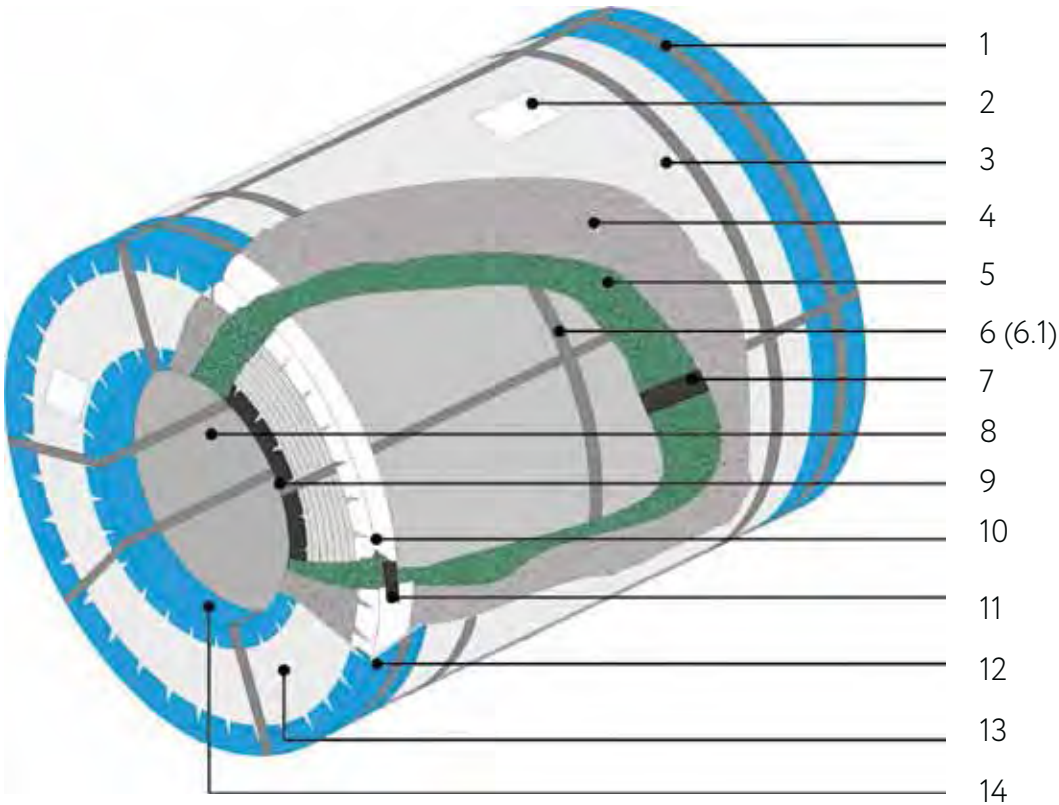
Main packaging patterns are shown on schemes. Upon agreement with the customer, other packing elements may be used.

For corrosion protection, steel in an intact original packing of a manufacturer shall be stored in roofed warehouses preventing moisture penetration.



Storage of anisotropic electrical steel in Lipetsk – key production site of NLMK Group

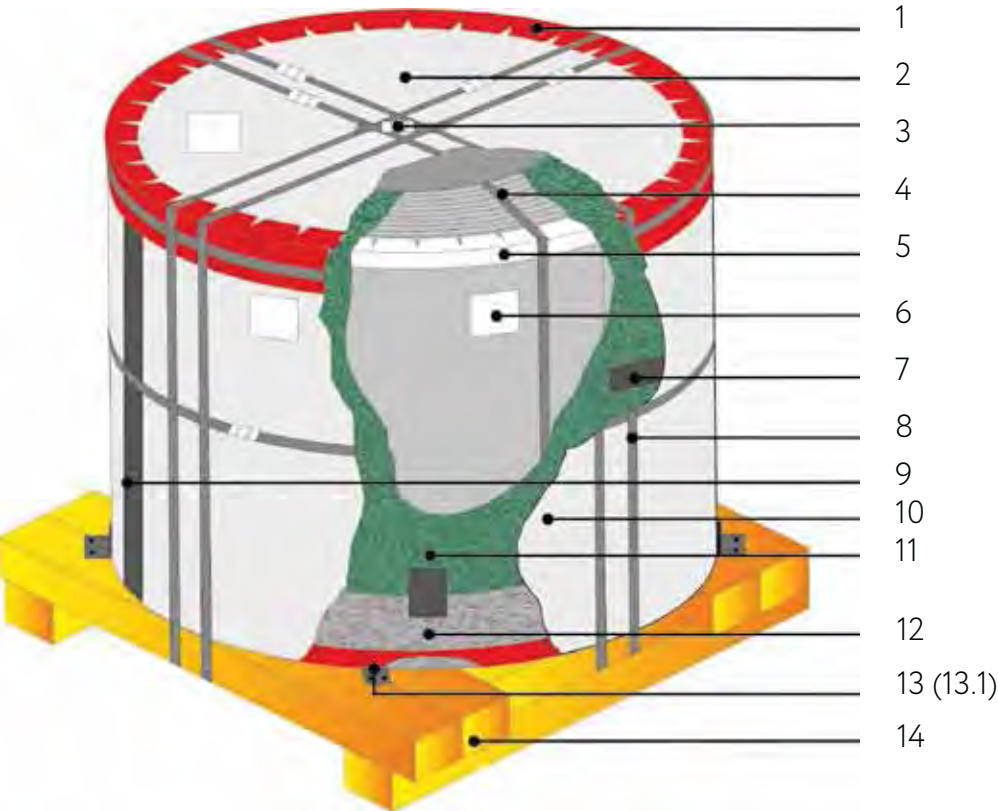
HORIZONTAL AXIS PACKAGING SCHEME



APPLICABLE PACKING ELEMENTS

Item №	Packing element
1	Polyester strap 1.3×25 mm
2	Shipment label
3	Outer packing steel sheet
4	PE film
5	Antirust packing paper
6	Polyester strap 1.0×19 mm
6.1	Steel strap 1.0×32 mm
7	Adhesive tape 100 mm
8	Inner packing sheet
9	Steel strap 1.0×30-32 mm
10	Protective cardboard angle 60x60 mm
11	Adhesive tape 50 mm
12	Inner angle
13	Steel angle 75x75 mm
14	Outer packing steel sheet

VERTICAL AXIS PACKAGING SCHEME



APPLICABLE PACKING ELEMENTS

Item №	Packing element
1	Outer corrugated angle
2	Steel top cover
3	Strapping fastener
4	Polyester strap 1.3×25 mm
5	Protective cardboard angle 60×60 mm
6	Shipment label
7	Adhesive tape 50 mm
8	Steel strap 0.8×32 mm
9	Adhesive tape 100 mm
10	Outer packing (steel) sheet
11	Antirust packing paper
12	PE film
13	Metal angle 75×75 mm
13.1	Nails
14	Pallet for vertical axis shipment

LOGISTICS

Starting from 2013 NLMK sites in Lipetsk and Ekaterinburg ship electrical steel in containers.

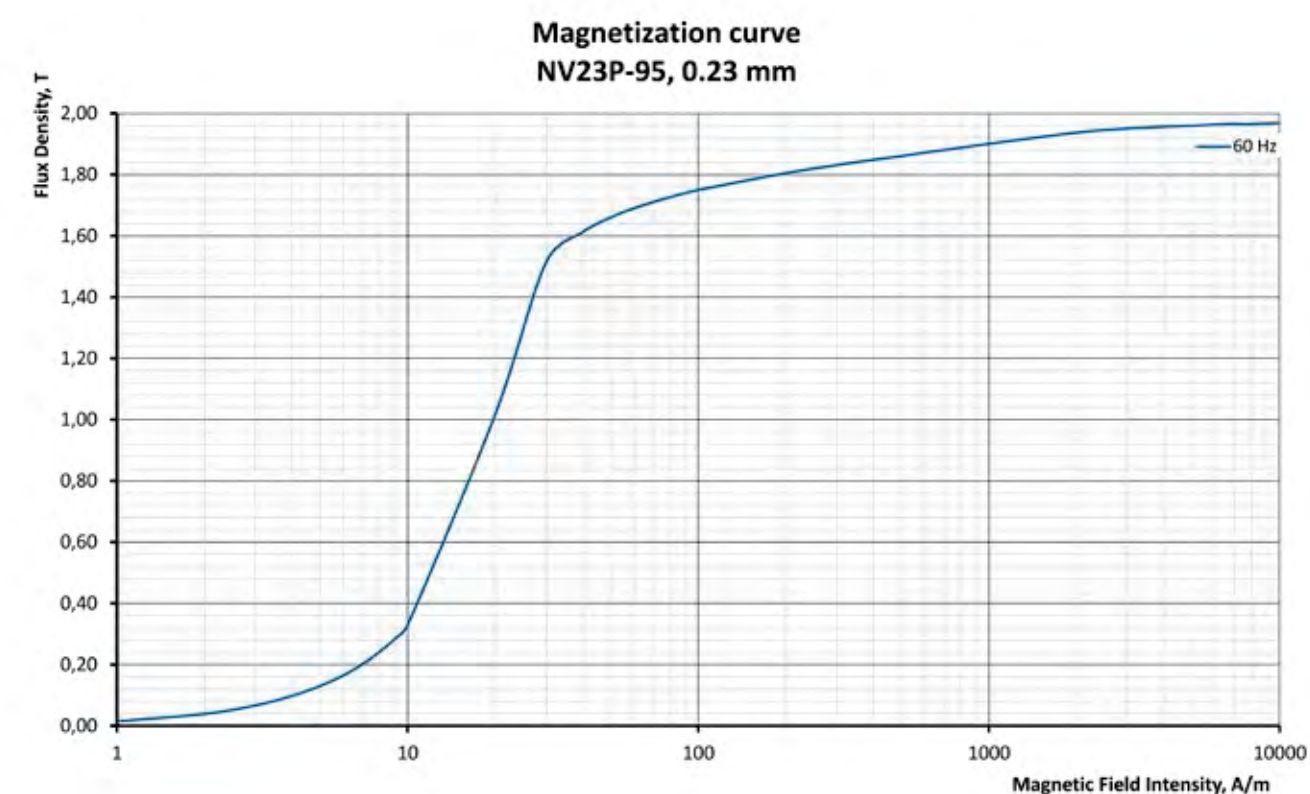
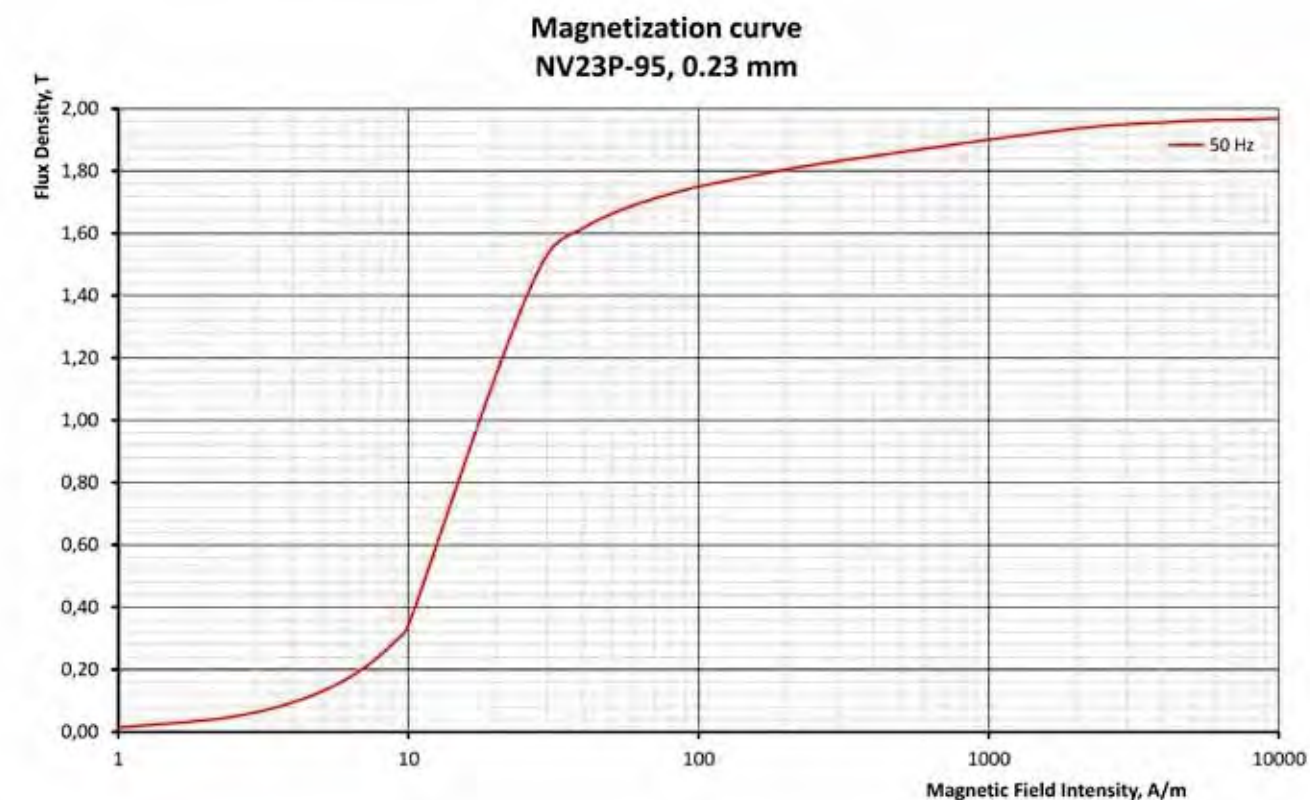
Shipment in containers in comparison with open wagons allows to reduce significantly risks of mechanical damage during transportation as well as corrosion generation. Container shipments are possible to different countries. Respective routes and container loading schemes on horizontal and vertical axes are developed.



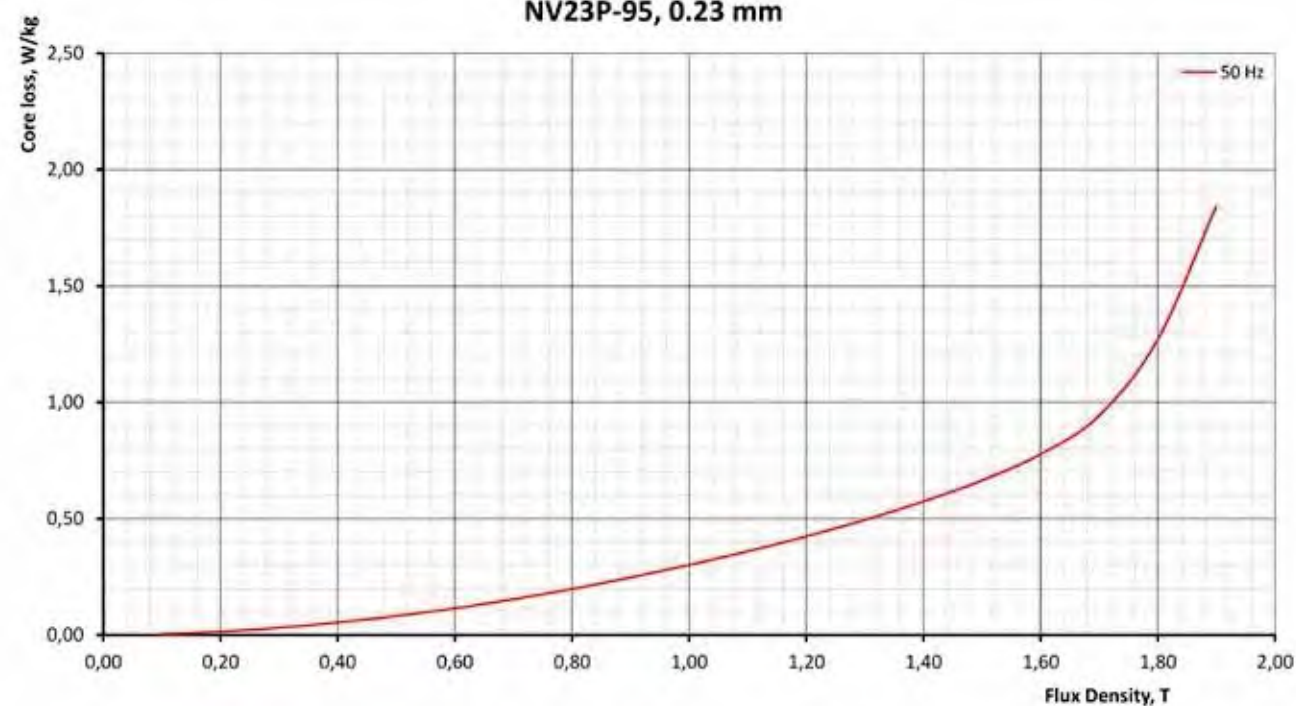
MAGNETIC PROPERTIES DIAGRAMS

PAGE INDEX OF DIAGRAMS OF STEEL MAGNETIC PROPERTIES PER GRADE

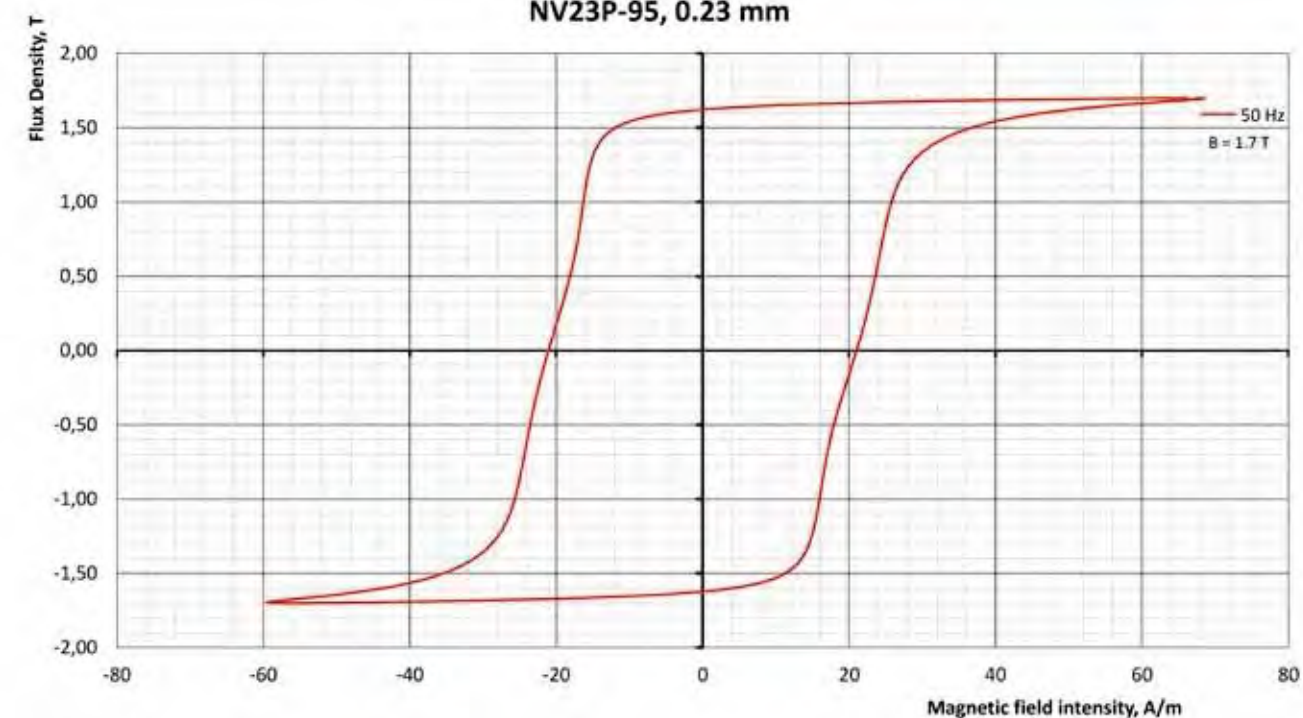
Thickness, mm	Steel grade per STO 05757665-008	Magnetization curves	Specific core loss curves	Hysteresis loops	Exciting power curves	Magnetic permeability amplitude
0,23	NV23P-95	27	28	29	30	31
	NV23S-95L	32	33	34	35	36
	NV23S-100L	37	38	39	40	41
	NV23S-100	42	43	44	45	46
	NV23S-110	47	48	49	50	51
	NV23S-120	52	53	54	55	56
0,27	NV27P-100	57	58	59	60	61
	NV27S-100L	62	63	64	65	66
	NV27S-105L	67	68	69	70	71
	NV27S-105	72	73	74	75	76
	NV27S-110	77	78	79	80	81
	NV27S-120	82	83	84	85	86
0,30	NV27S-130	87	88	89	90	91
	NV30S-110L	92	93	94	95	96
	NV30S-110	97	98	99	100	101
	NV30S-120	102	103	104	105	106
	NV30S-130	107	108	109	110	111
	NV35S-120	112	113	114	115	116
	NV35S-130	117	118	119	120	121
	NV35S-145	122	123	124	125	126



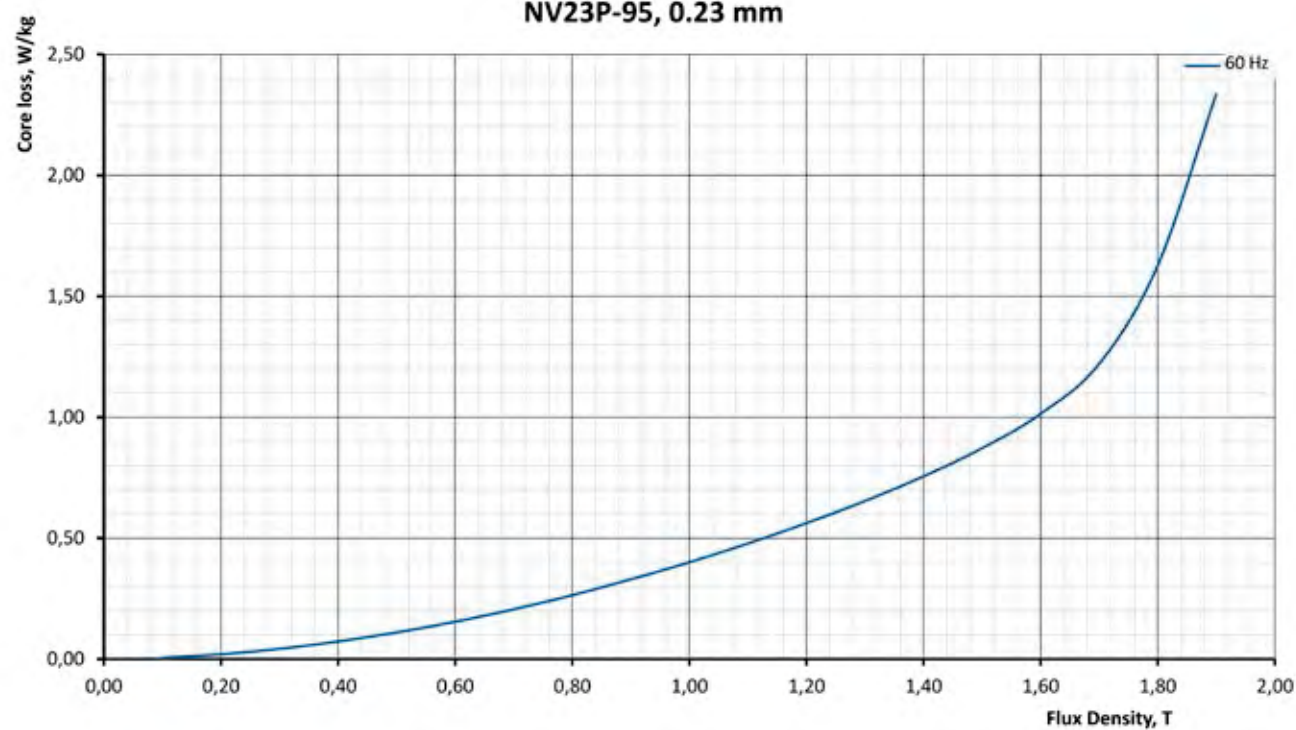
Specific core loss
NV23P-95, 0.23 mm



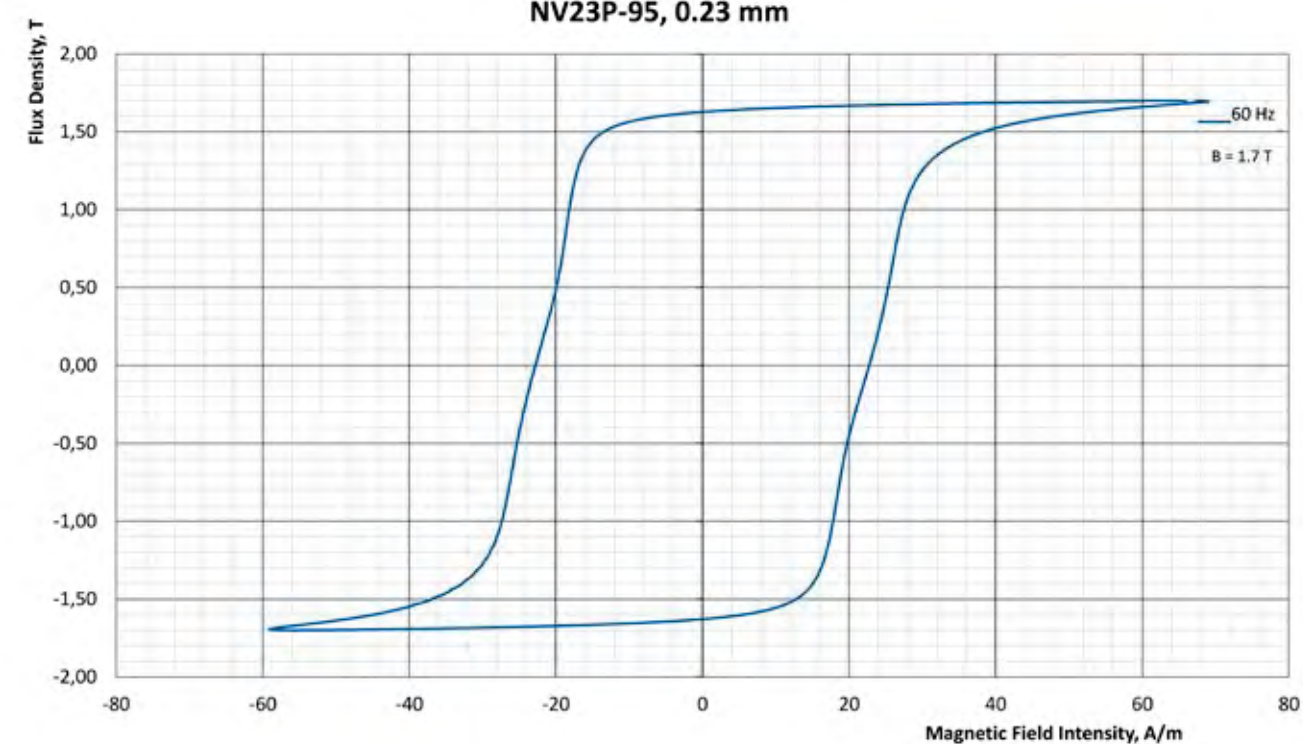
Hysteresis loop
NV23P-95, 0.23 mm

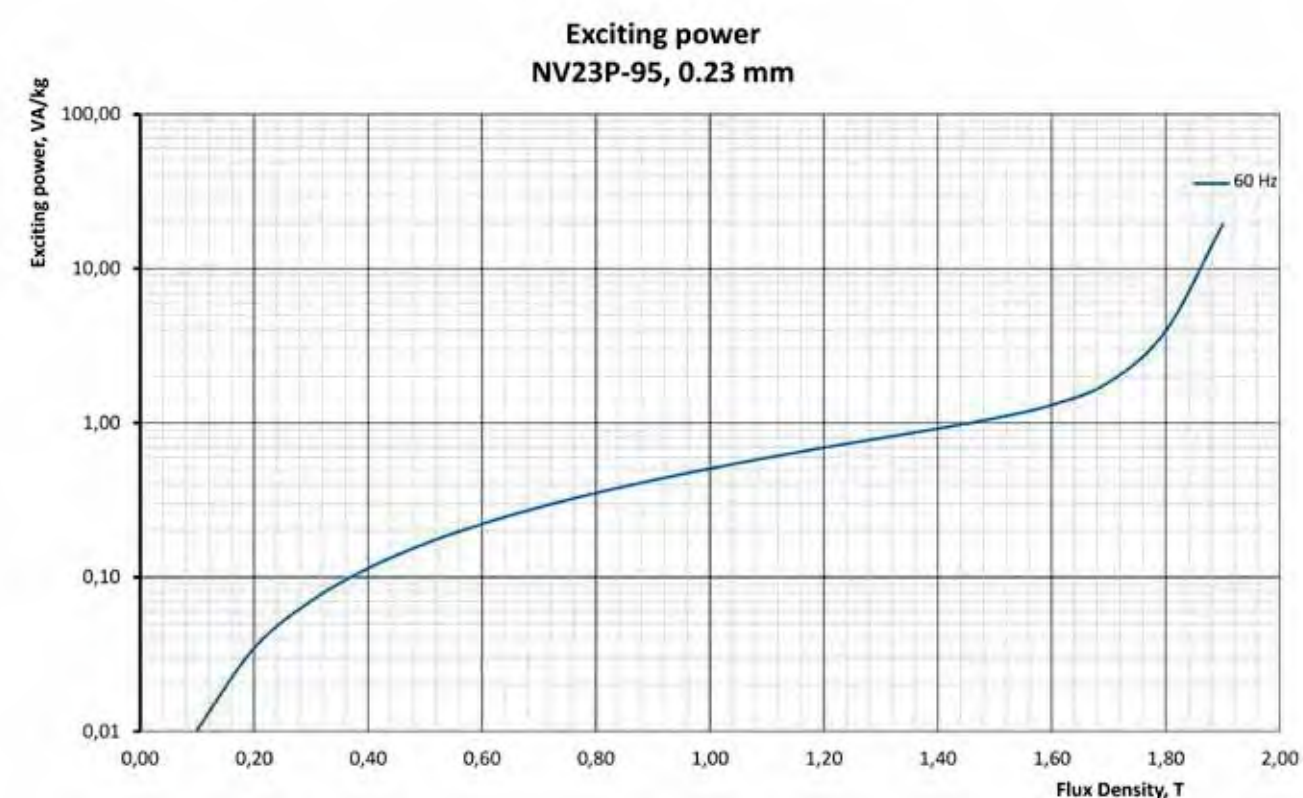
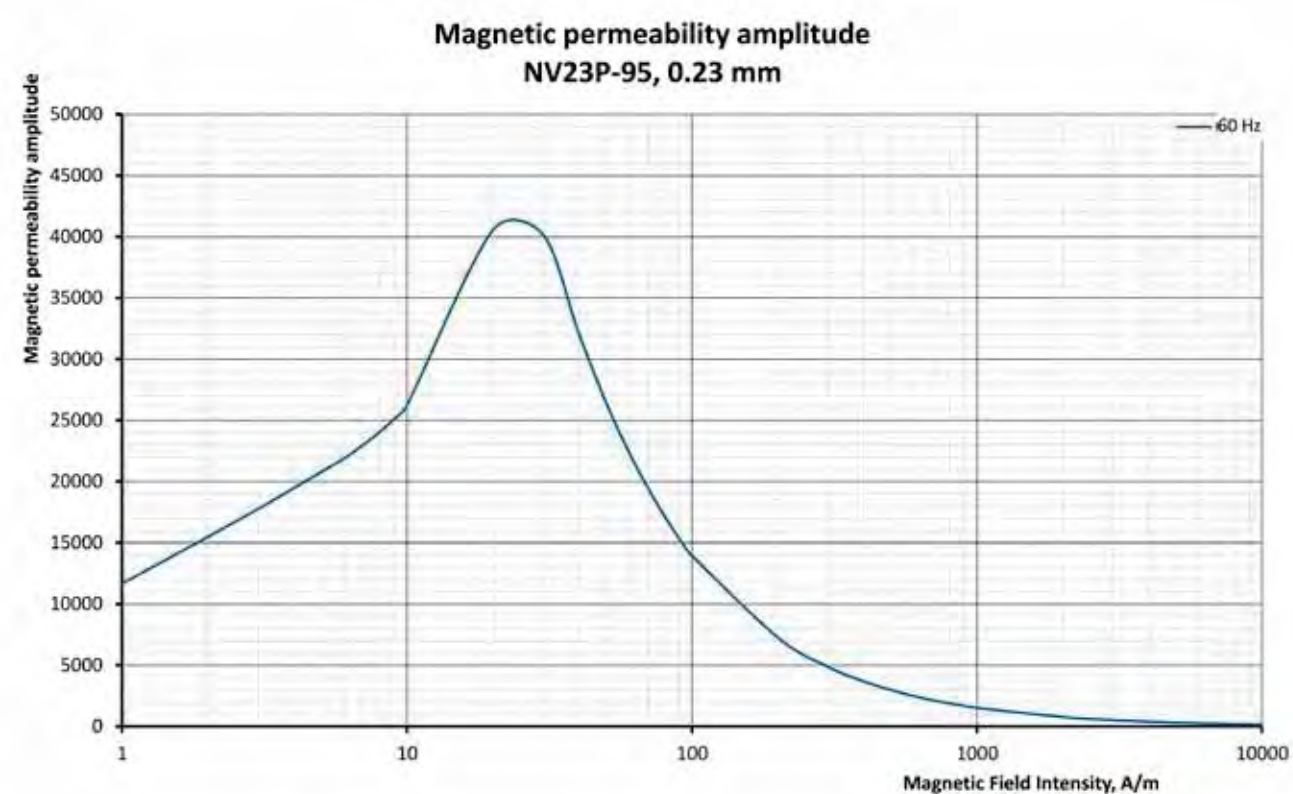
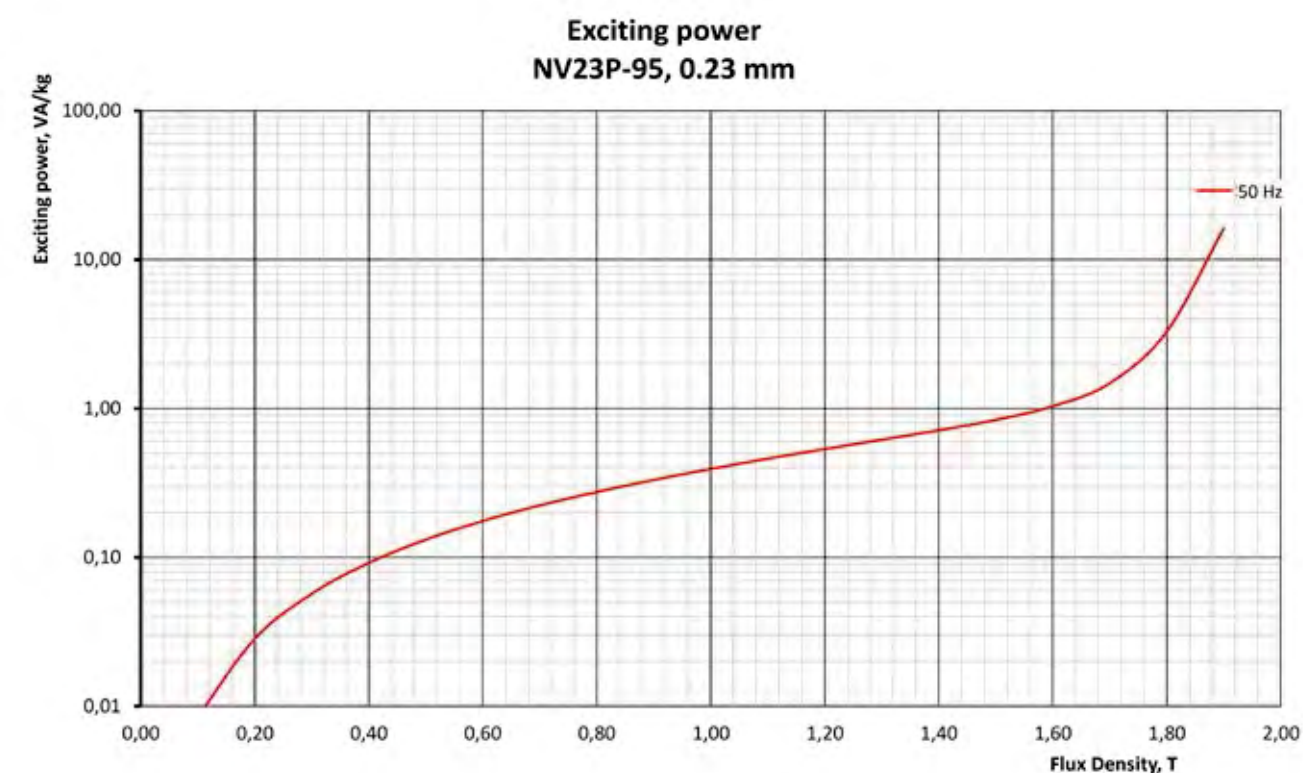
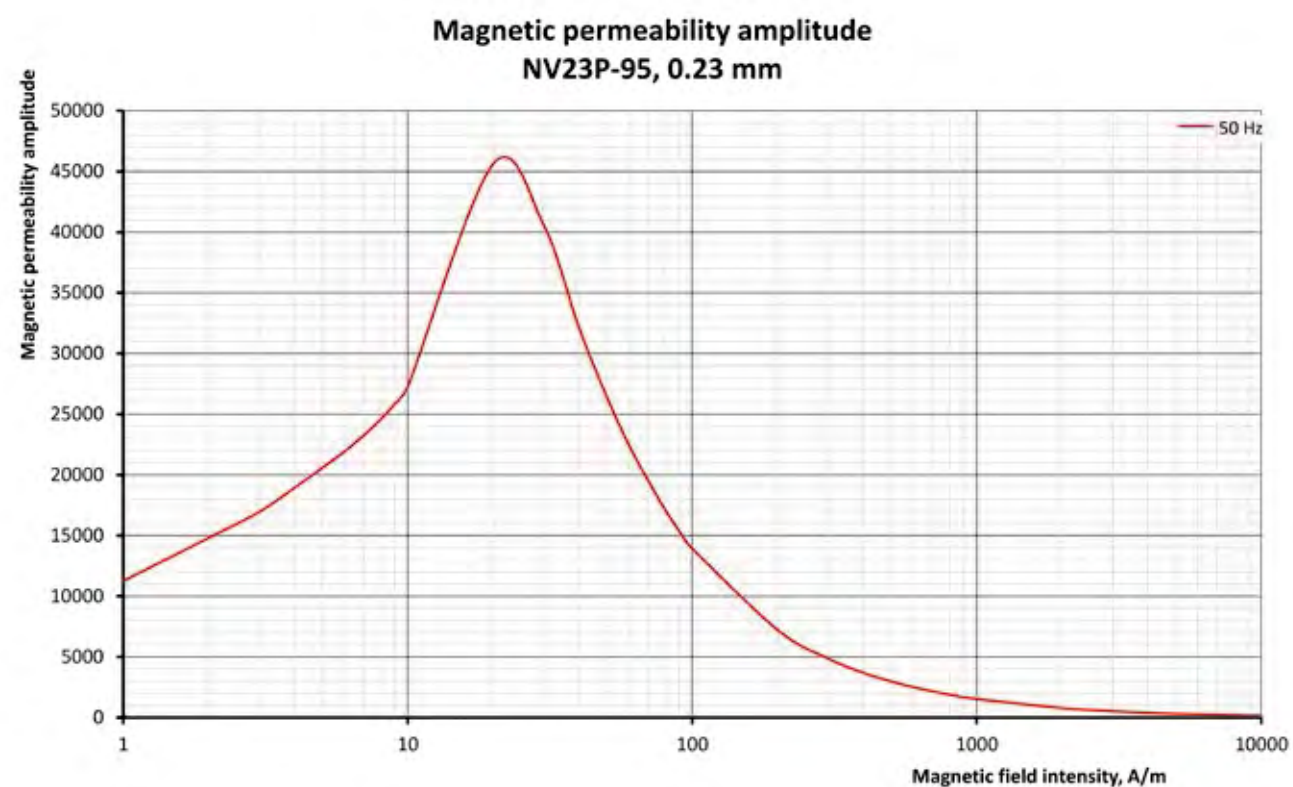


Specific core loss
NV23P-95, 0.23 mm



Hysteresis loop
NV23P-95, 0.23 mm

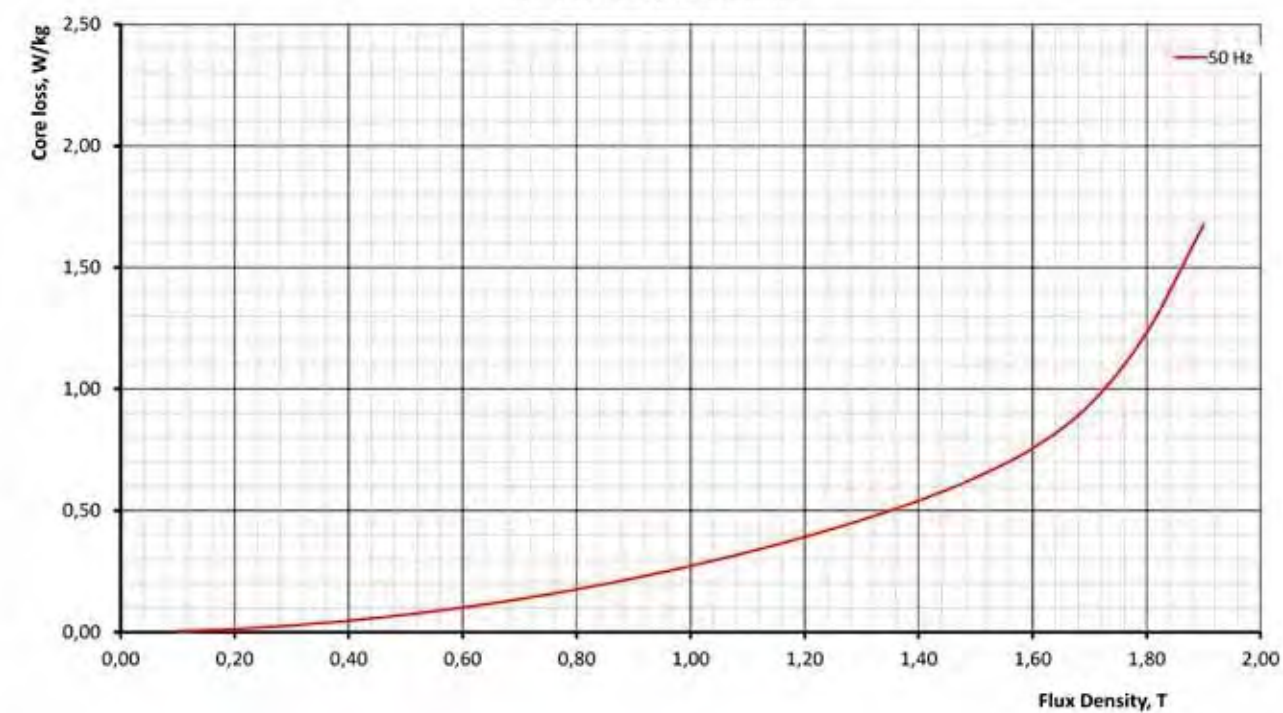




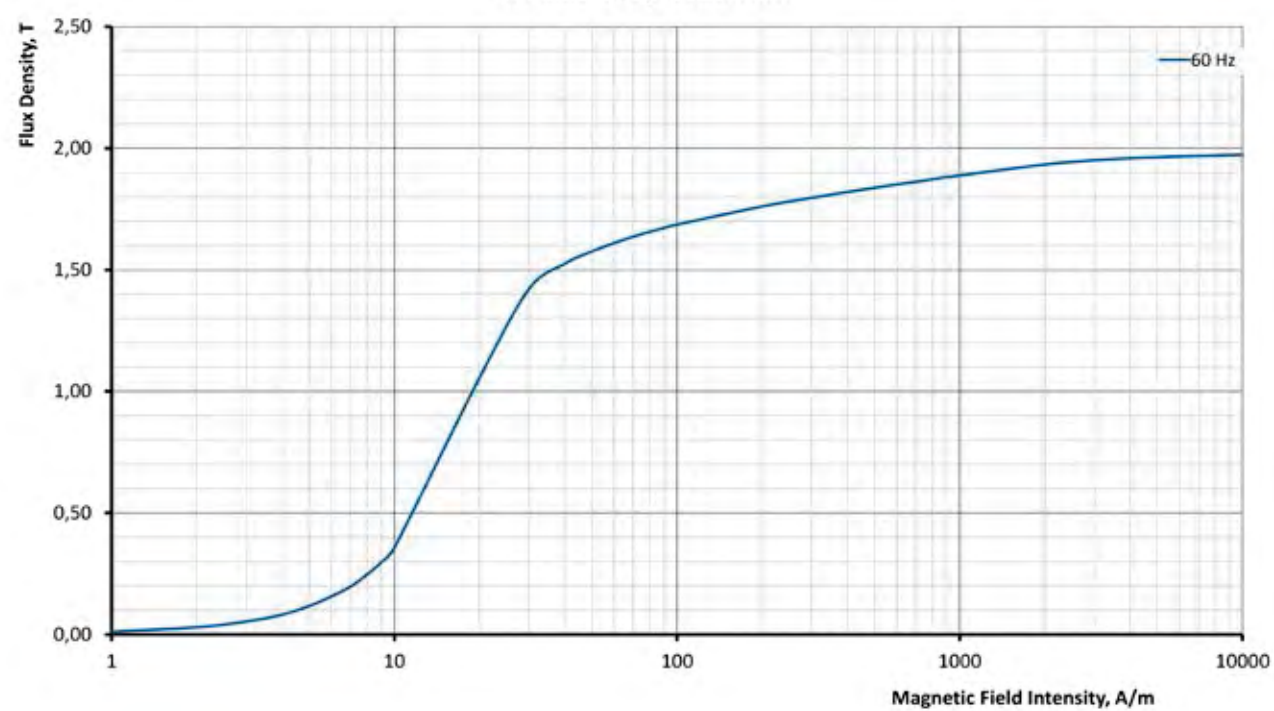
**Magnetization curve
NV23S-95L, 0.23 mm**



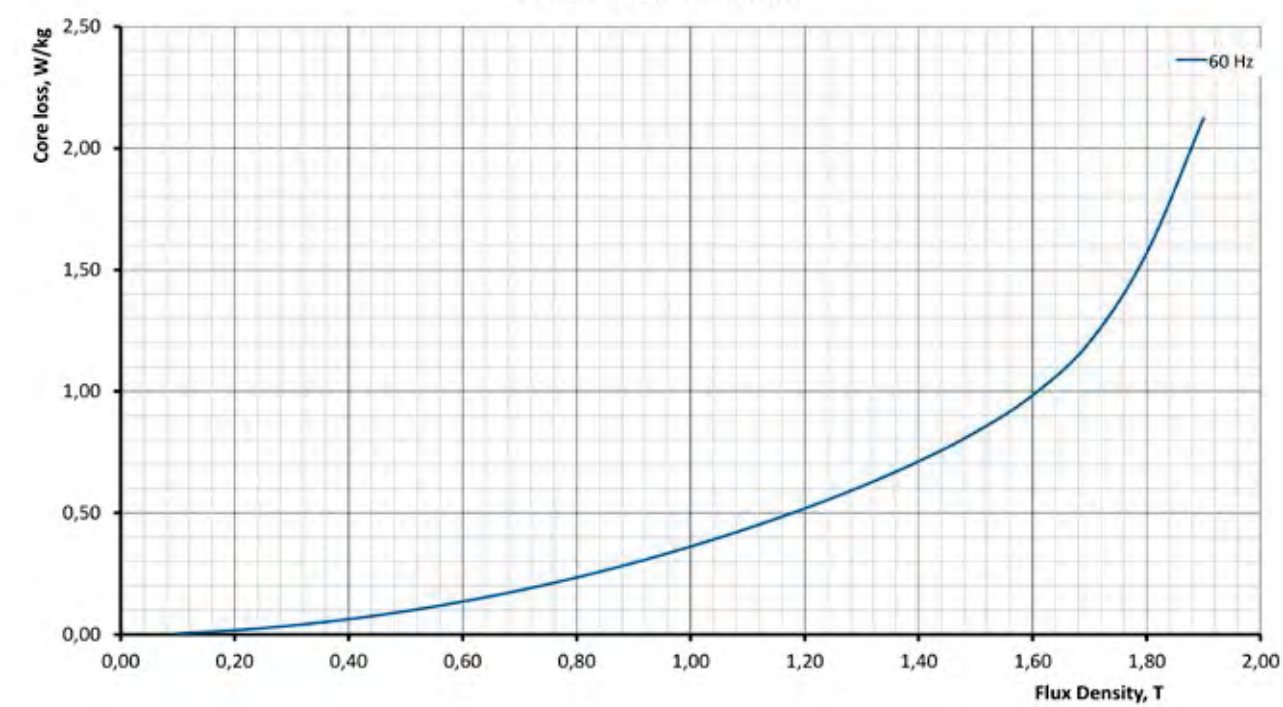
**Specific core loss
NV23S-95L, 0.23 mm**

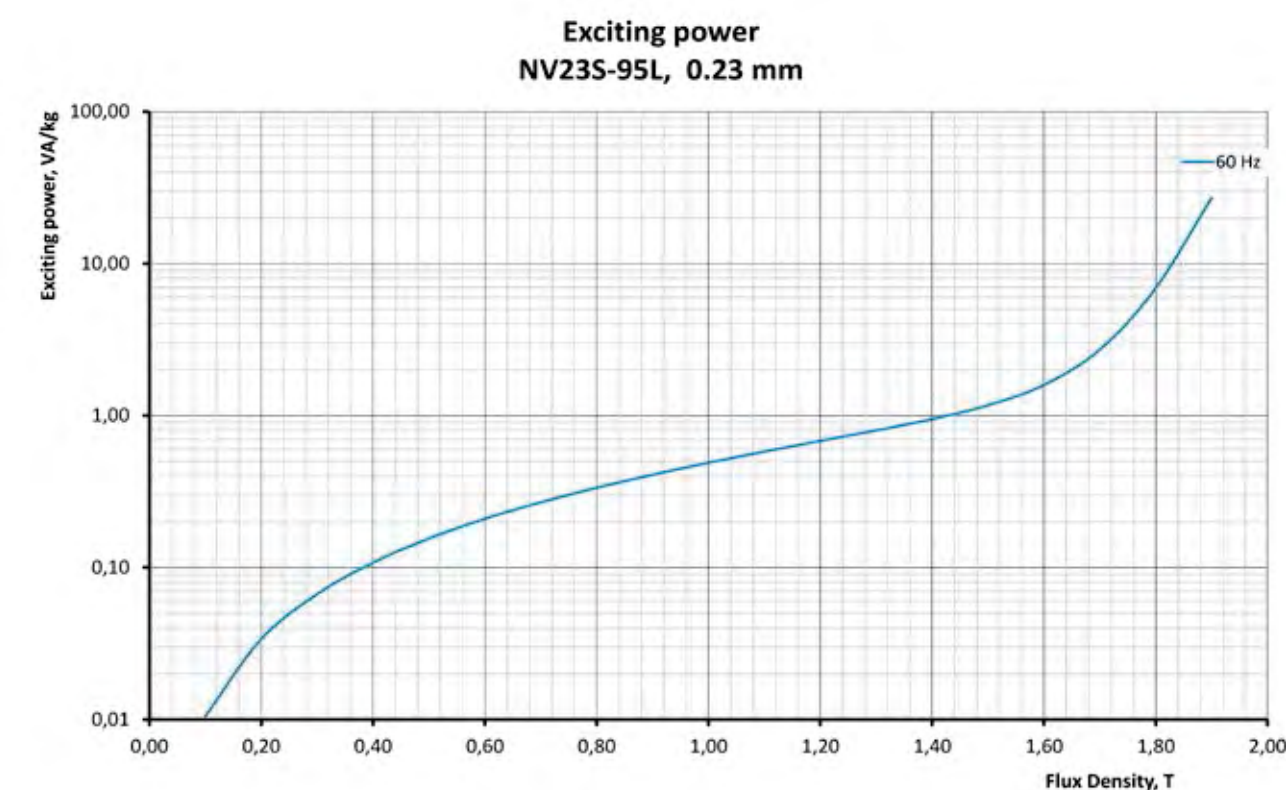
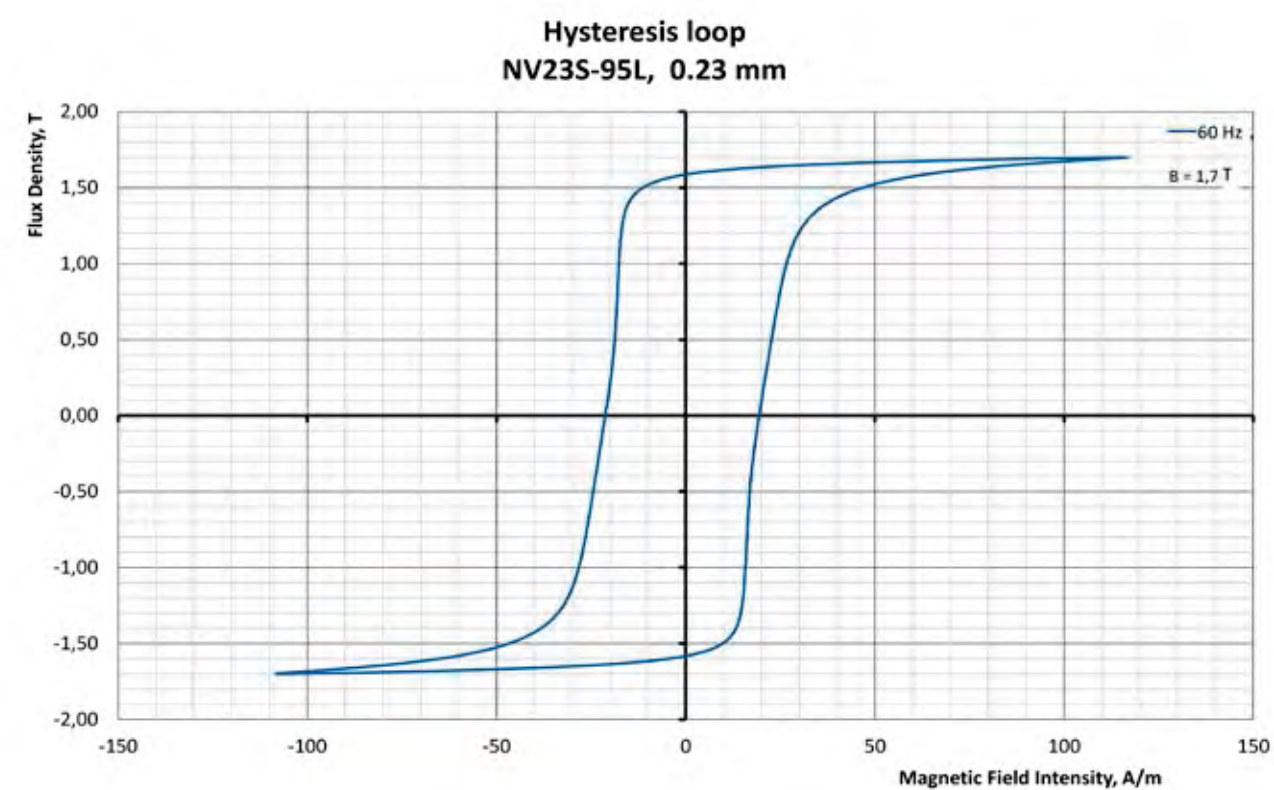
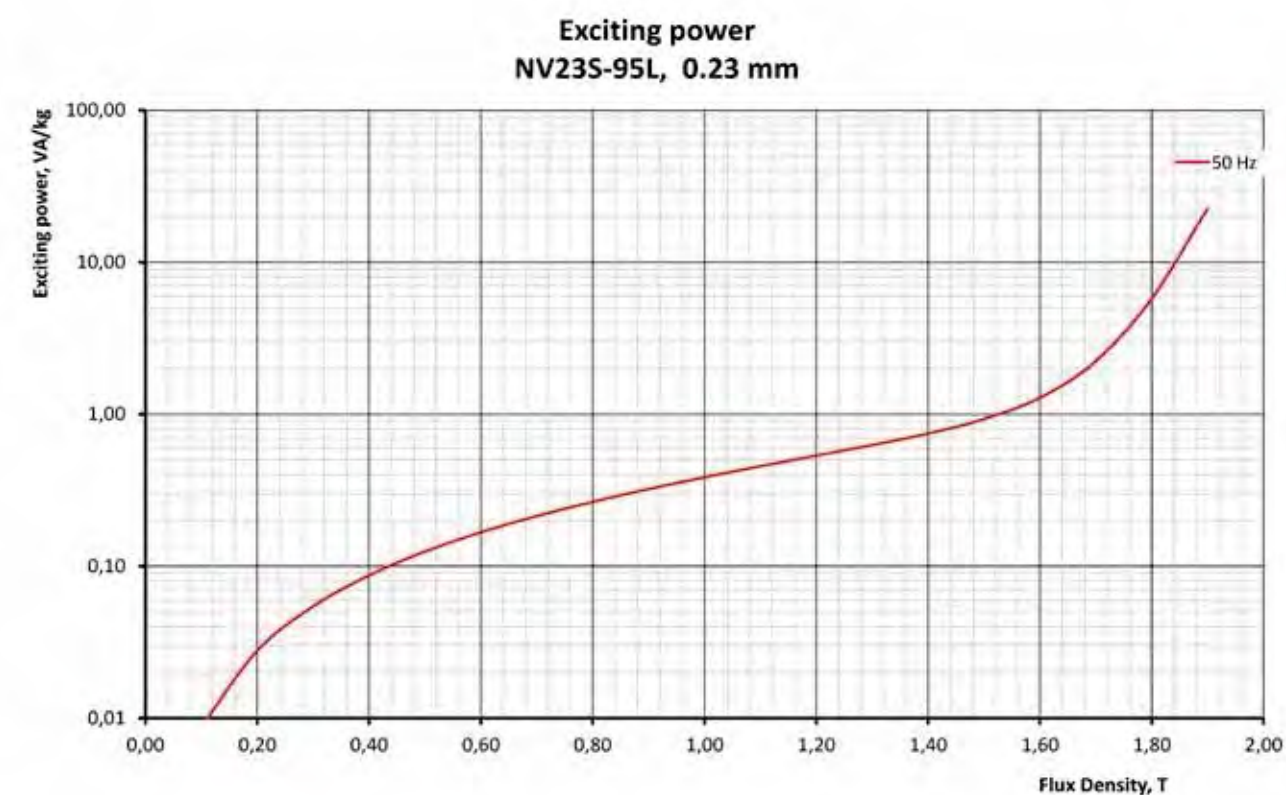
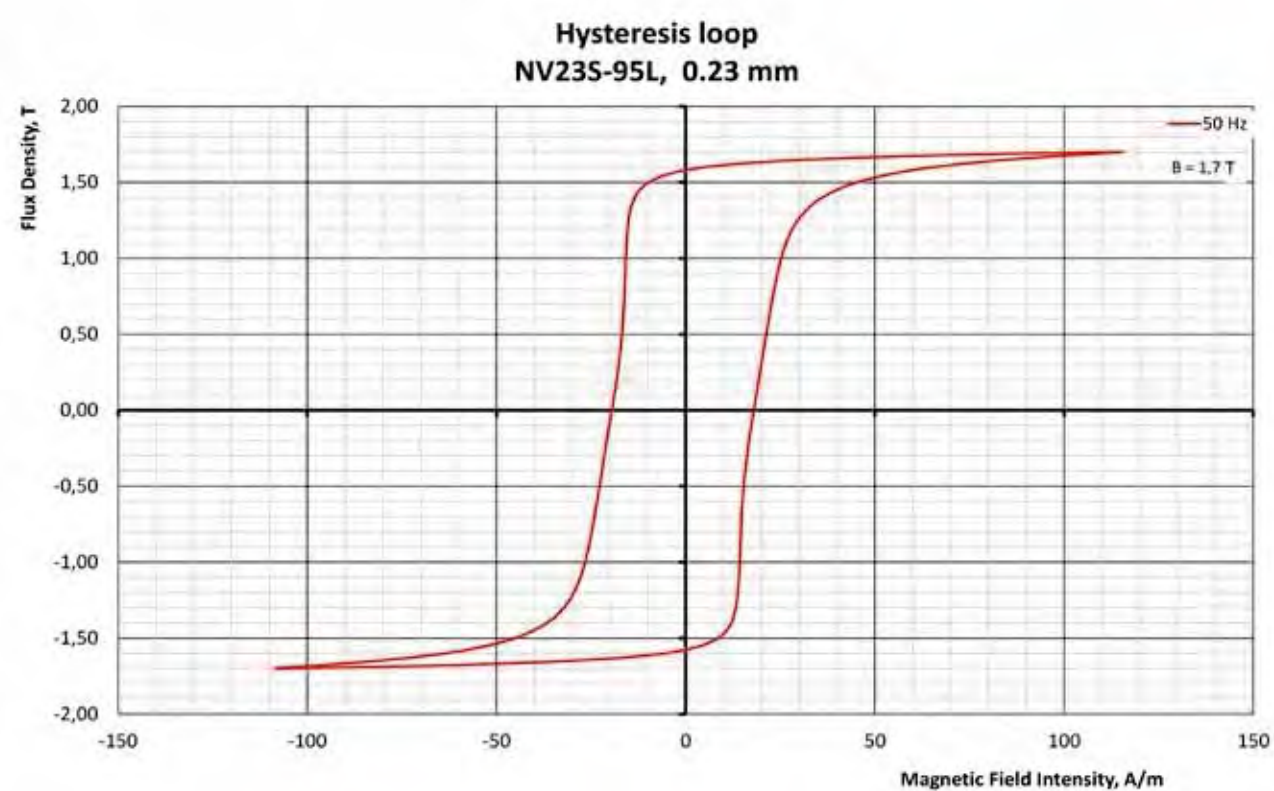


**Magnetization curve
NV23S-95L, 0.23 mm**

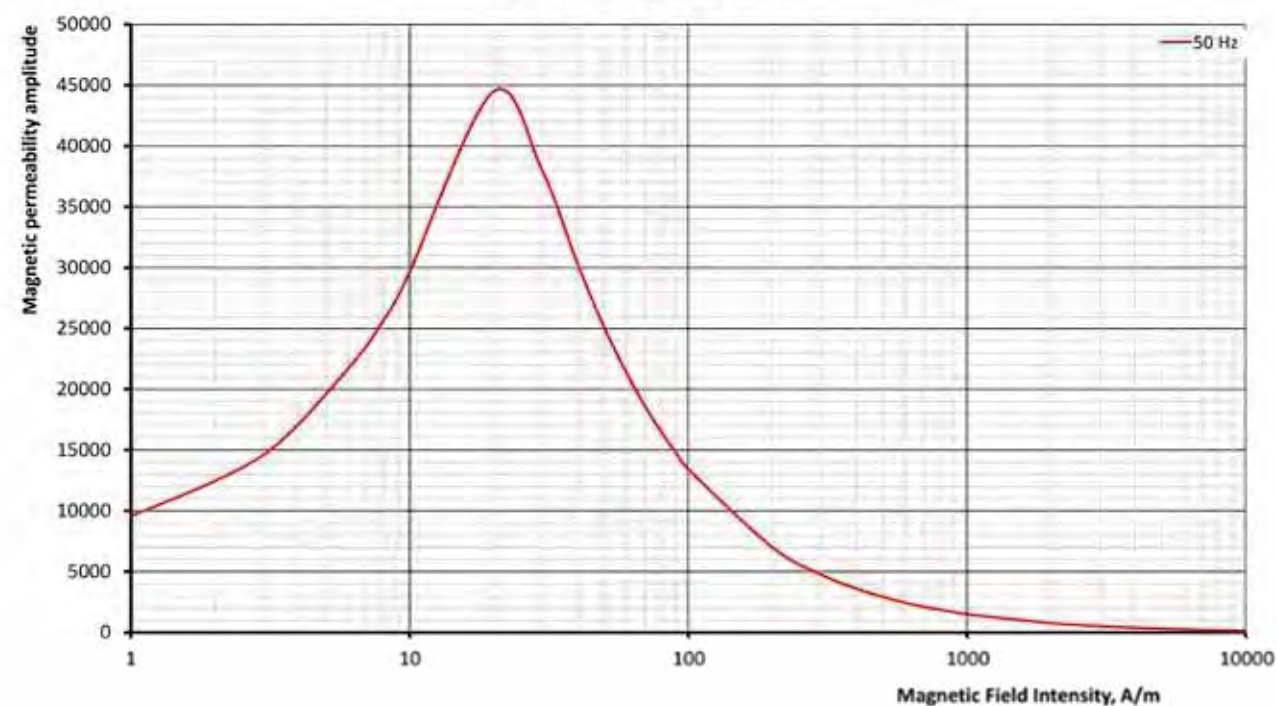


**Specific core loss
NV23S-95L, 0.23 mm**

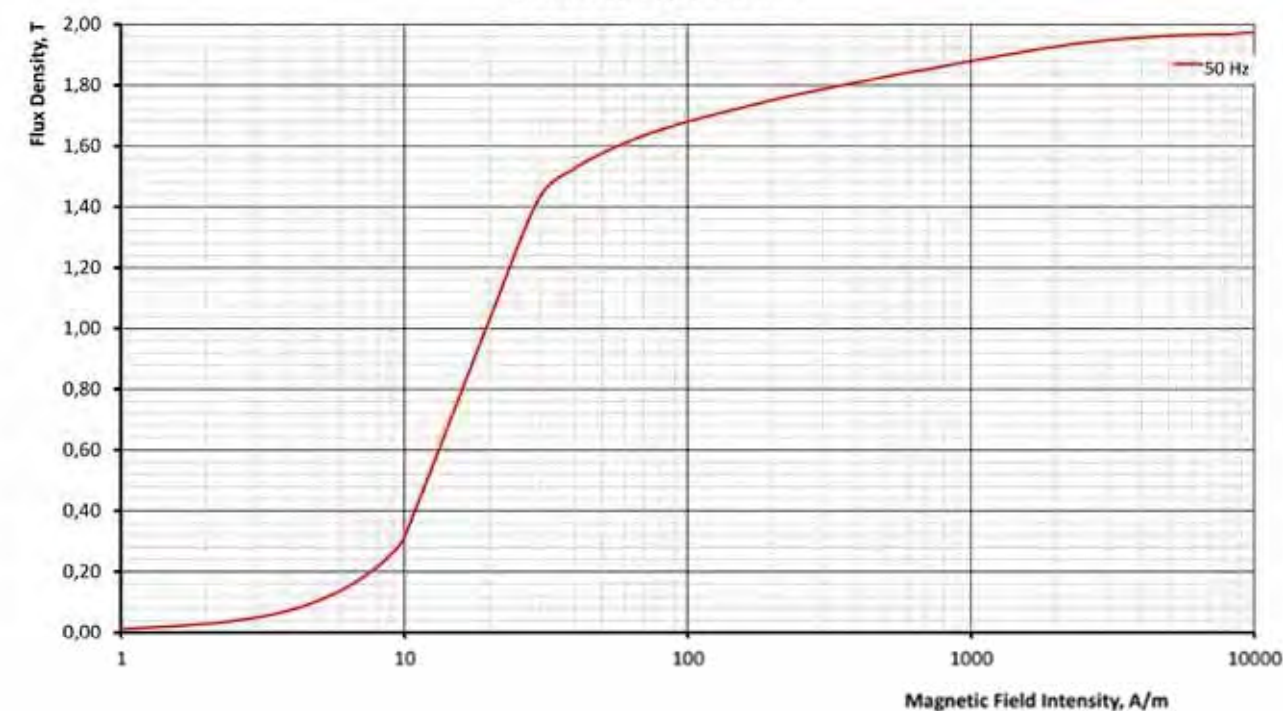




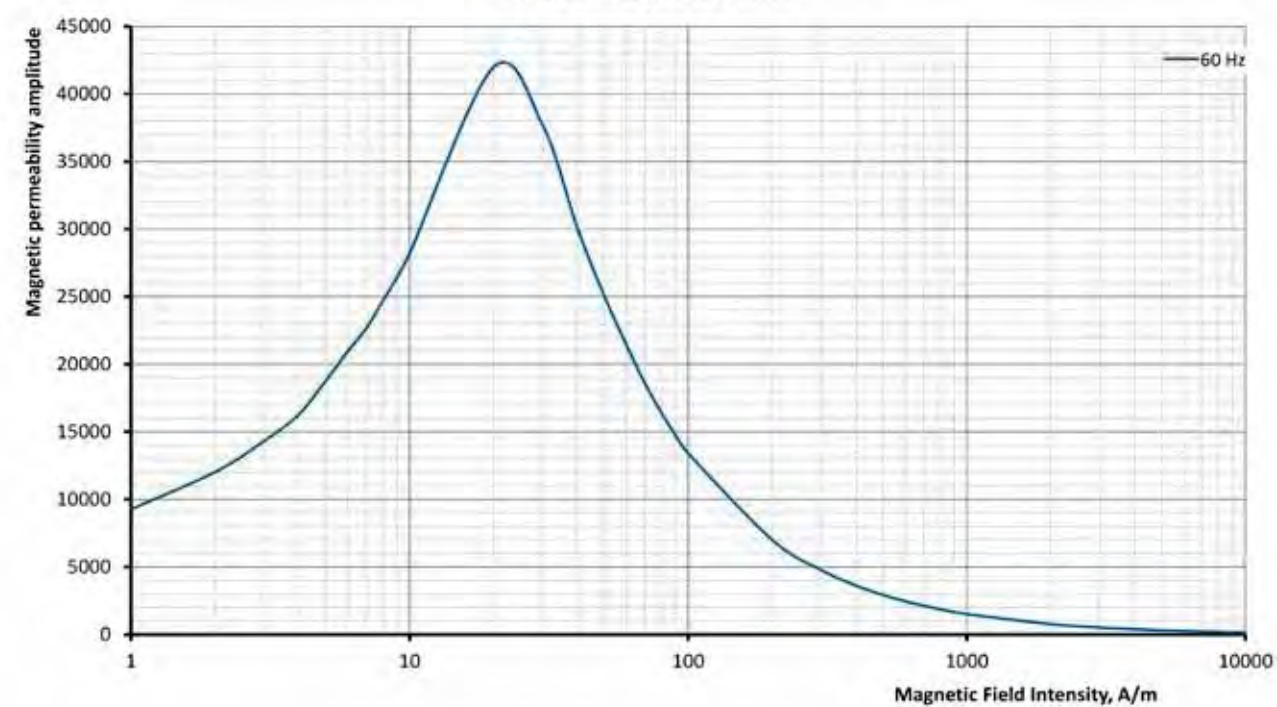
Magnetic permeability amplitude
NV23S-95L, 0.23 mm



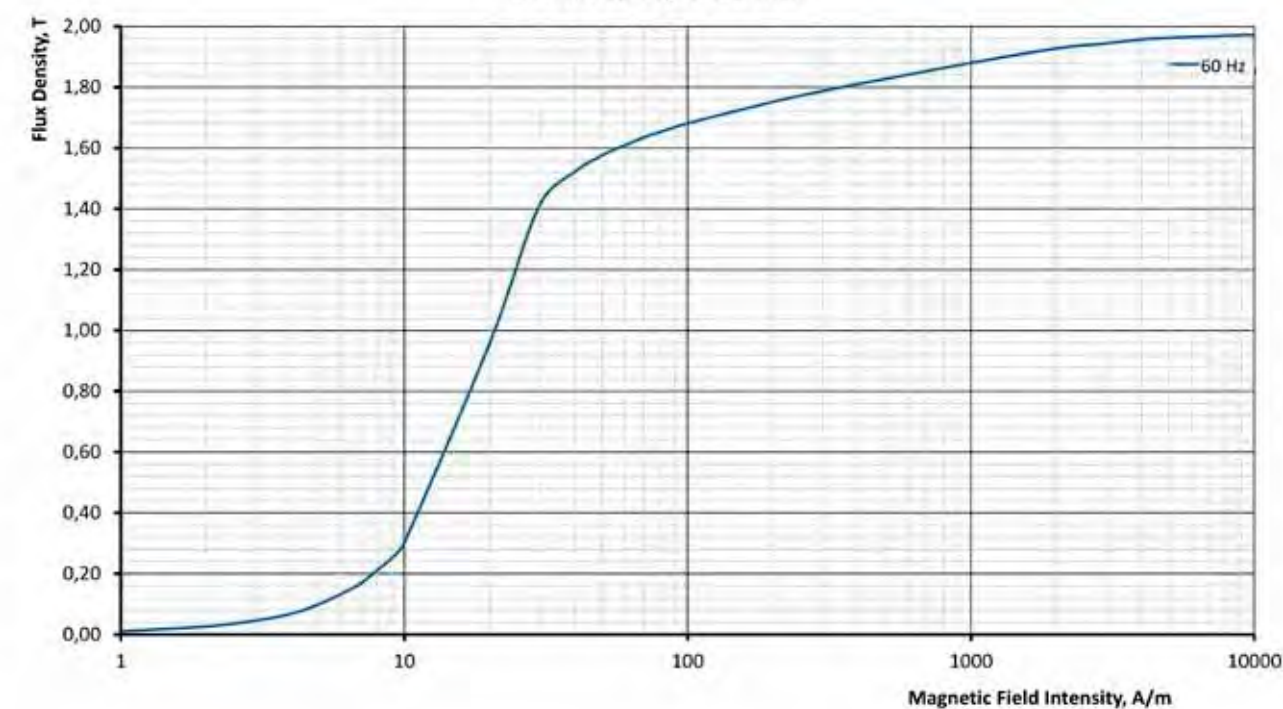
Magnetization curve
NV23S-100L, 0.23 mm



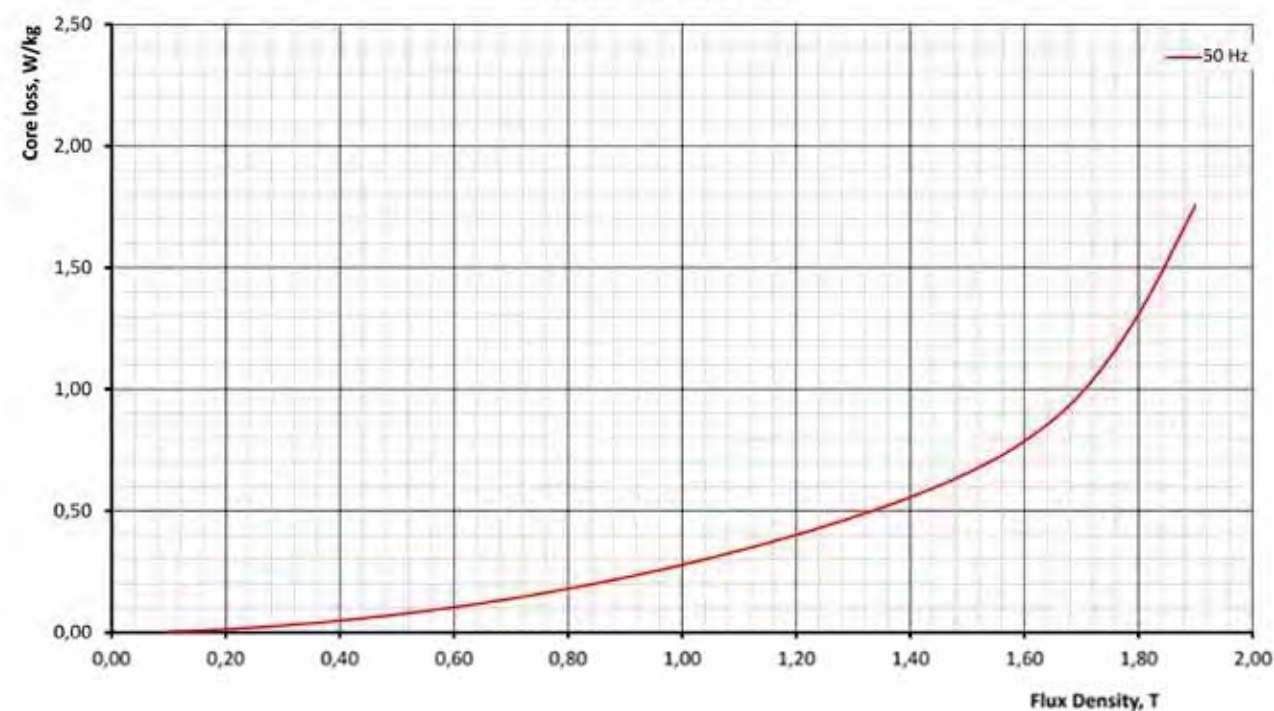
Magnetic permeability amplitude
NV23S-95L, 0.23 mm



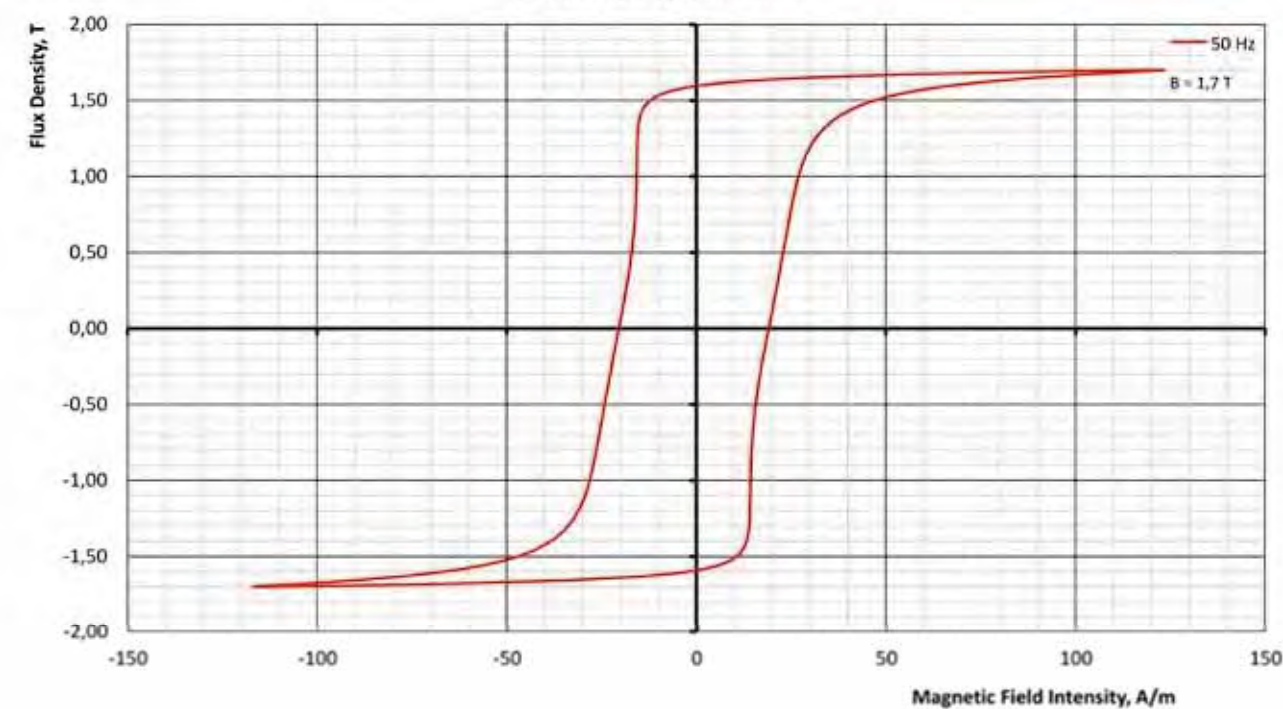
Magnetization curve
NV23S-100L, 0.23 mm



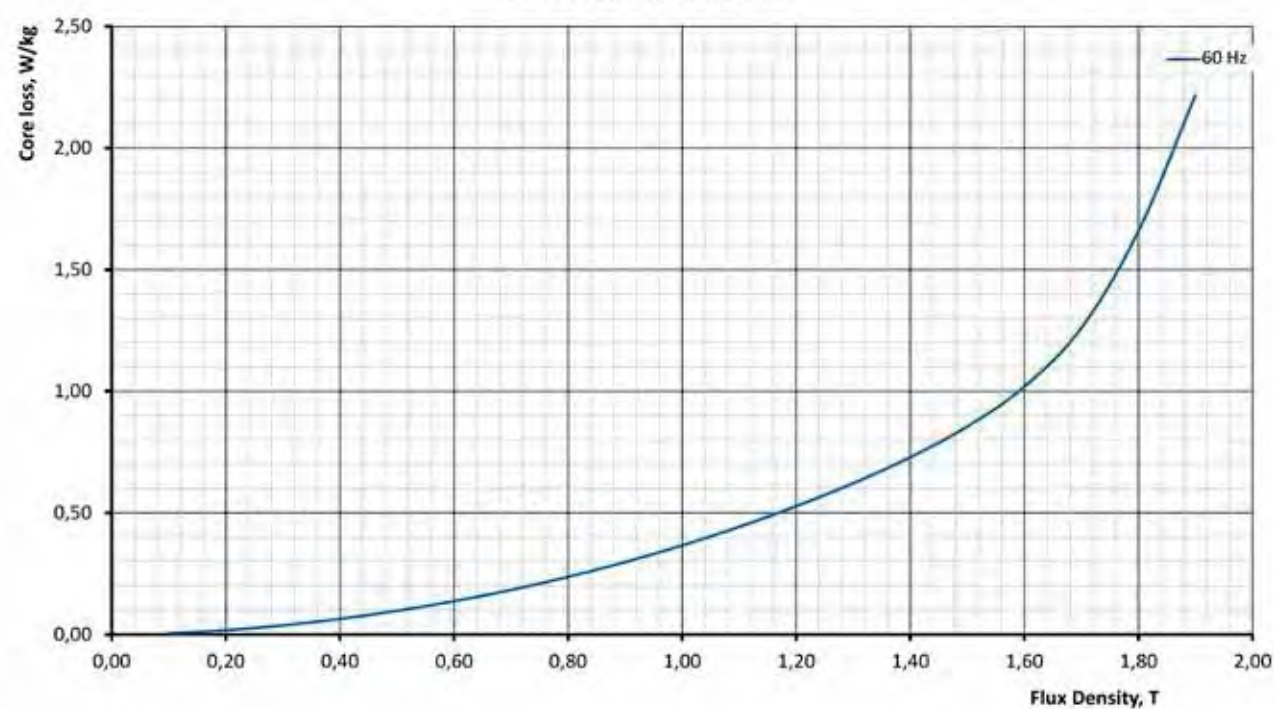
Specific core loss
NV23S-100L, 0.23 mm



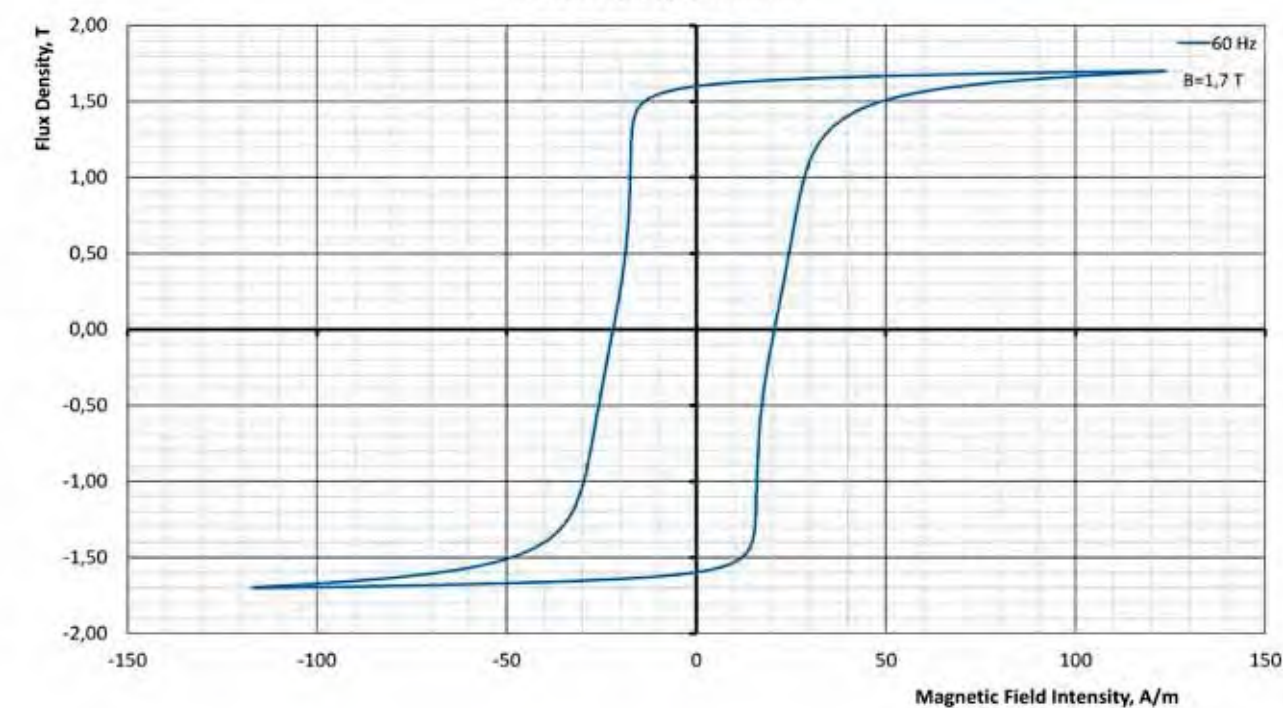
Hysteresis loop
NV23S-100L, 0.23 mm



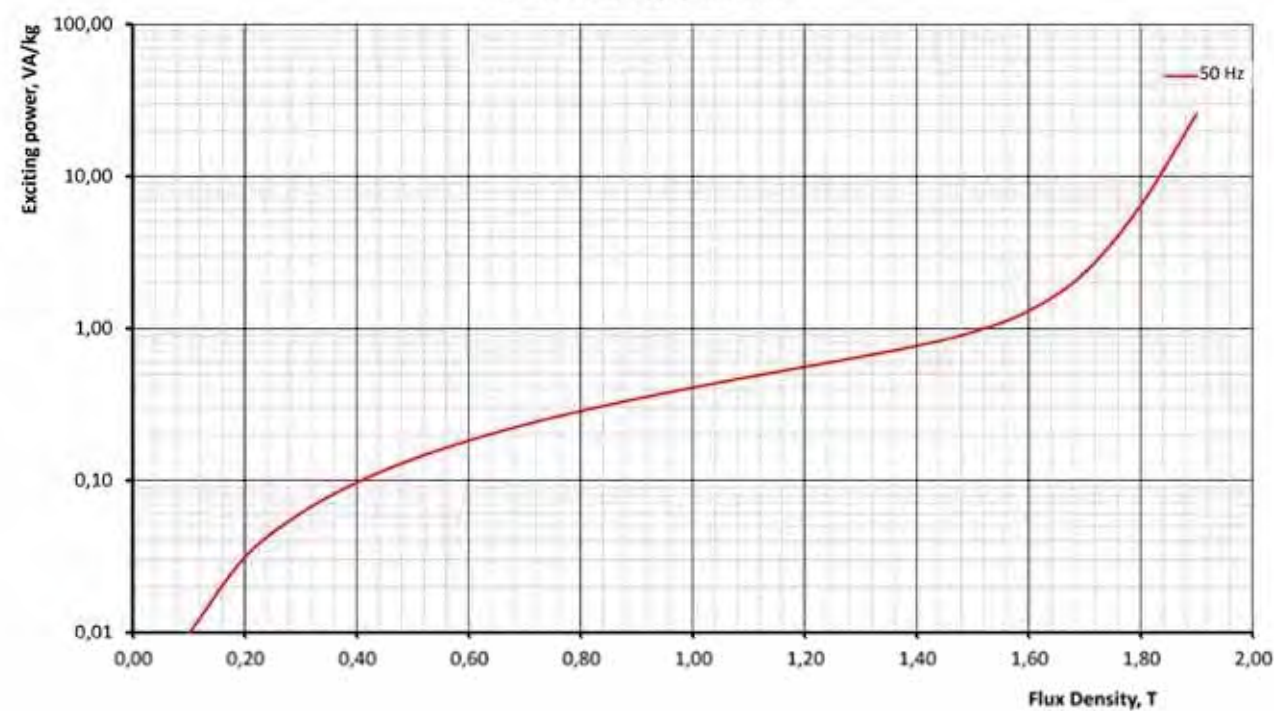
Specific core loss
NV23S-100L, 0.23 mm



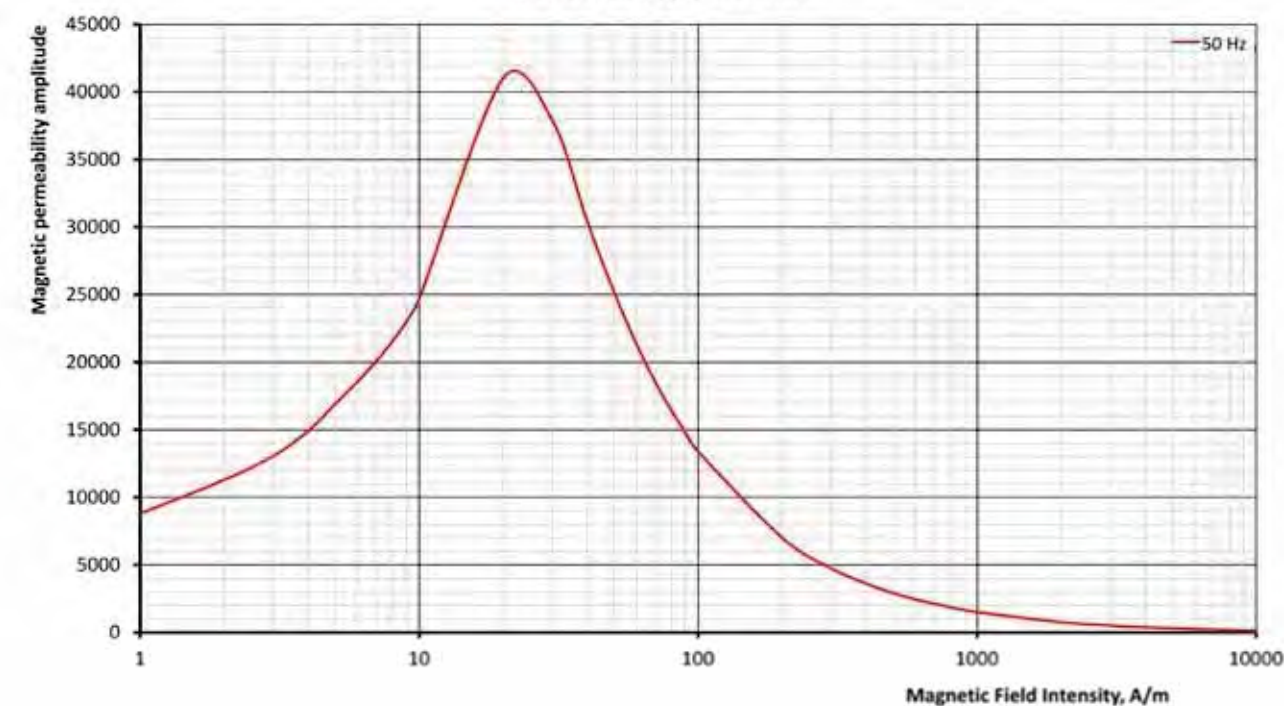
Hysteresis loop
NV23S-100L, 0.23 mm



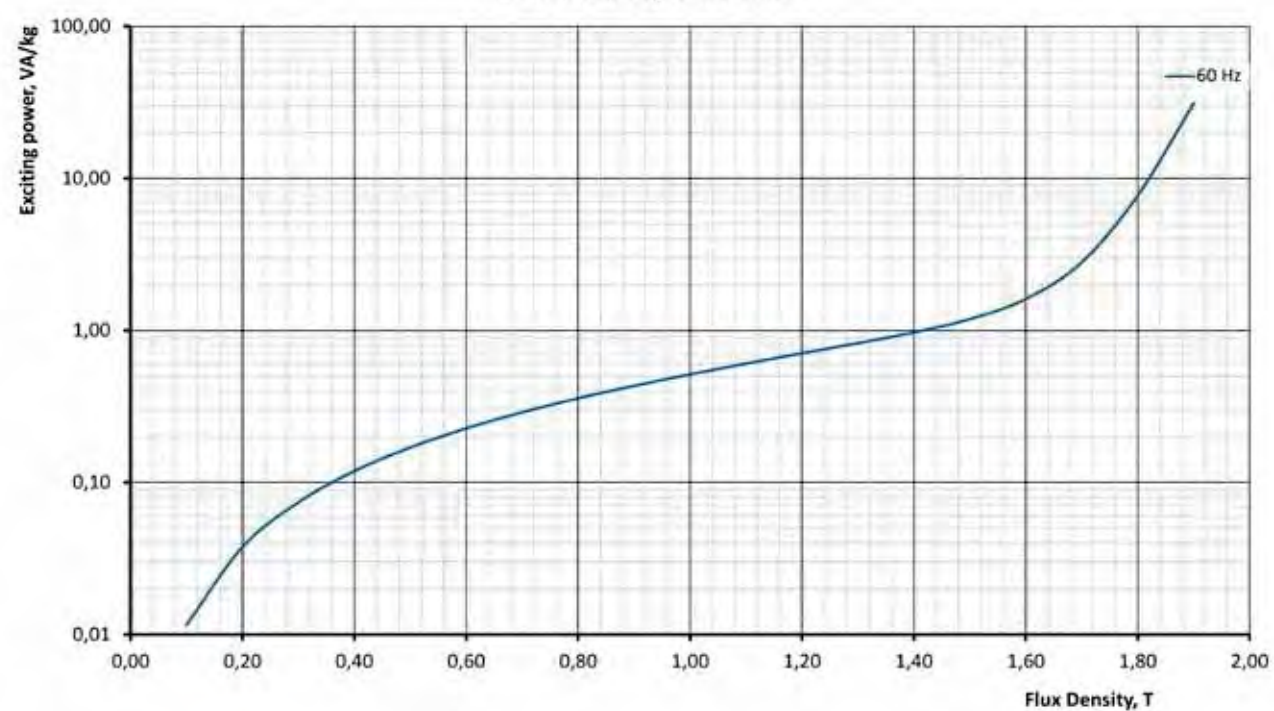
Exciting power
NV23S-100L, 0.23 mm



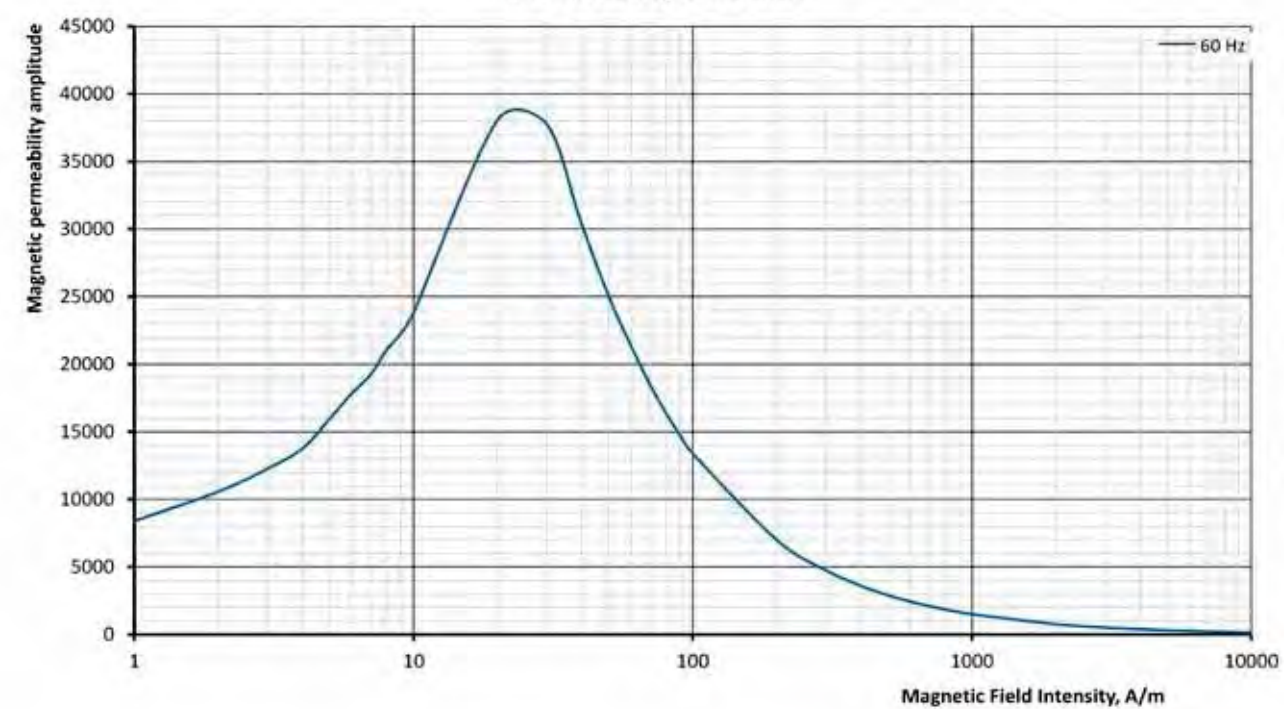
Magnetic permeability amplitude
NV23S-100L, 0.23 mm



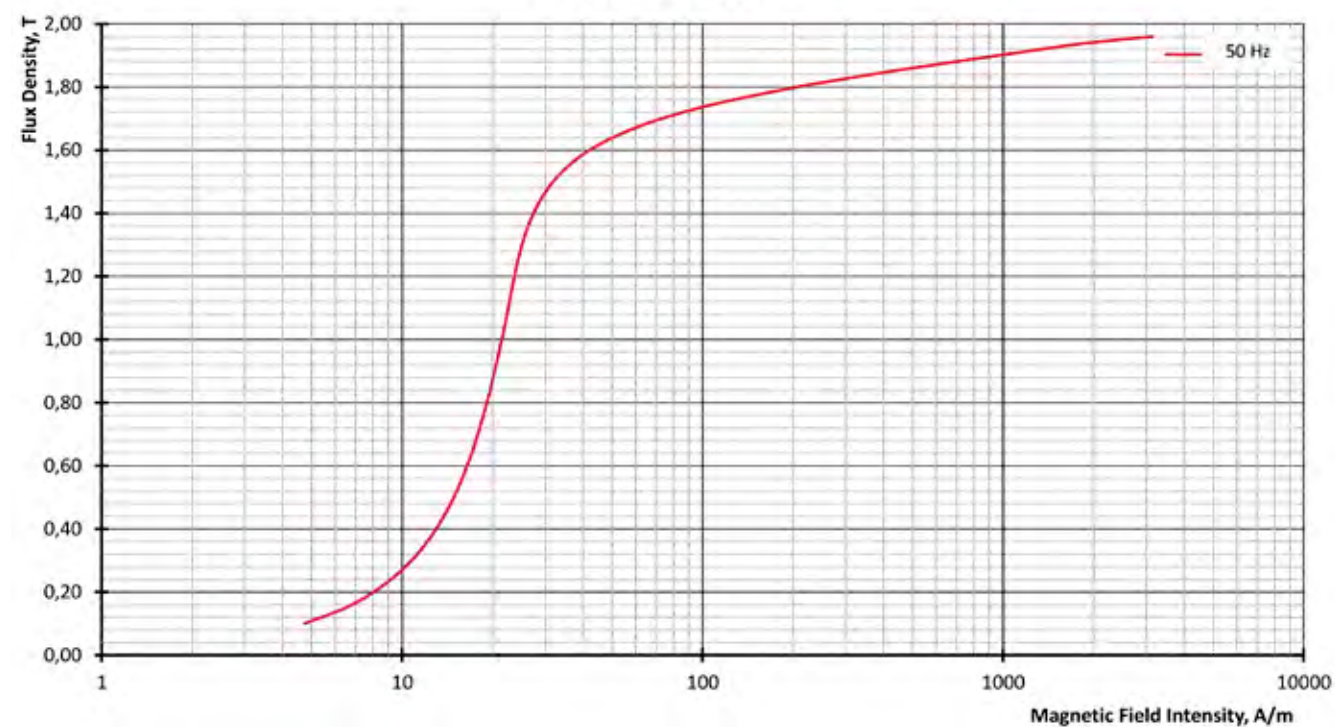
Exciting power
NV23S-100L, 0.23 mm



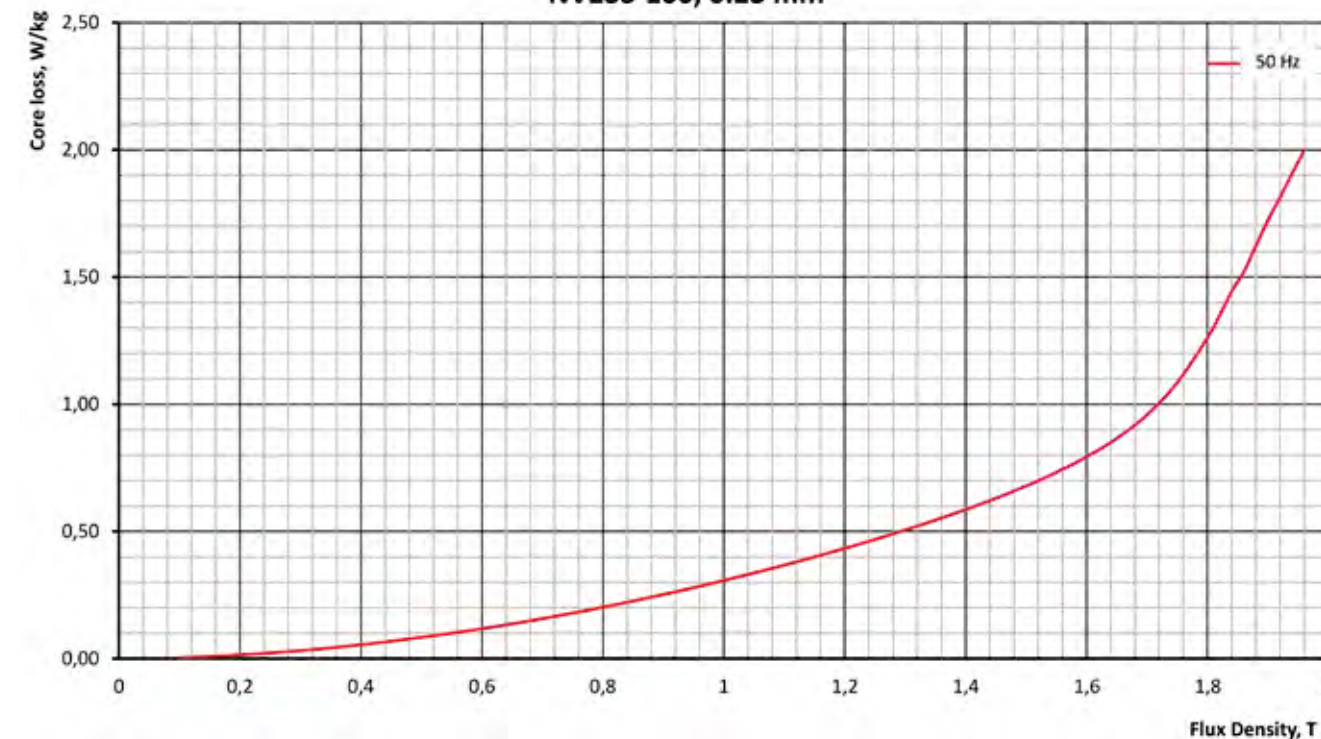
Magnetic permeability amplitude
NV23S-100L, 0.23 mm



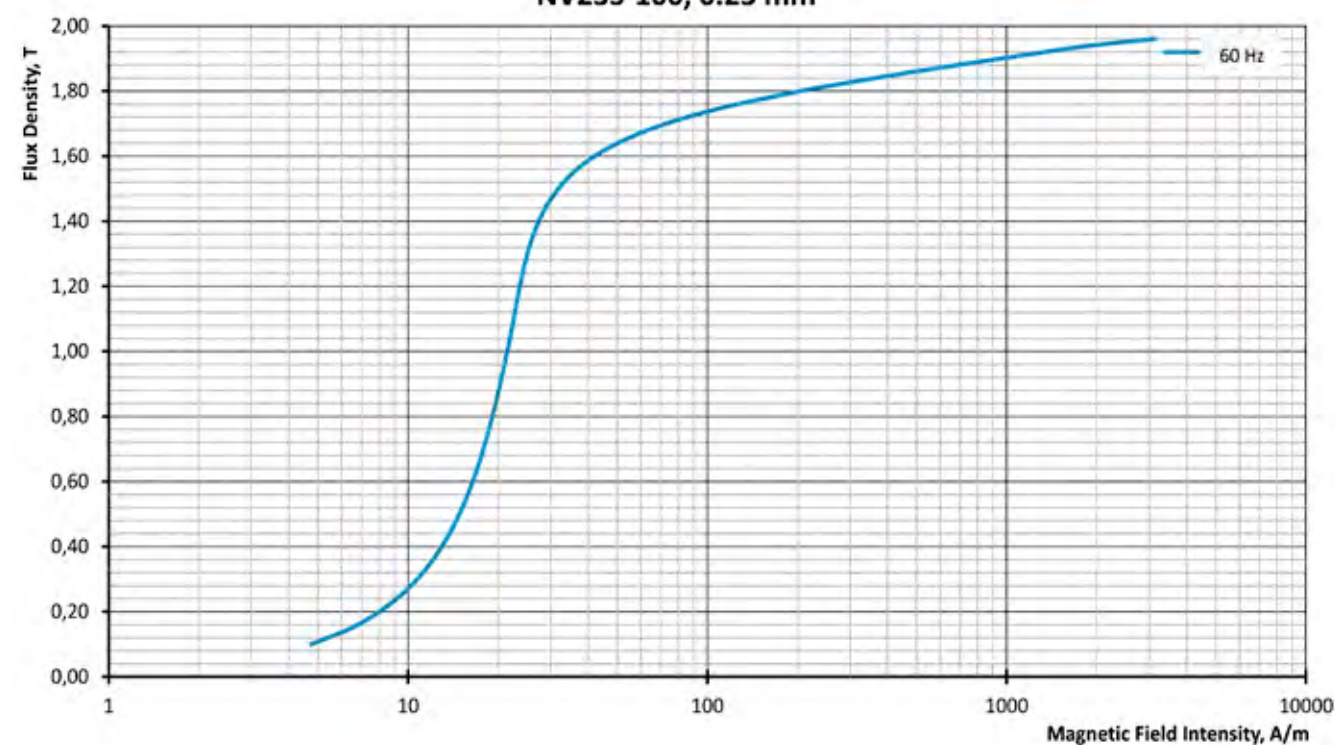
**Magnetization curve
NV23S-100, 0.23 mm**



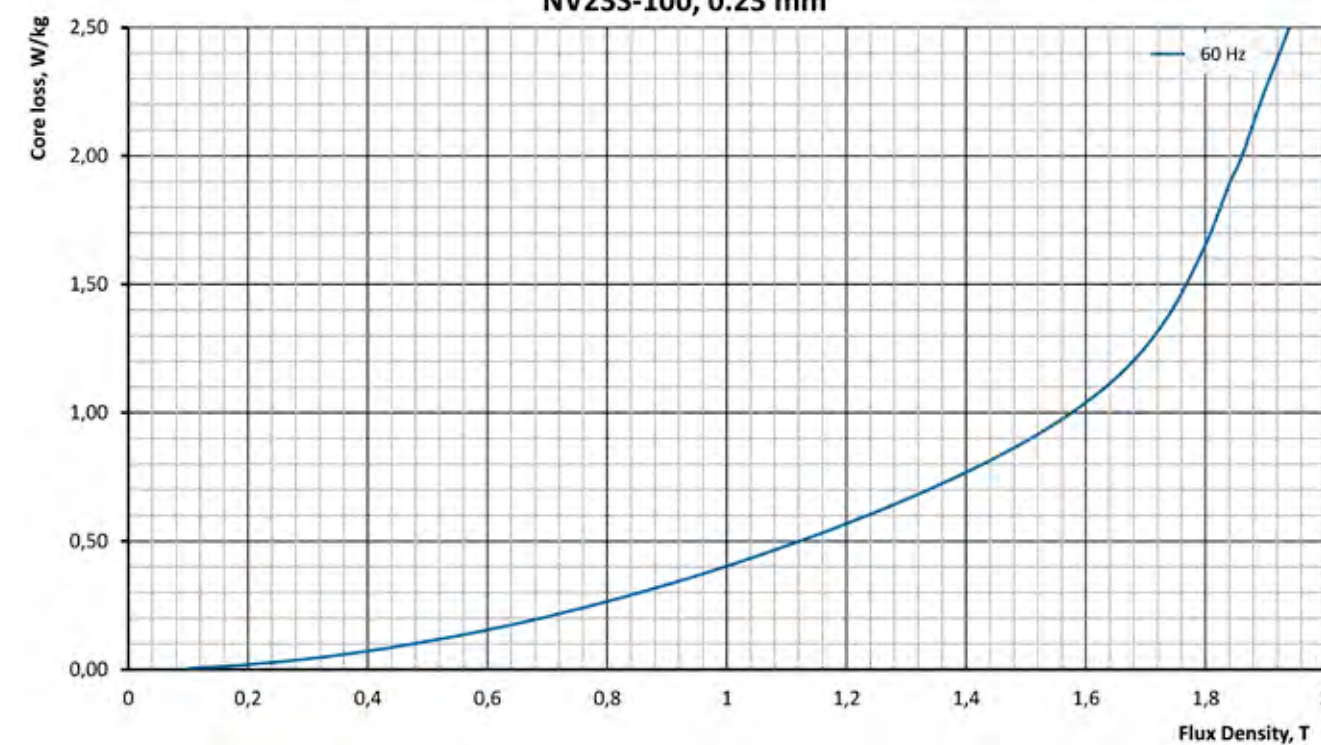
**Specific core loss
NV23S-100, 0.23 mm**



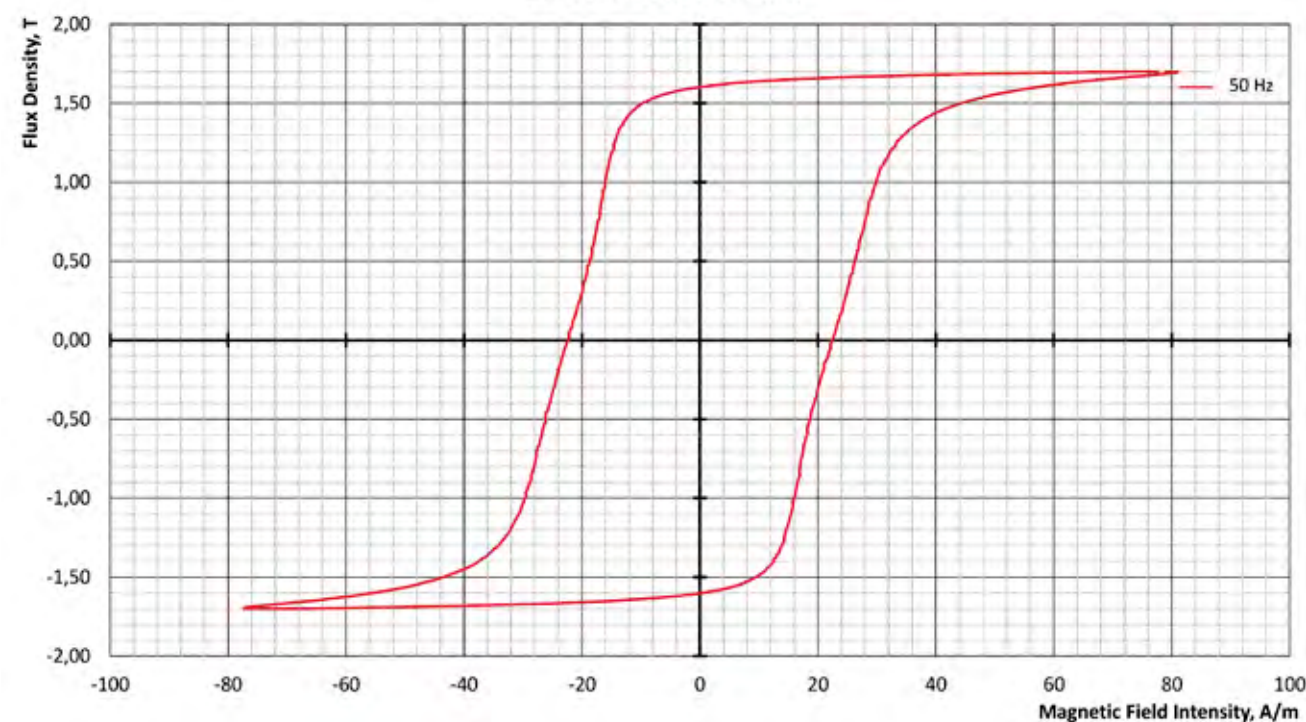
**Magnetization curve
NV23S-100, 0.23 mm**



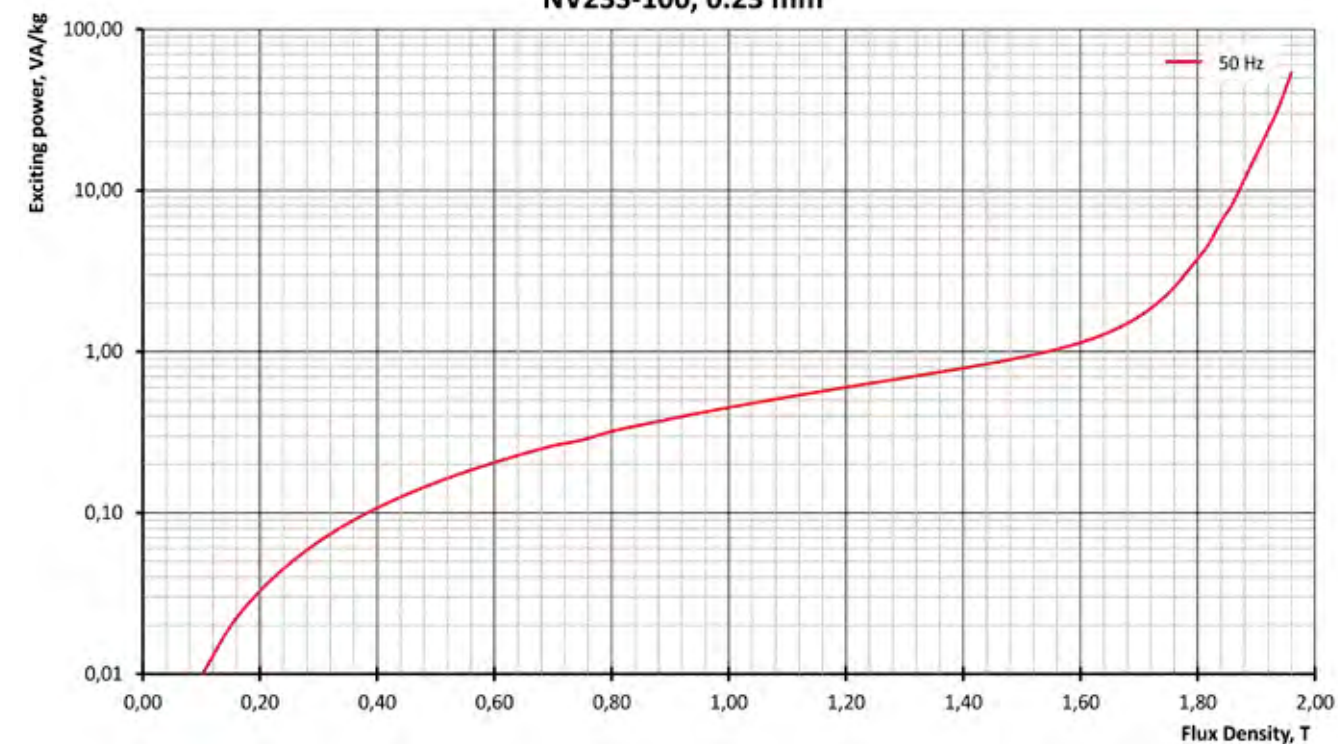
**Specific core loss
NV23S-100, 0.23 mm**



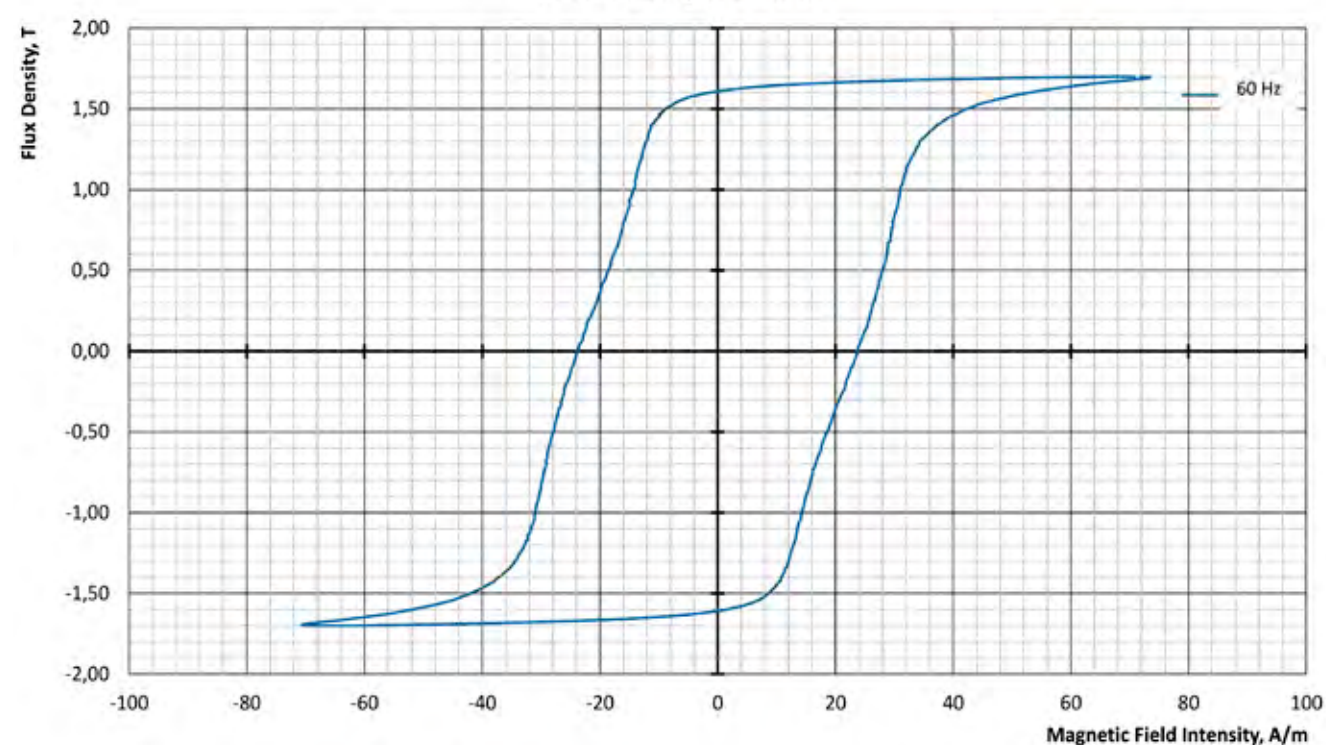
Hysteresis loop
NV23S-100, 0.23 mm



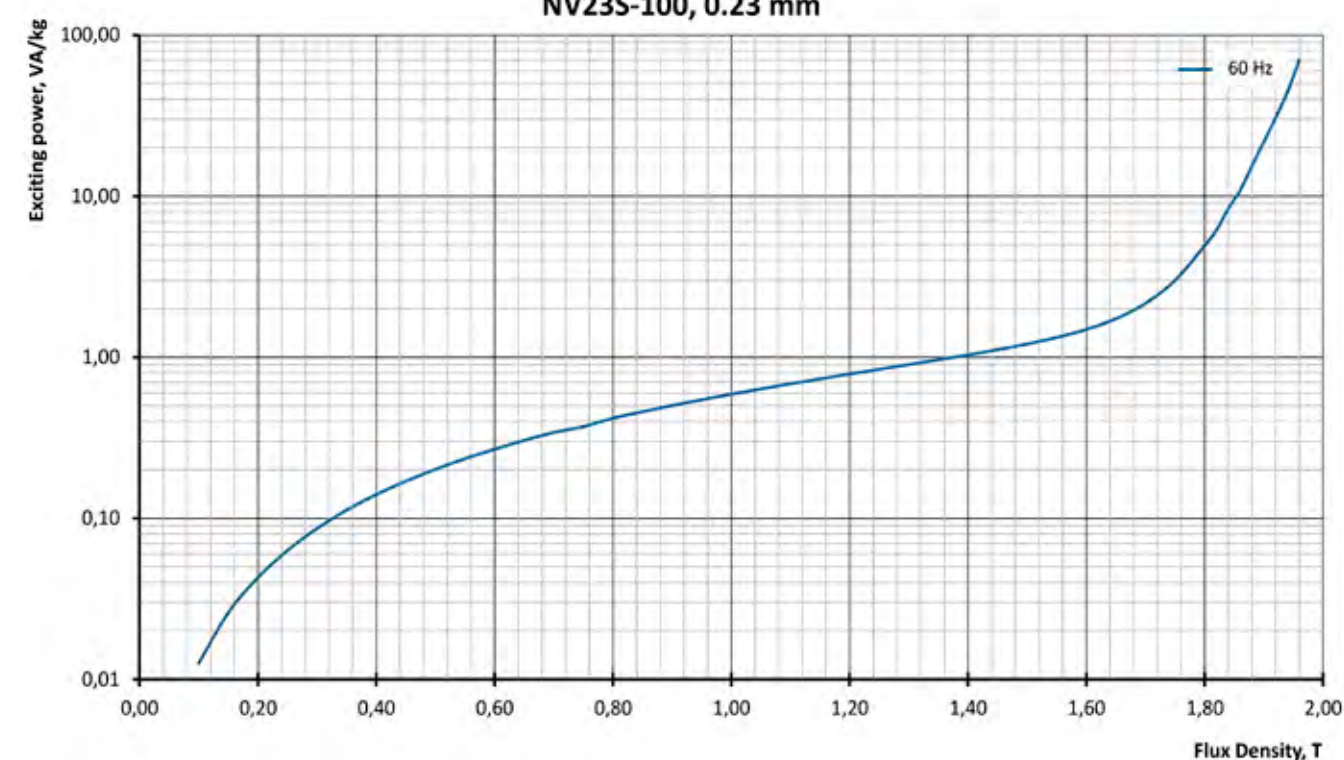
Exciting power
NV23S-100, 0.23 mm



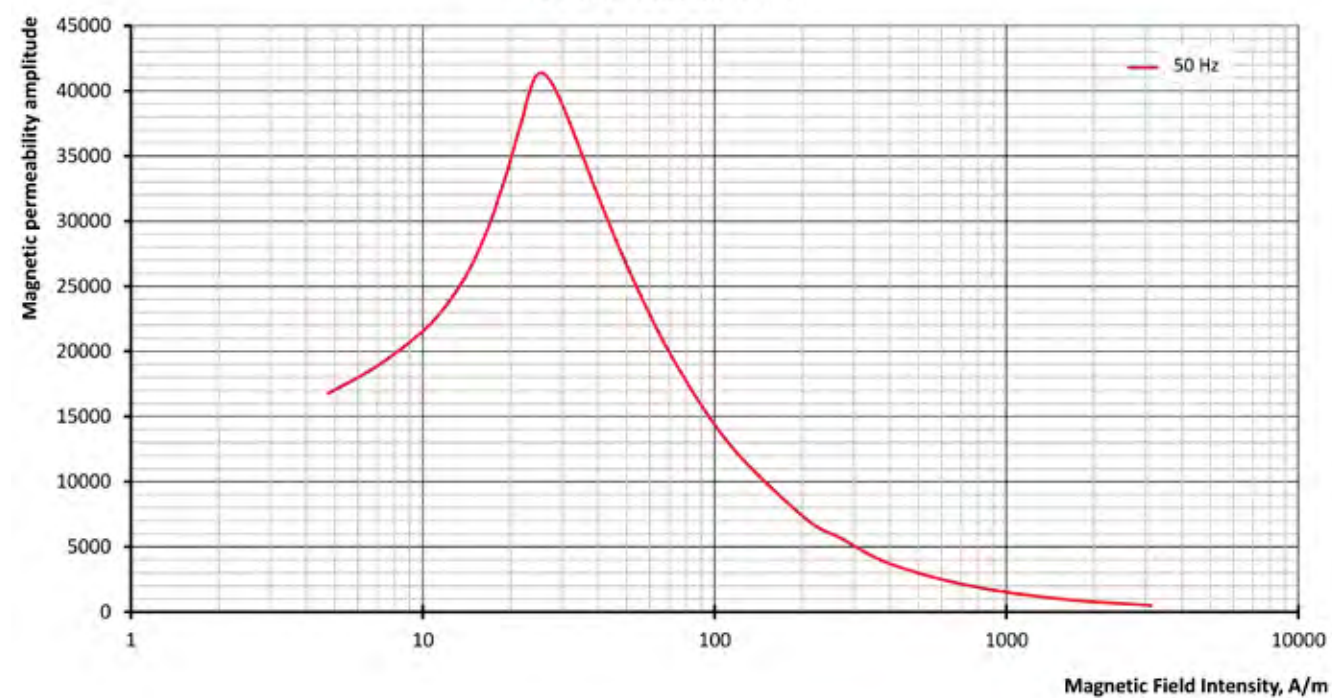
Hysteresis loop
NV23S-100, 0.23 mm



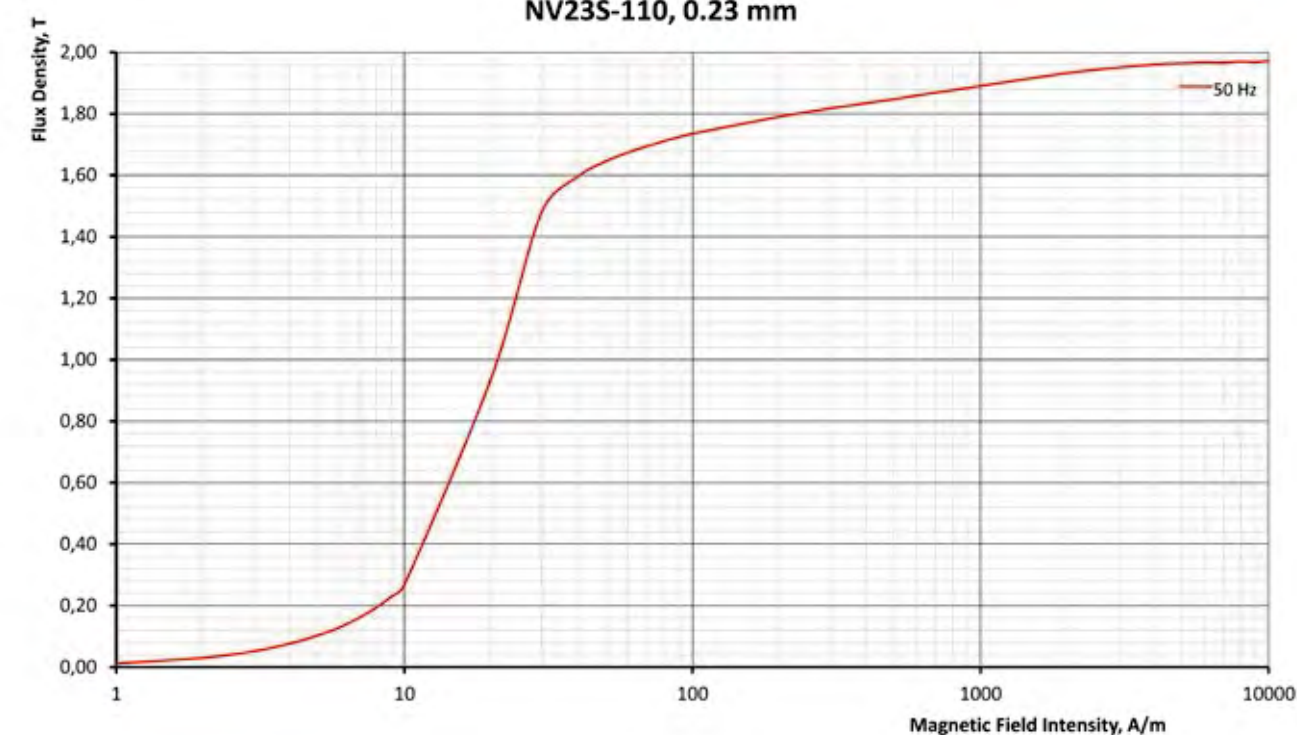
Exciting power
NV23S-100, 0.23 mm



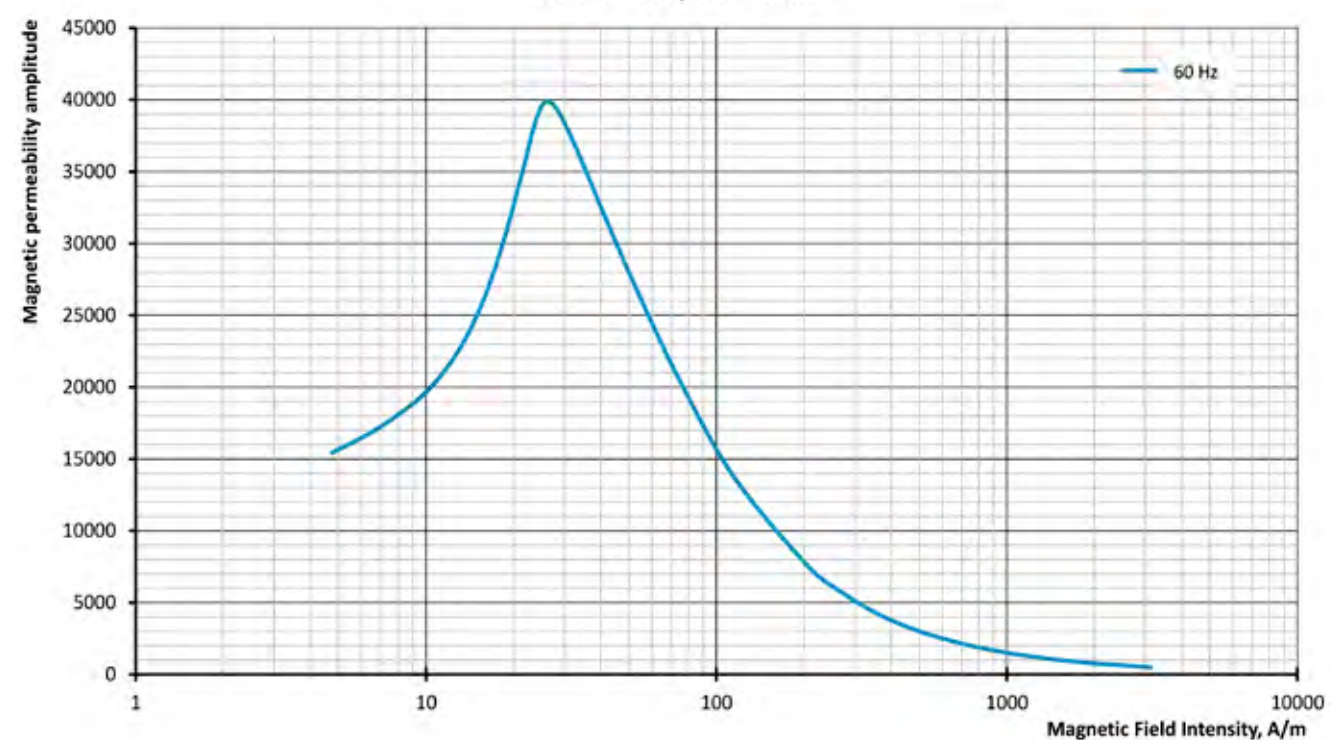
**Magnetic permeability amplitude
NV23S-100, 0.23 mm**



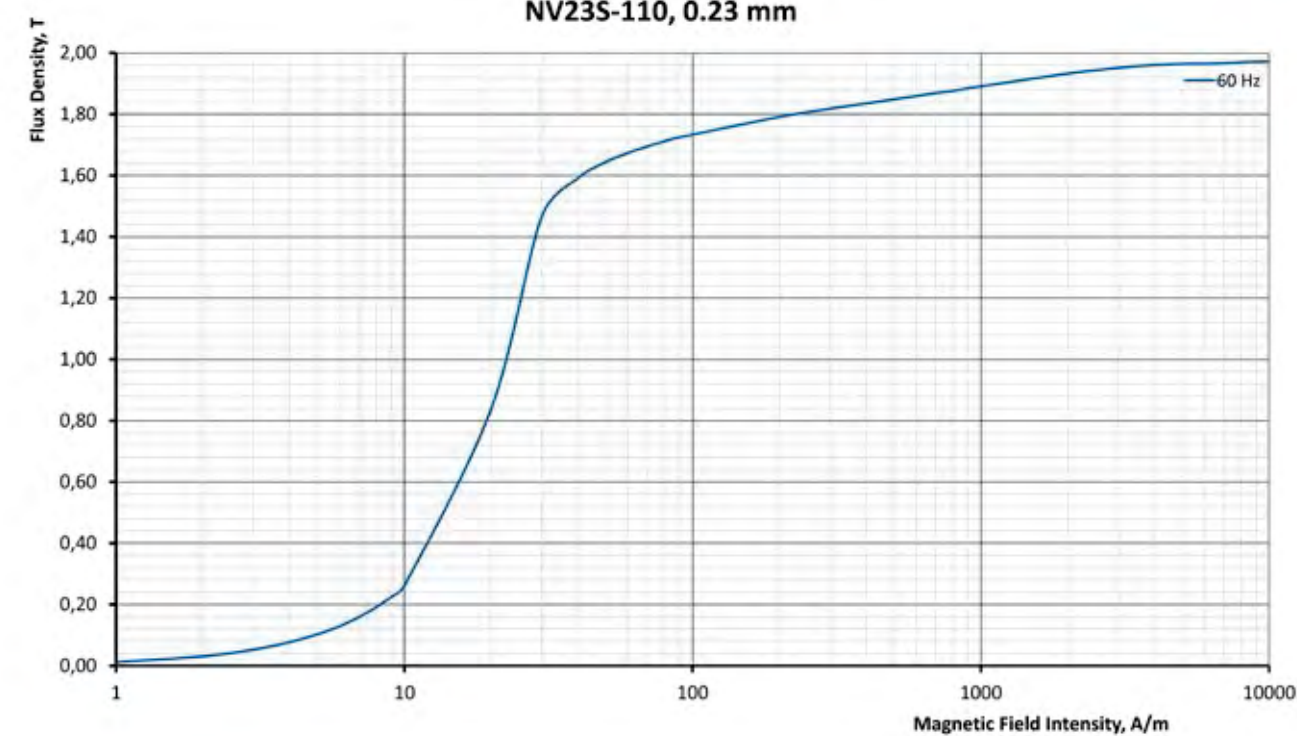
**Magnetization curve
NV23S-110, 0.23 mm**



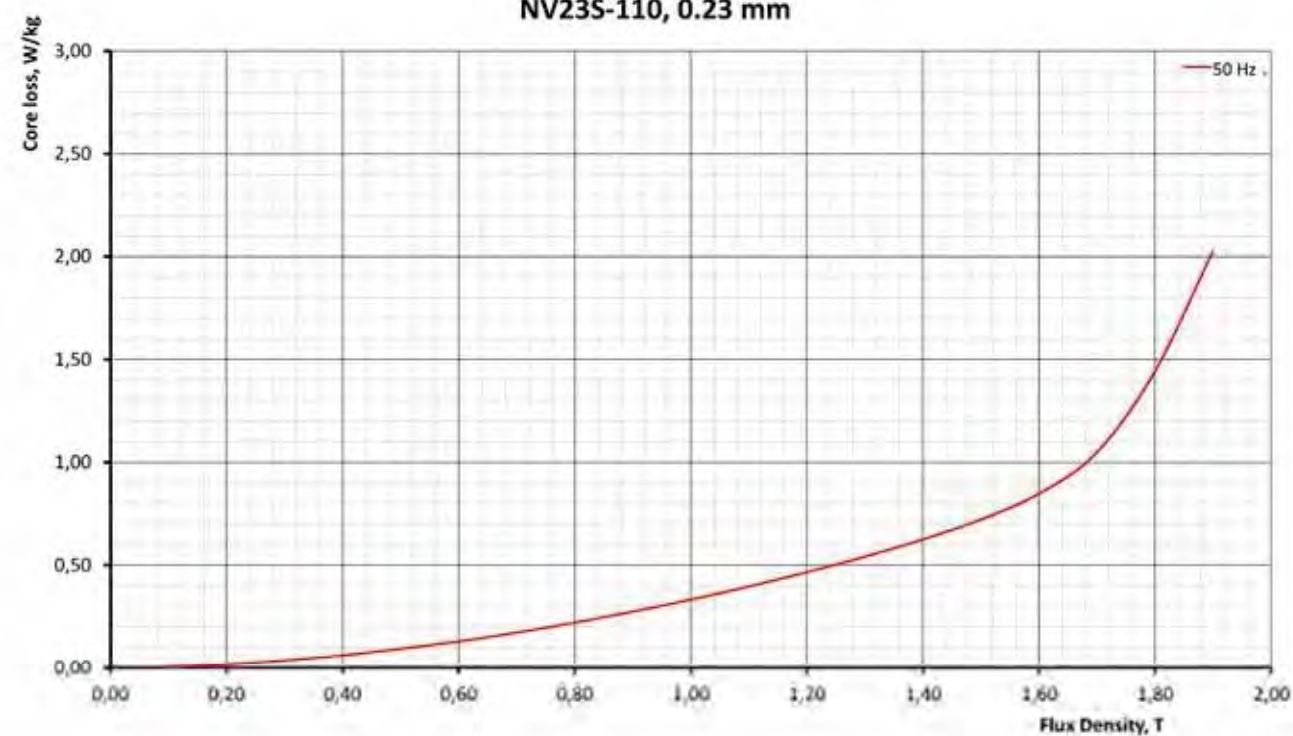
**Magnetic permeability amplitude
NV23S-100, 0.23 mm**



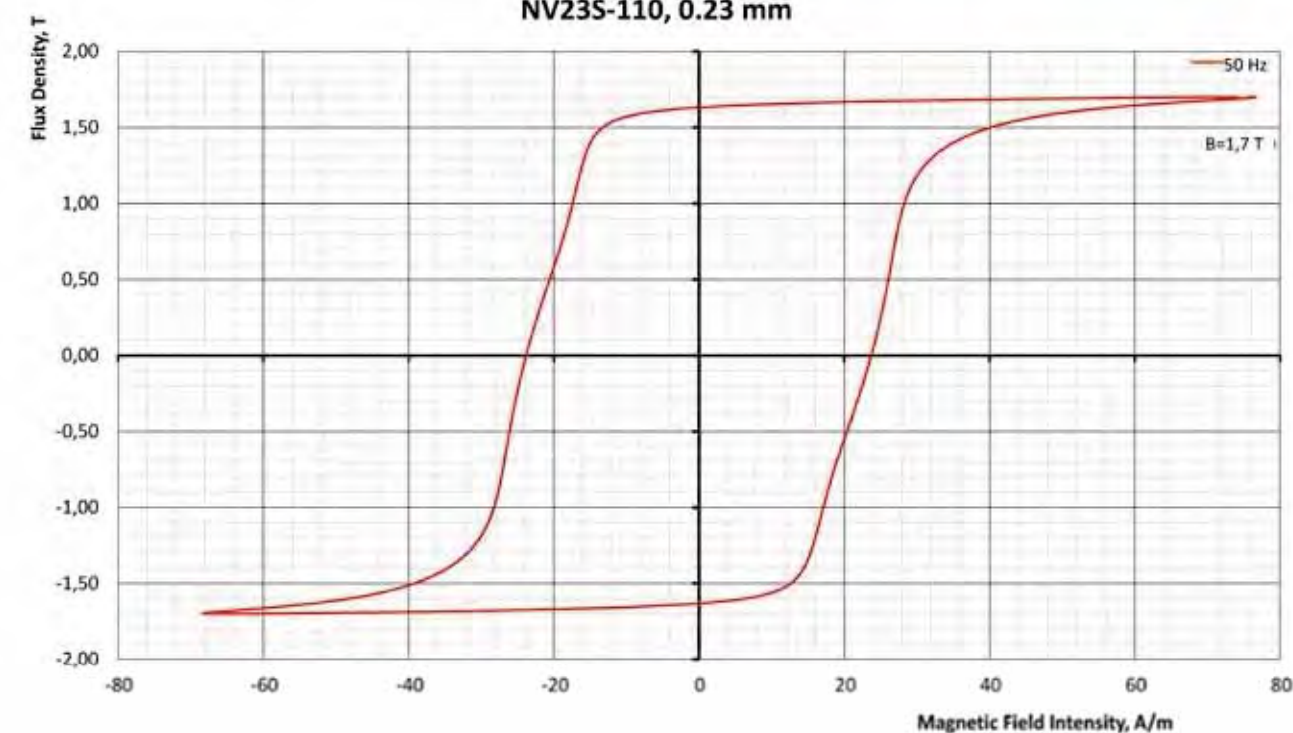
**Magnetization curve
NV23S-110, 0.23 mm**



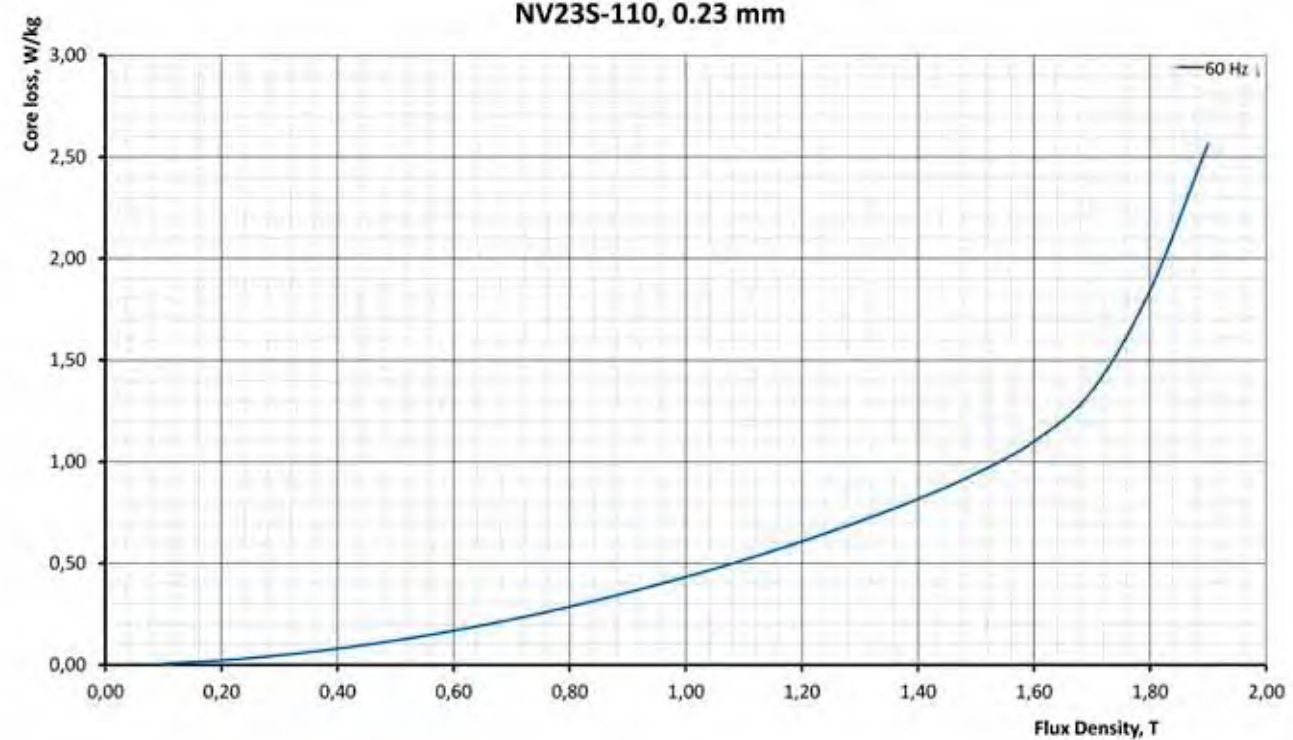
Specific core loss
NV23S-110, 0.23 mm



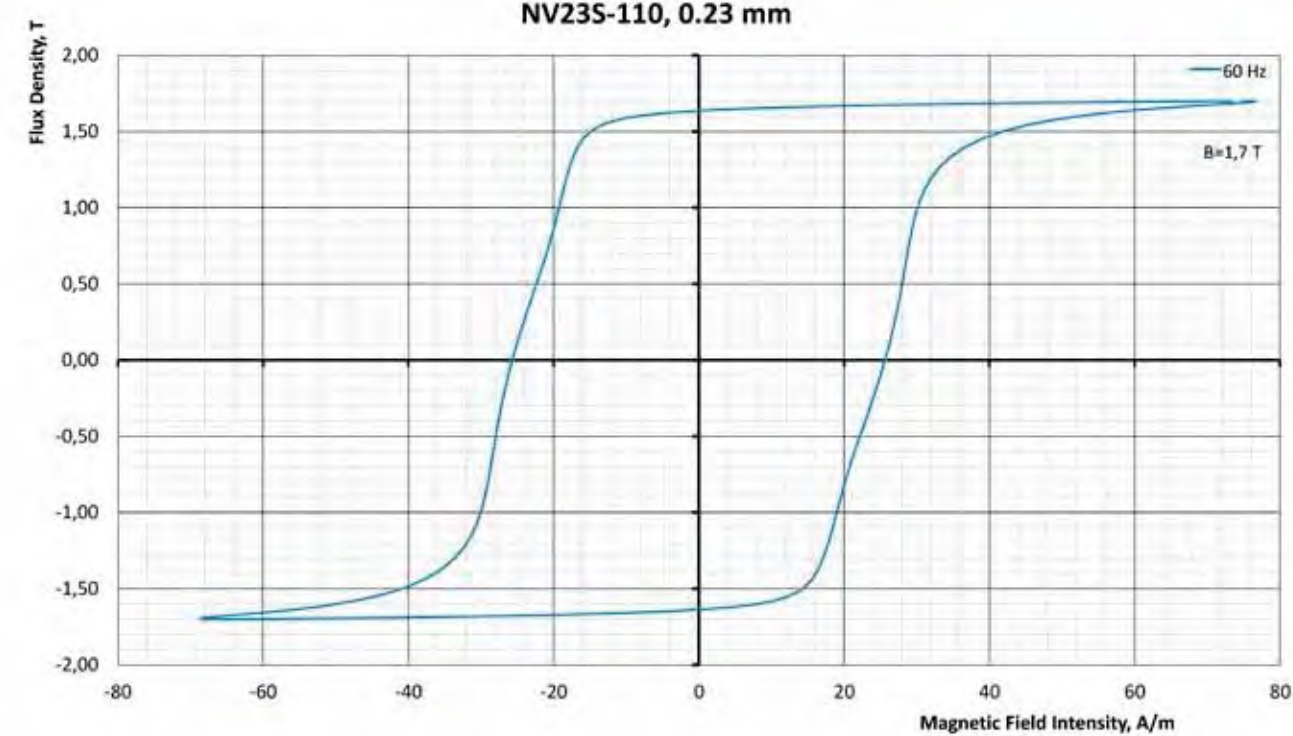
Hysteresis loop
NV23S-110, 0.23 mm

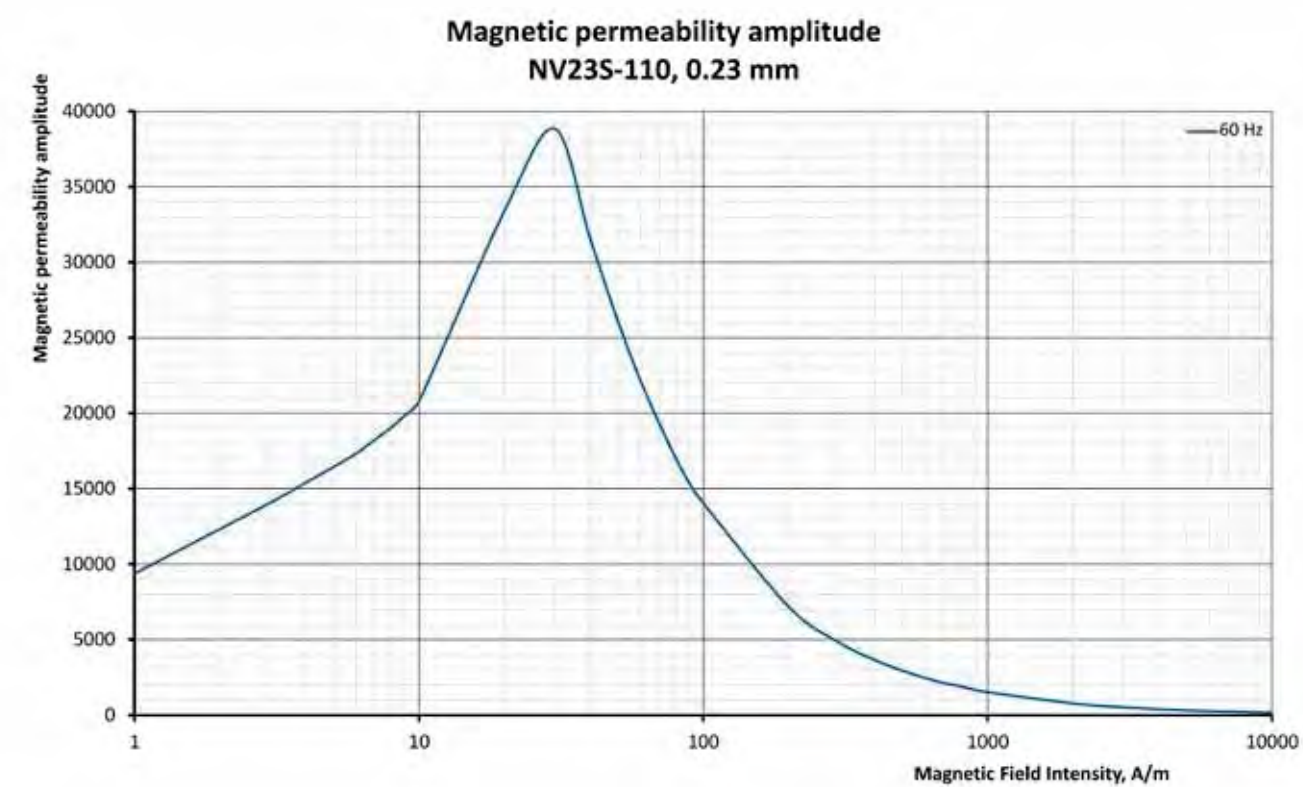
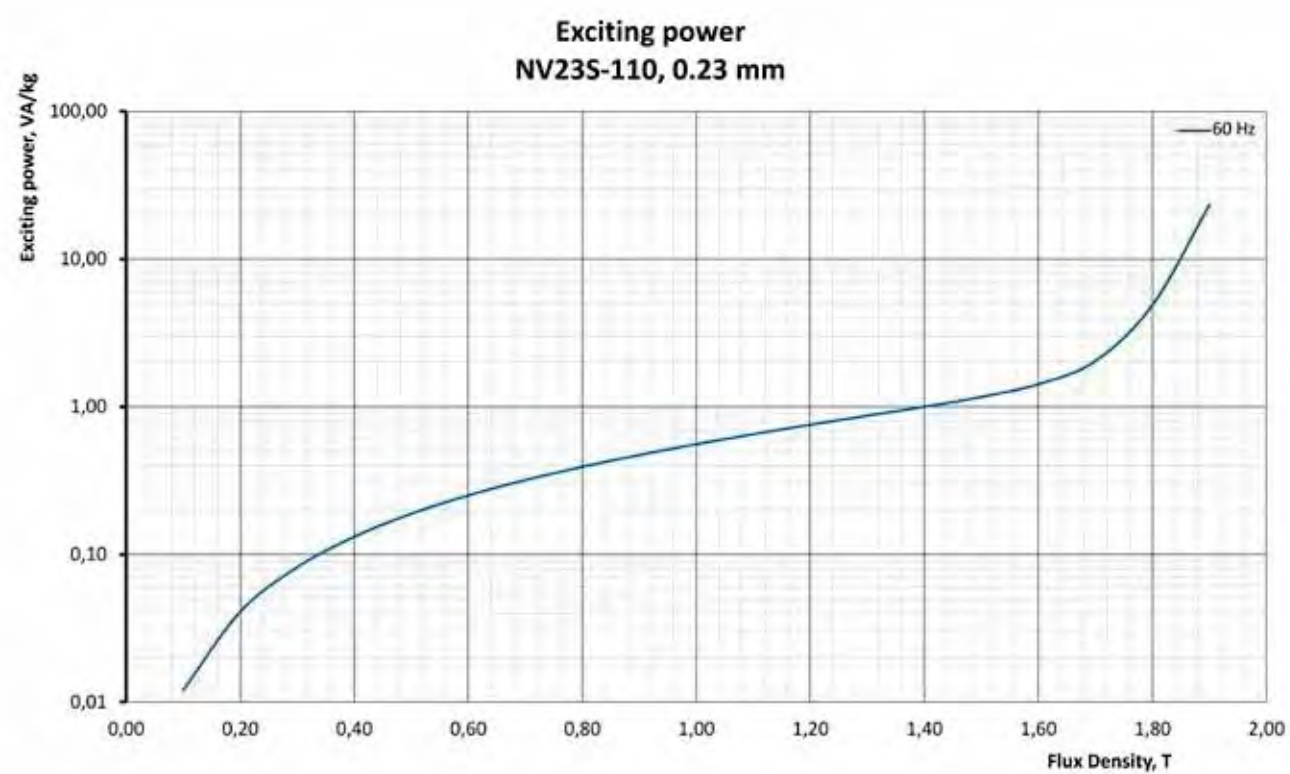
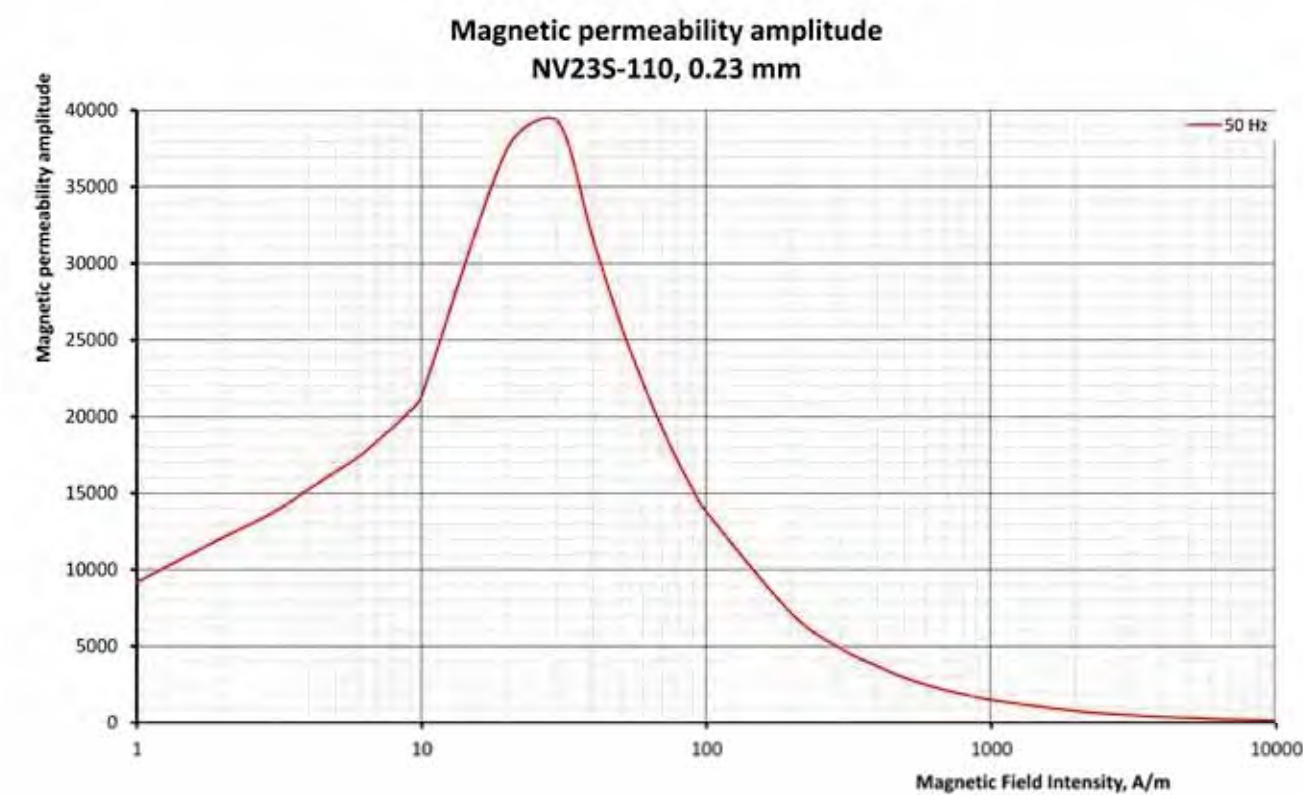
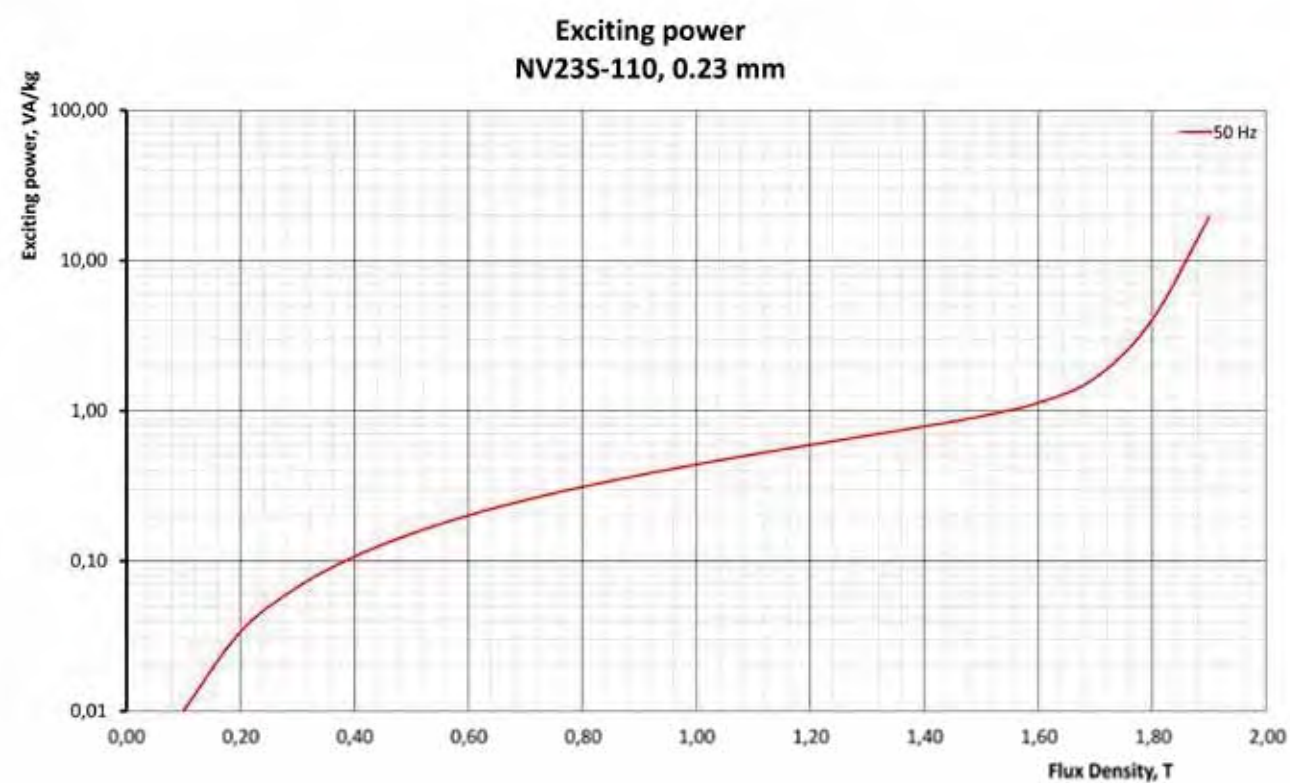


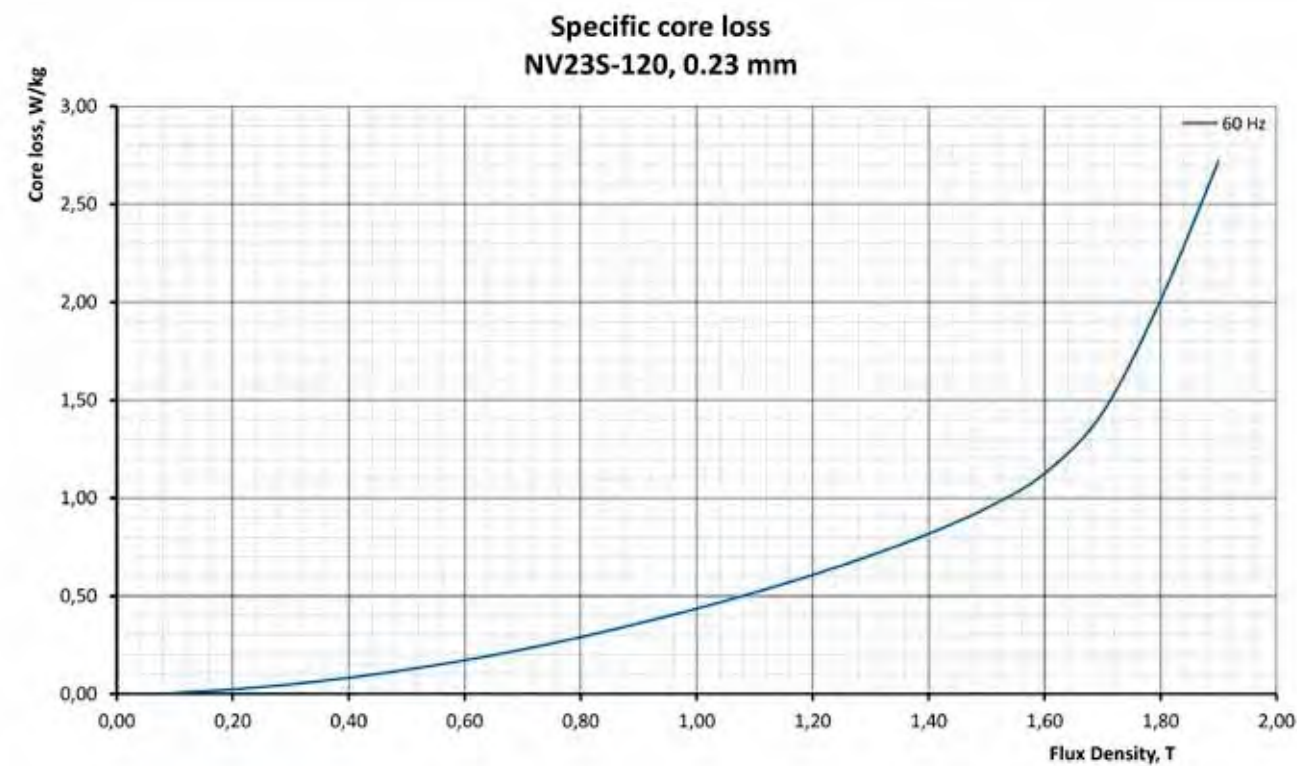
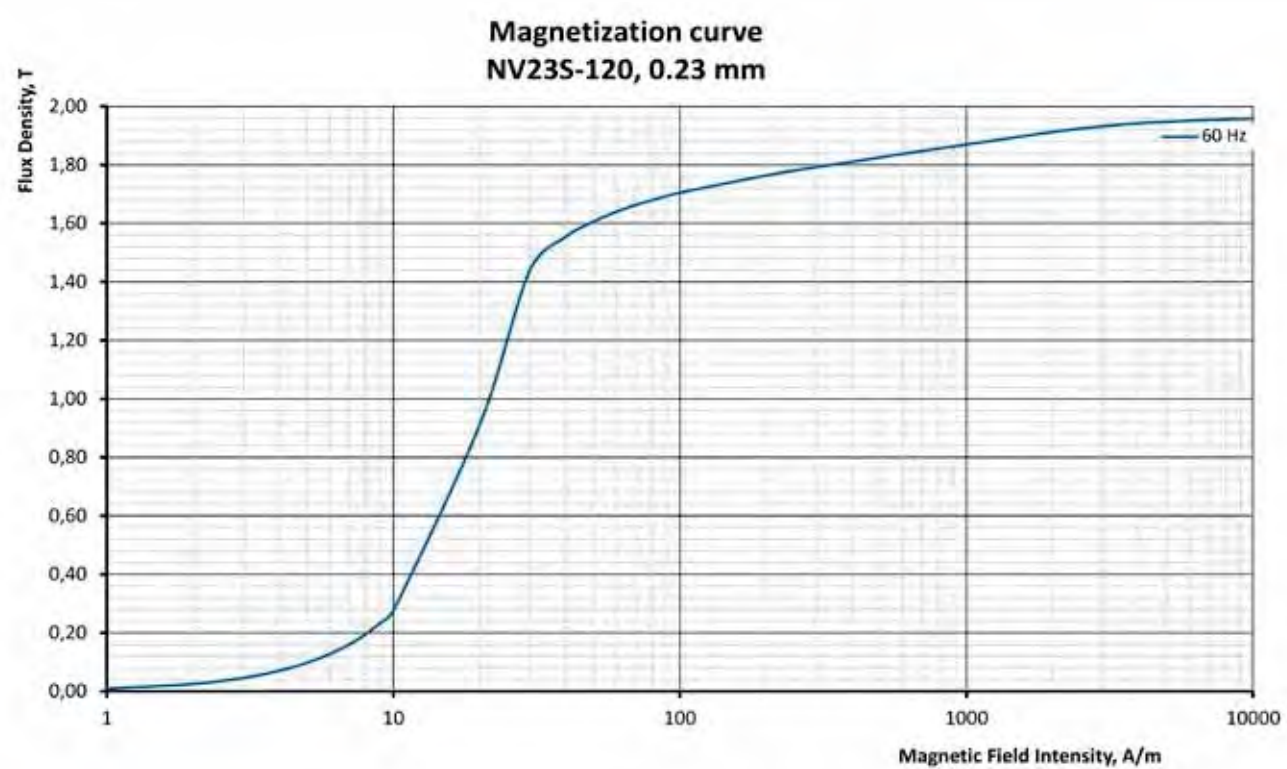
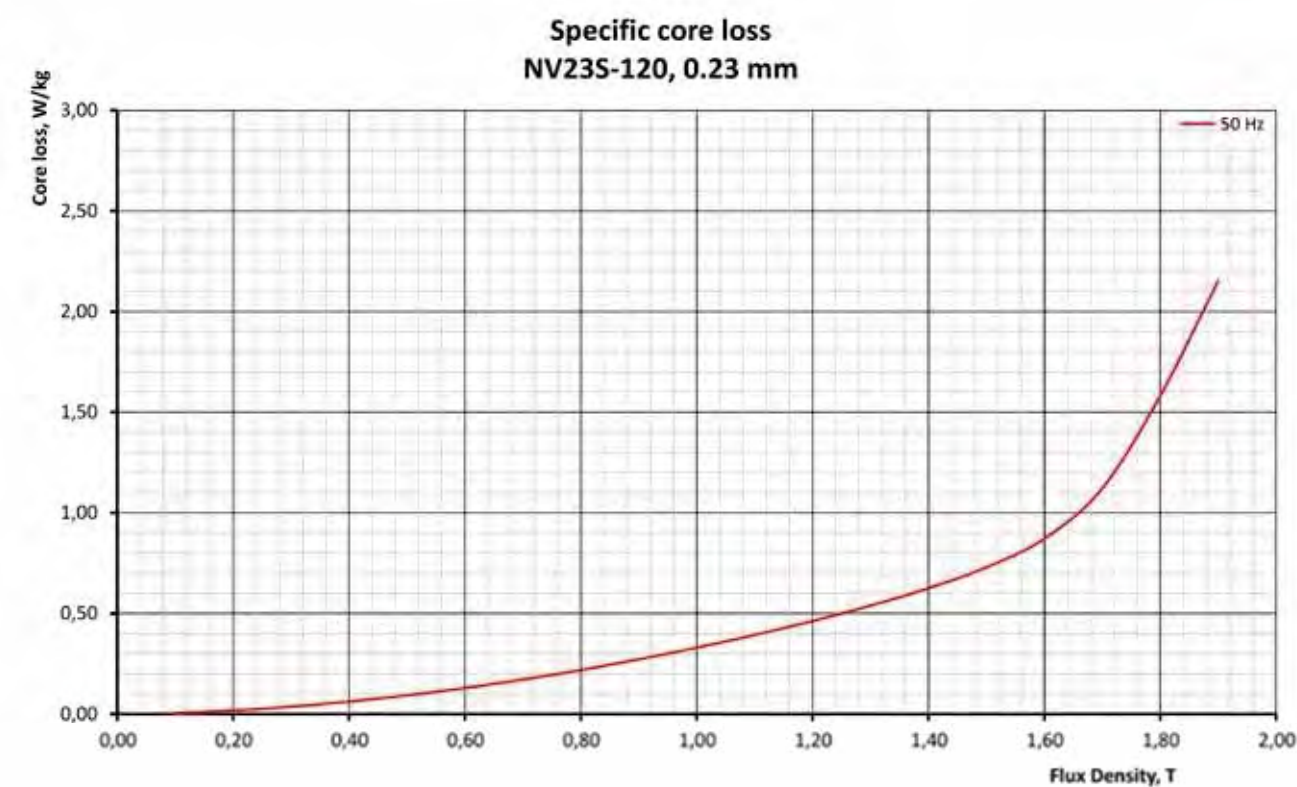
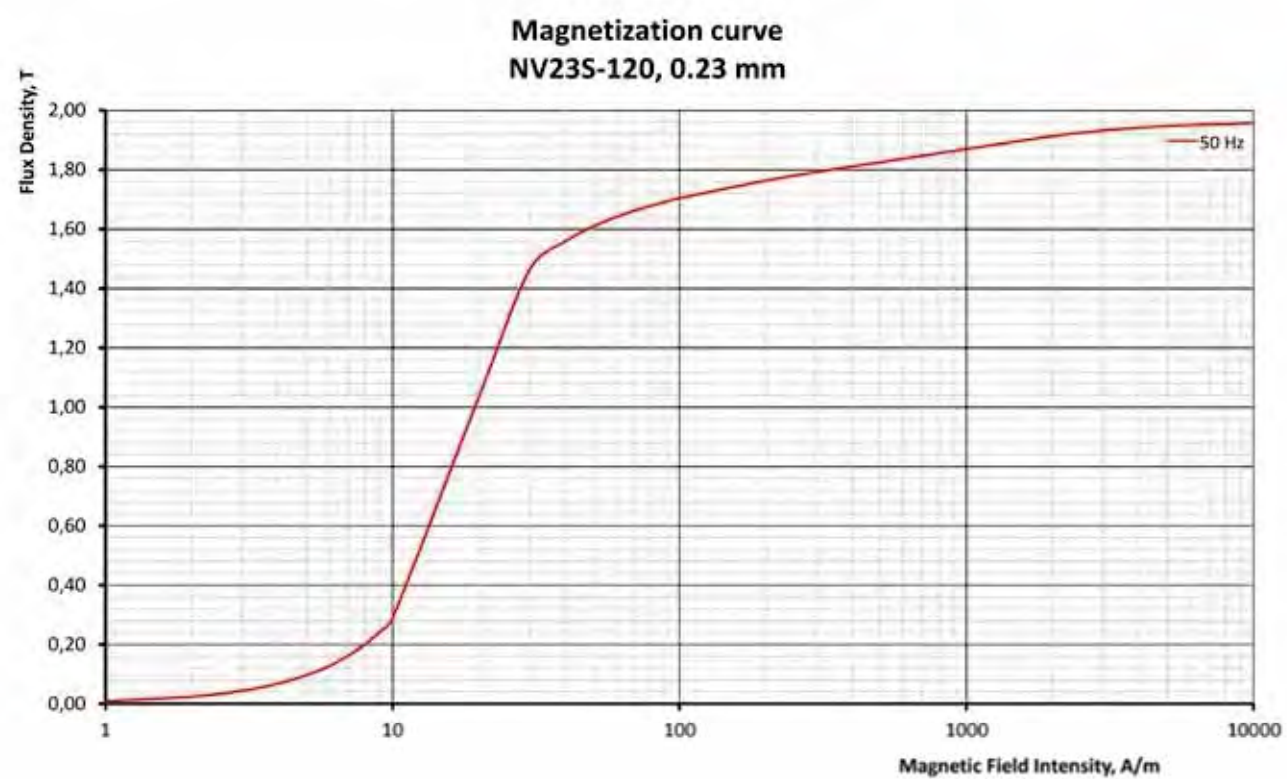
Specific core loss
NV23S-110, 0.23 mm

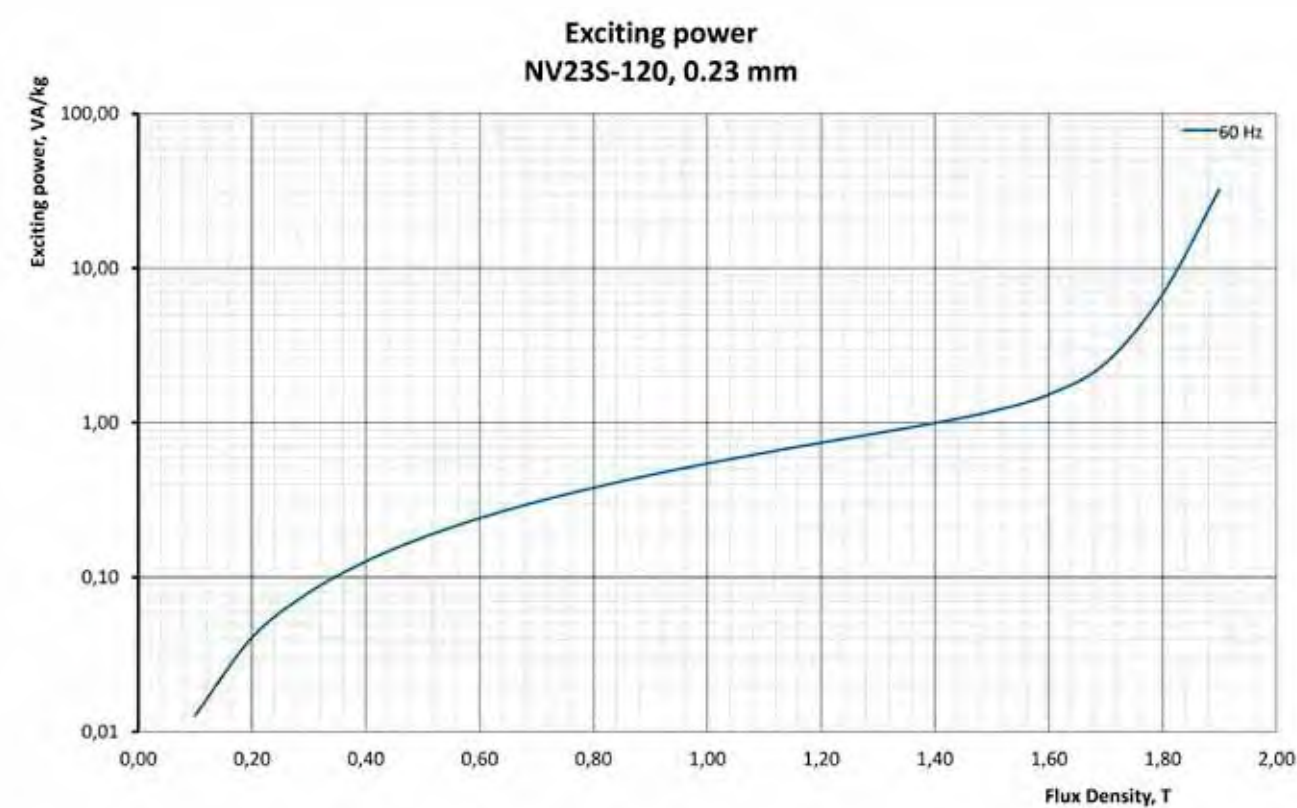
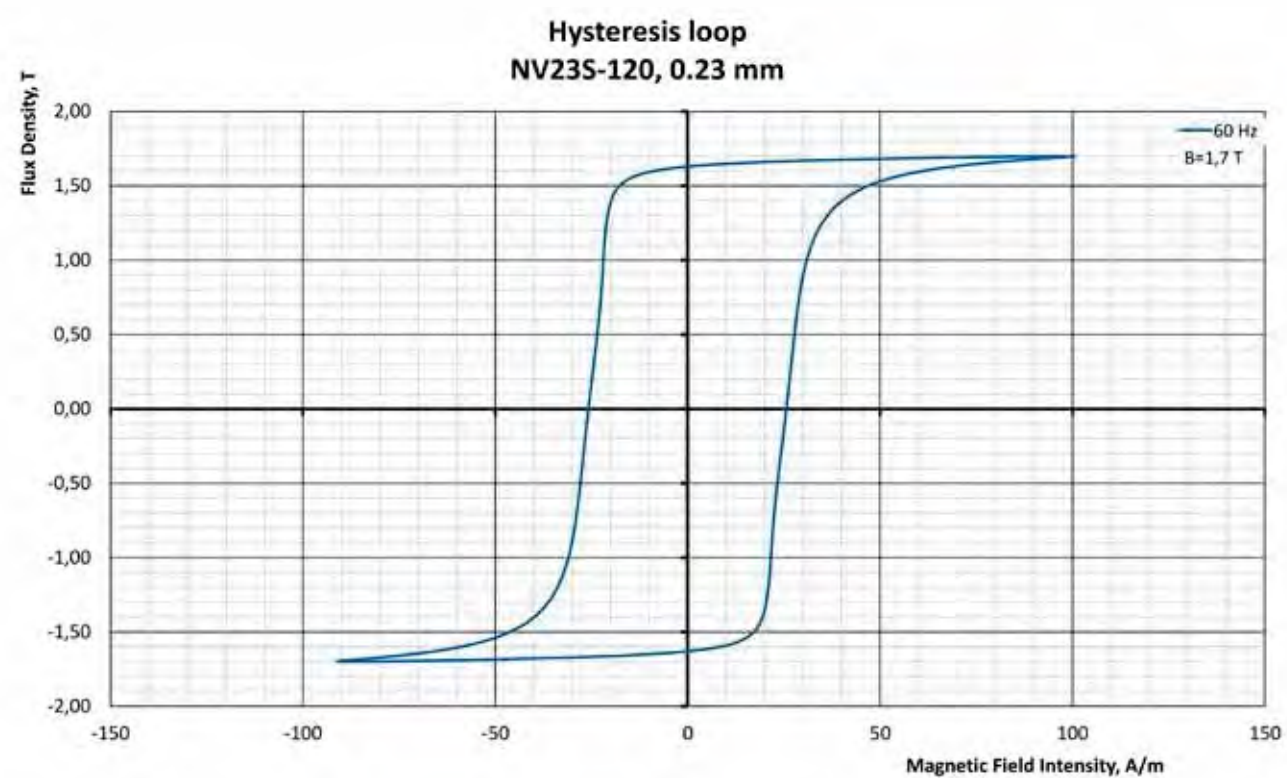
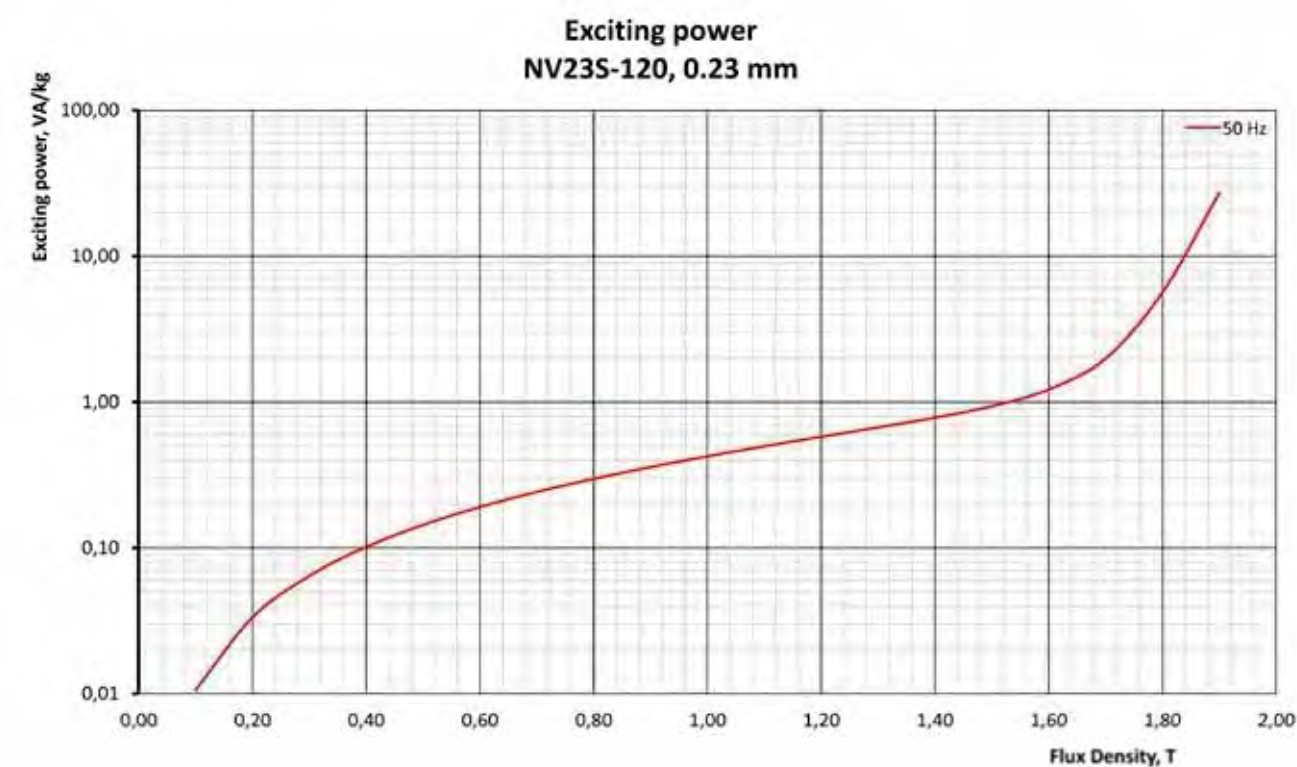
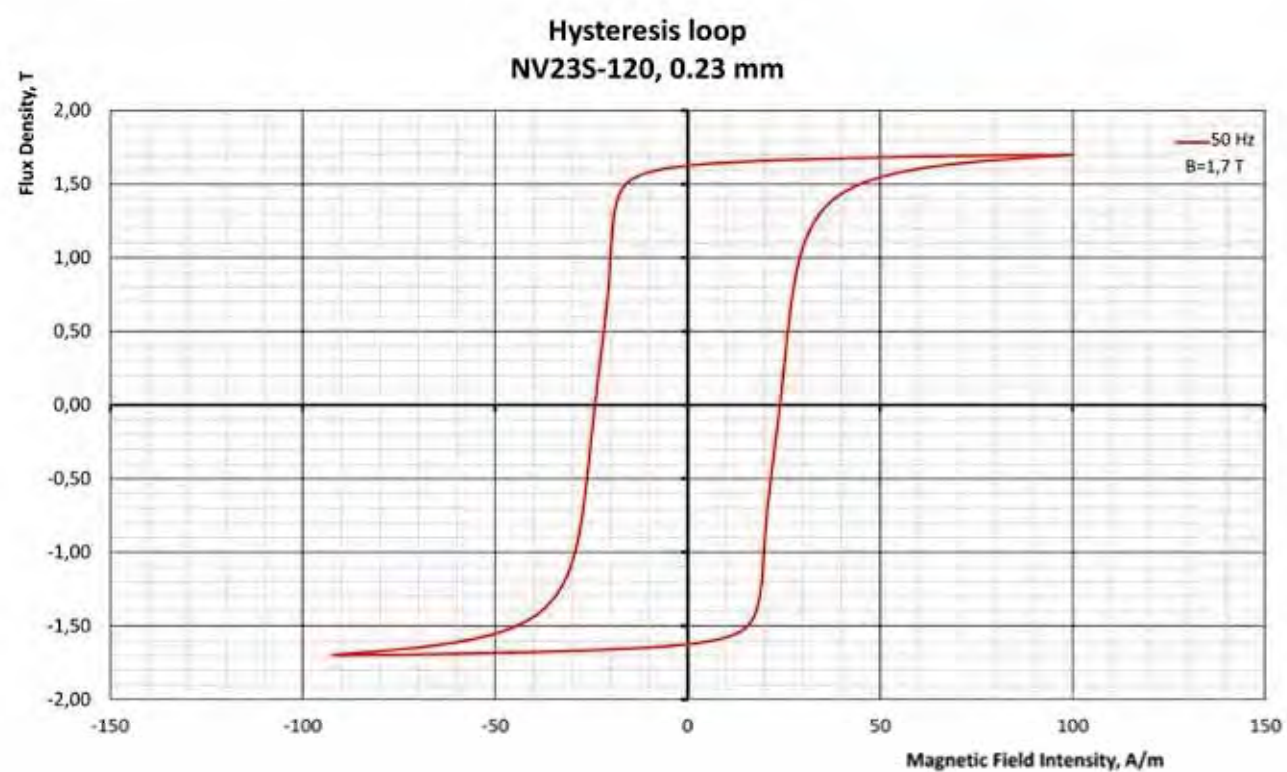


Hysteresis loop
NV23S-110, 0.23 mm

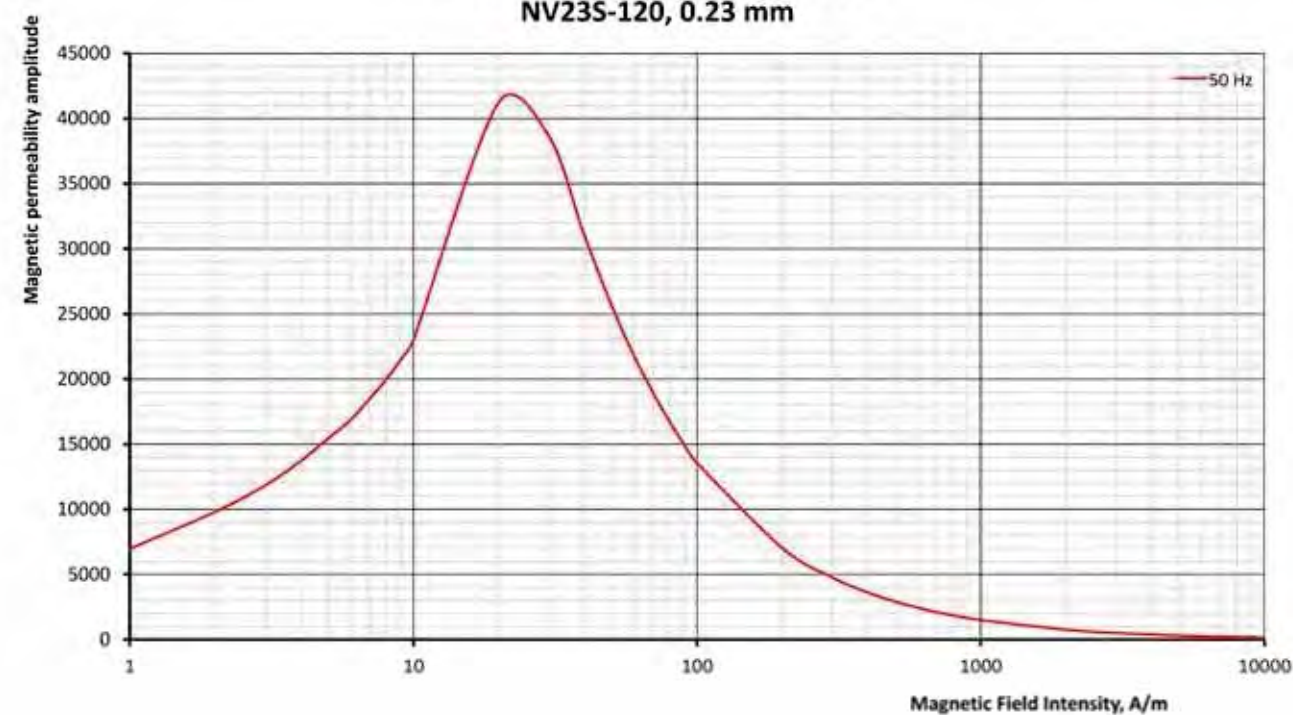




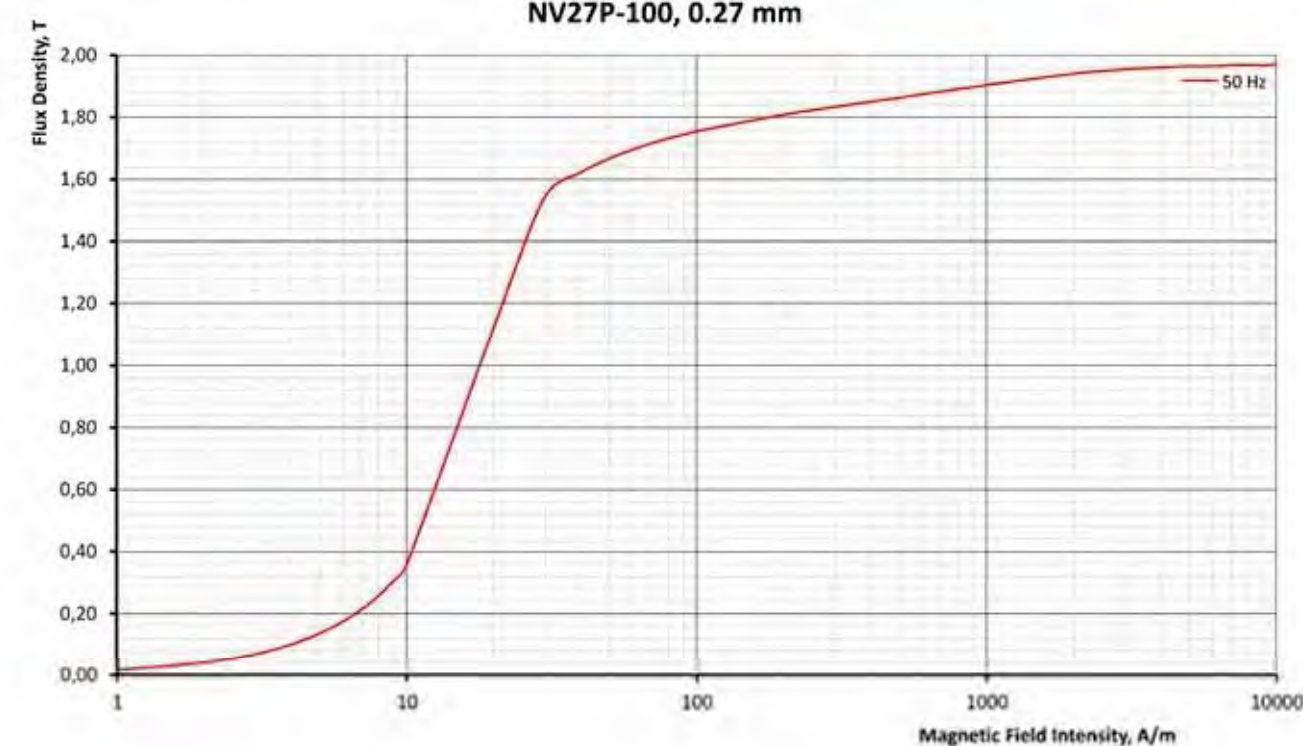




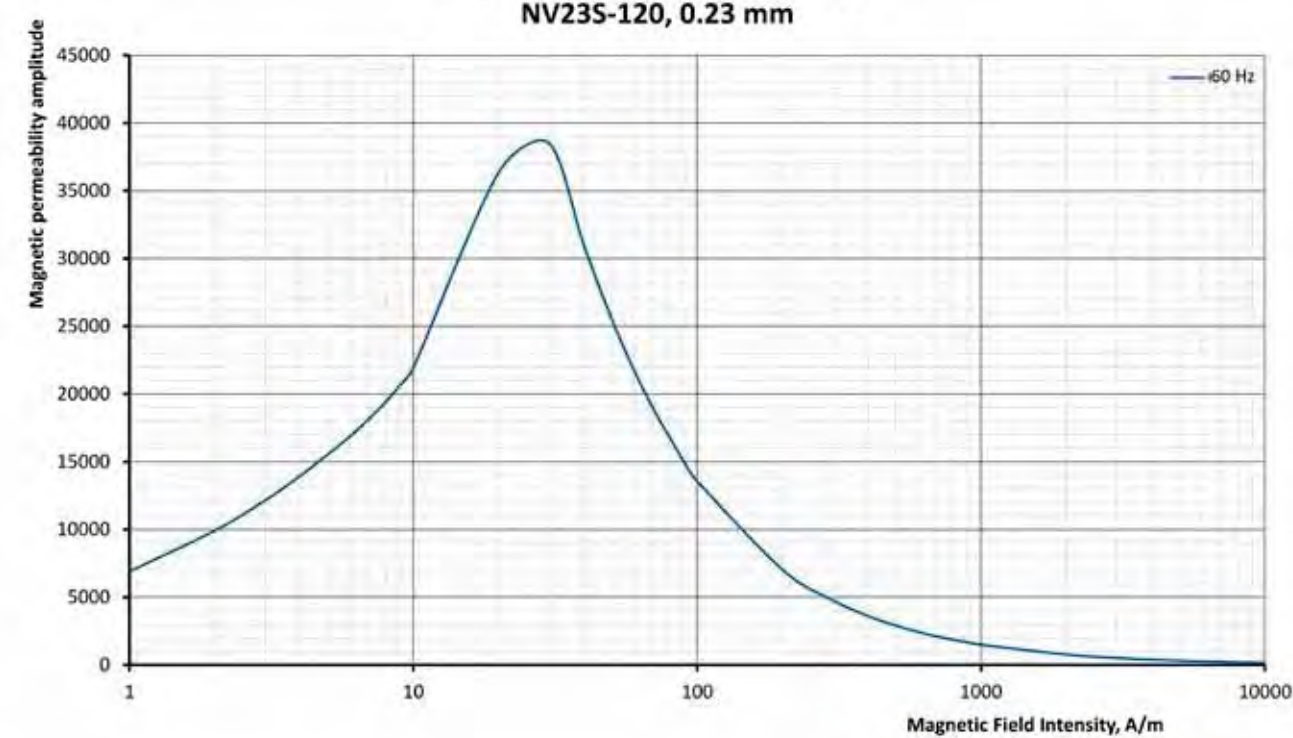
Magnetic permeability amplitude
NV23S-120, 0.23 mm



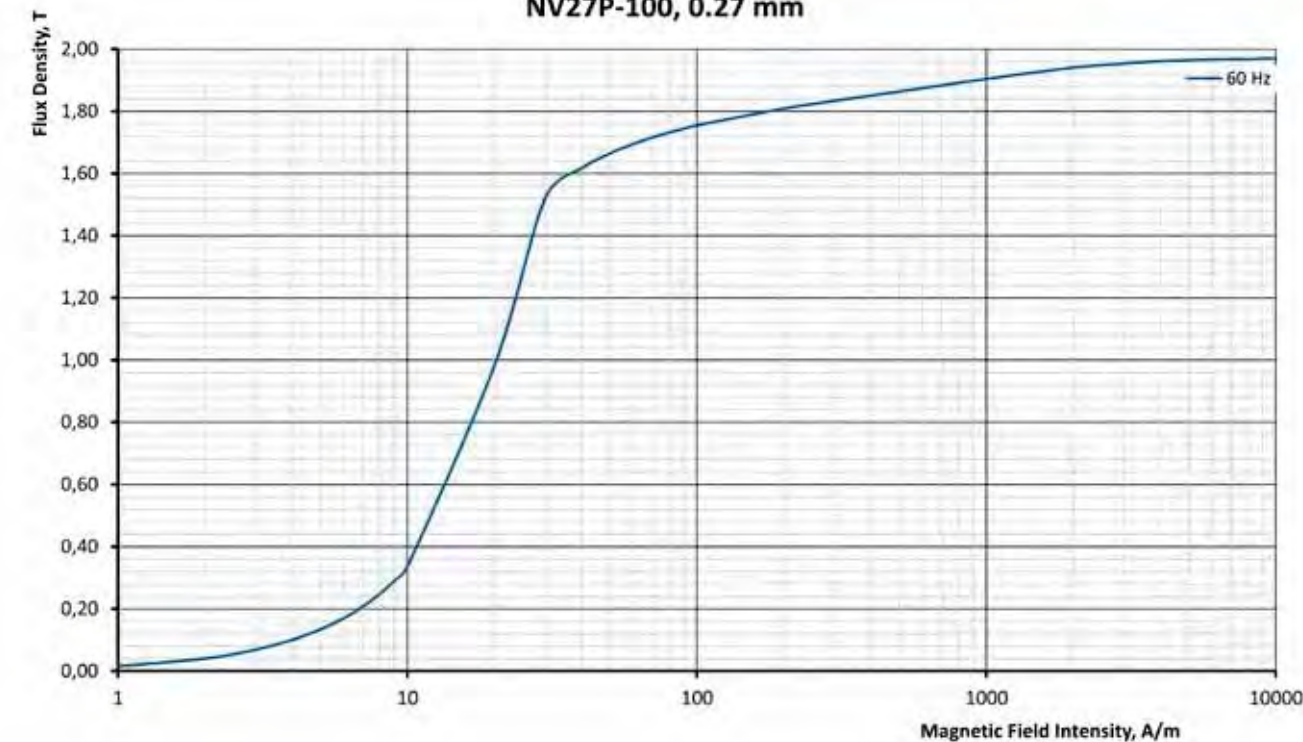
Magnetization curve
NV27P-100, 0.27 mm



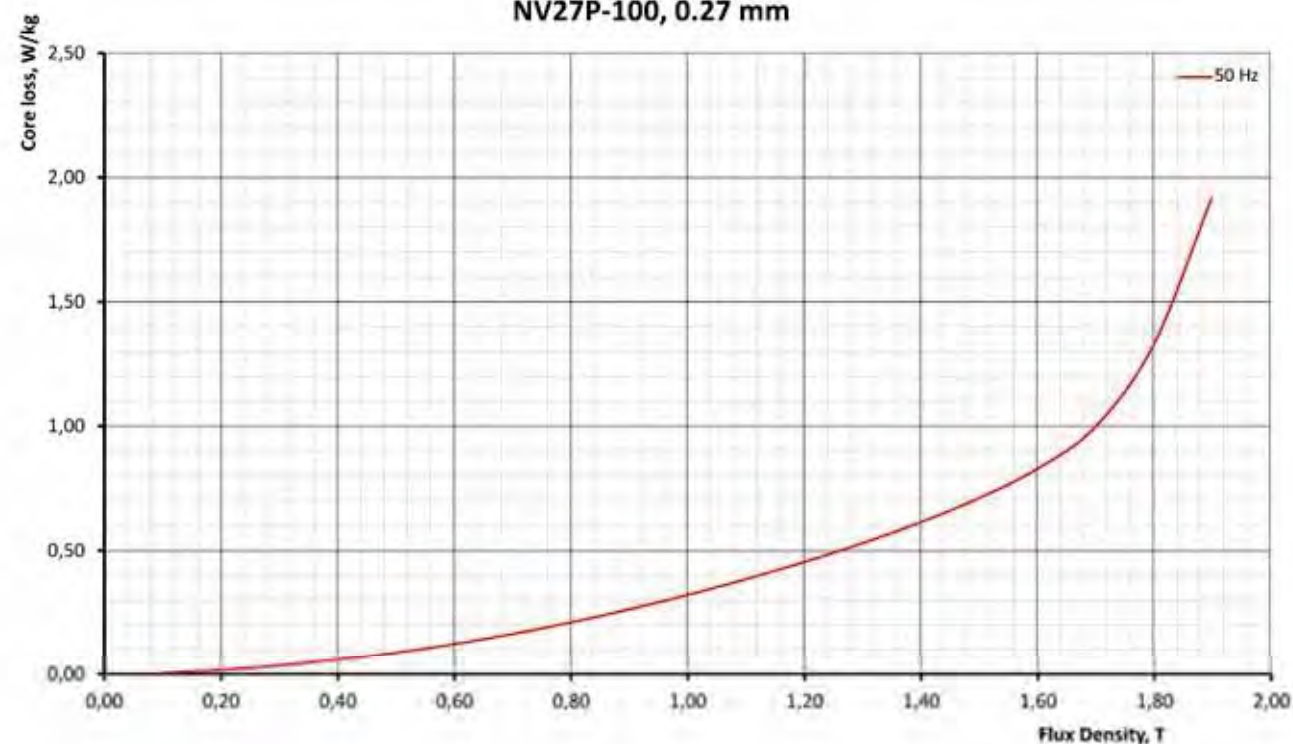
Magnetic permeability amplitude
NV23S-120, 0.23 mm



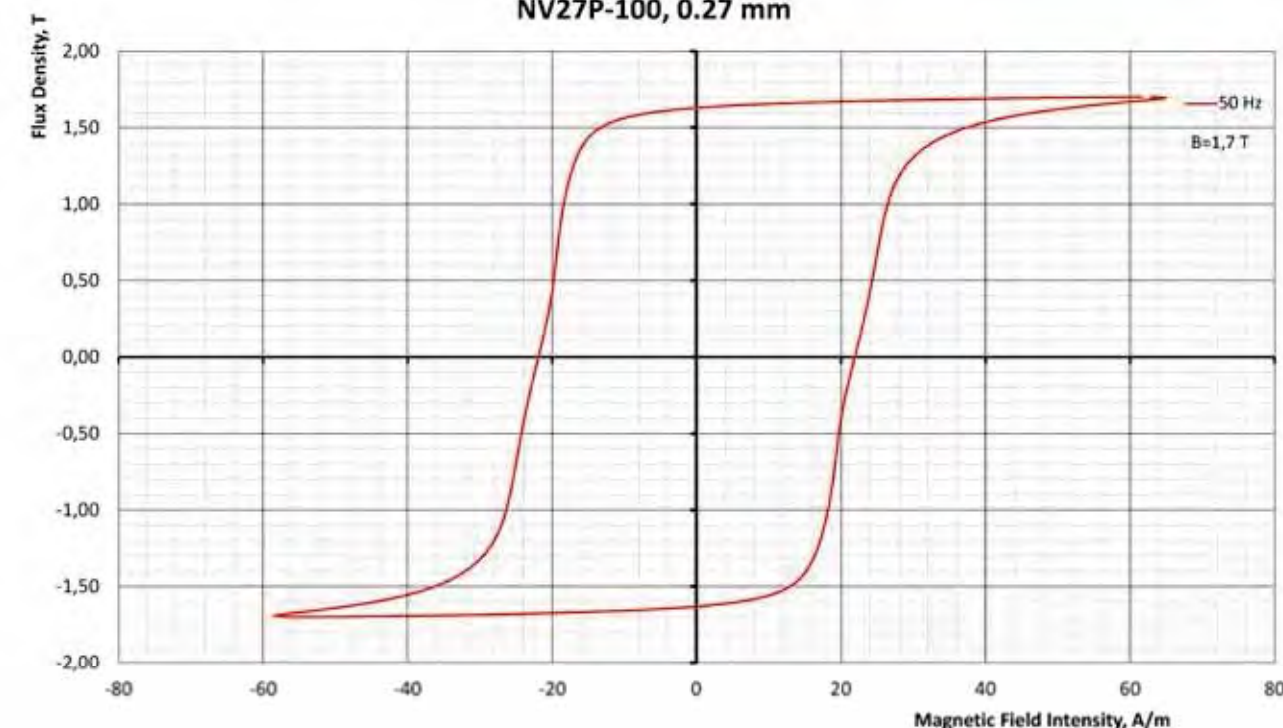
Magnetization curve
NV27P-100, 0.27 mm



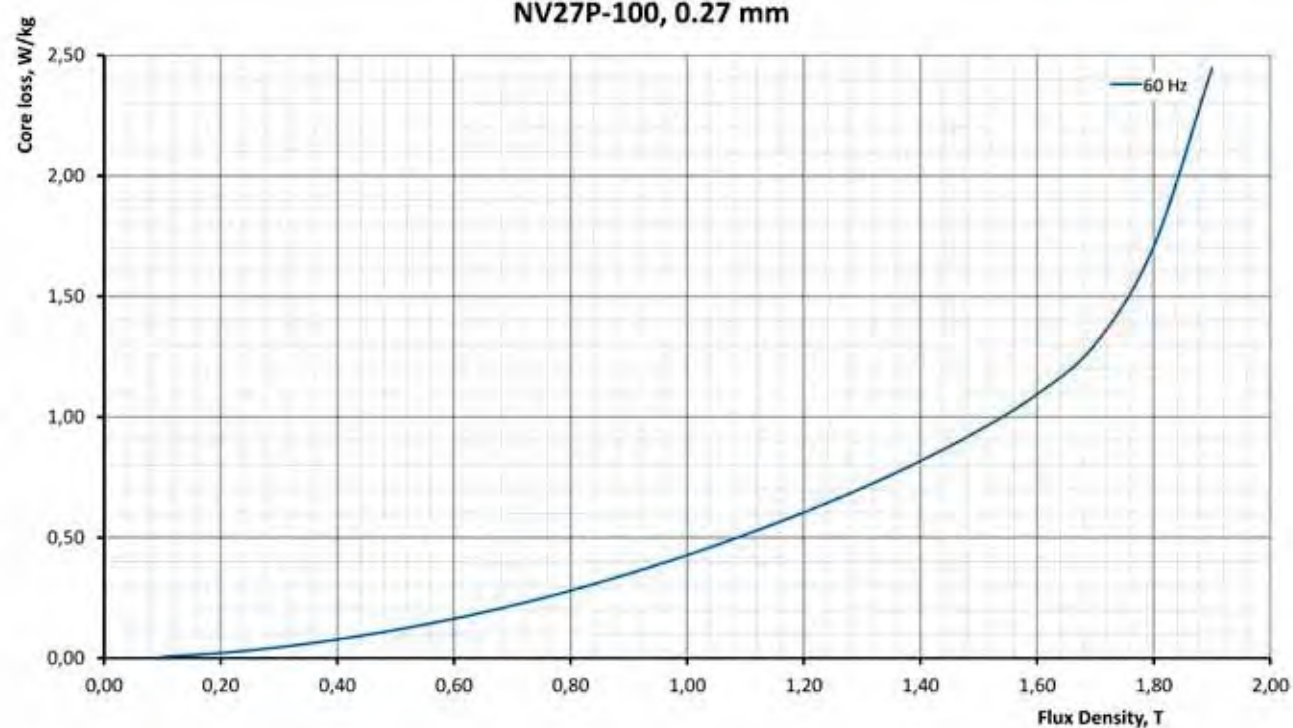
Specific core loss
NV27P-100, 0.27 mm



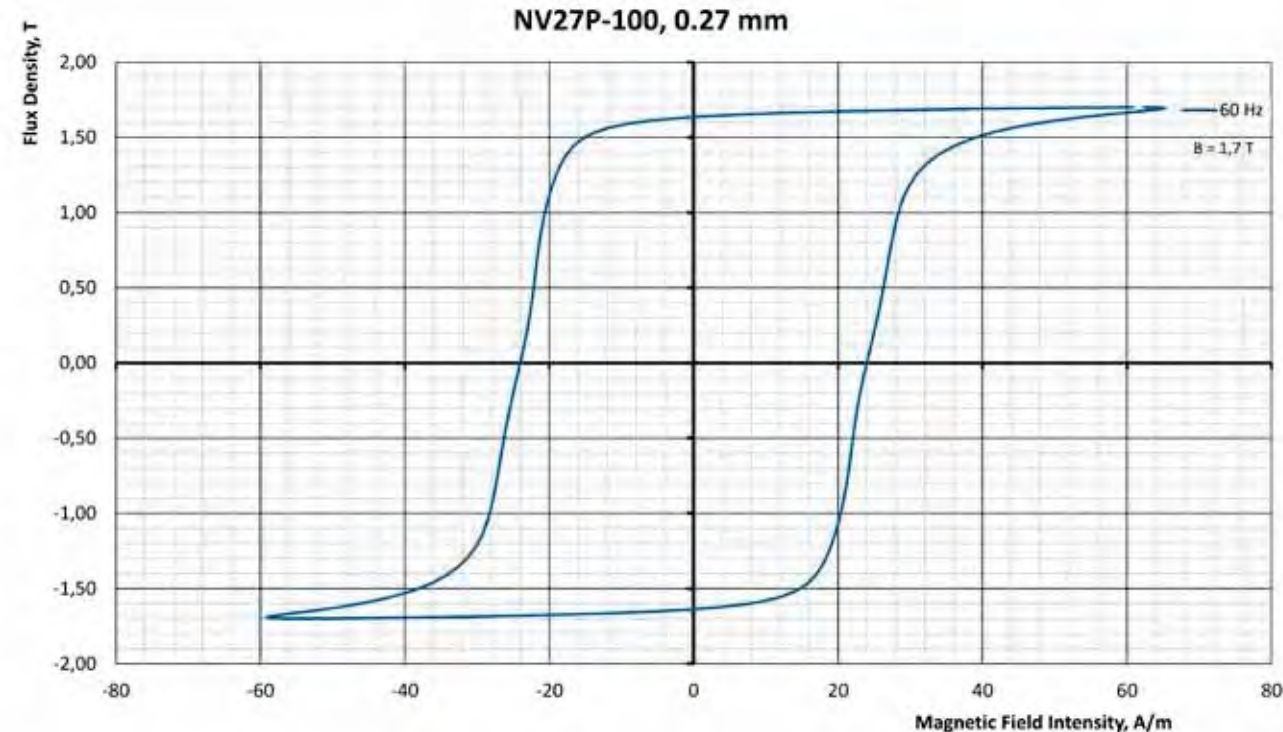
Hysteresis loop
NV27P-100, 0.27 mm

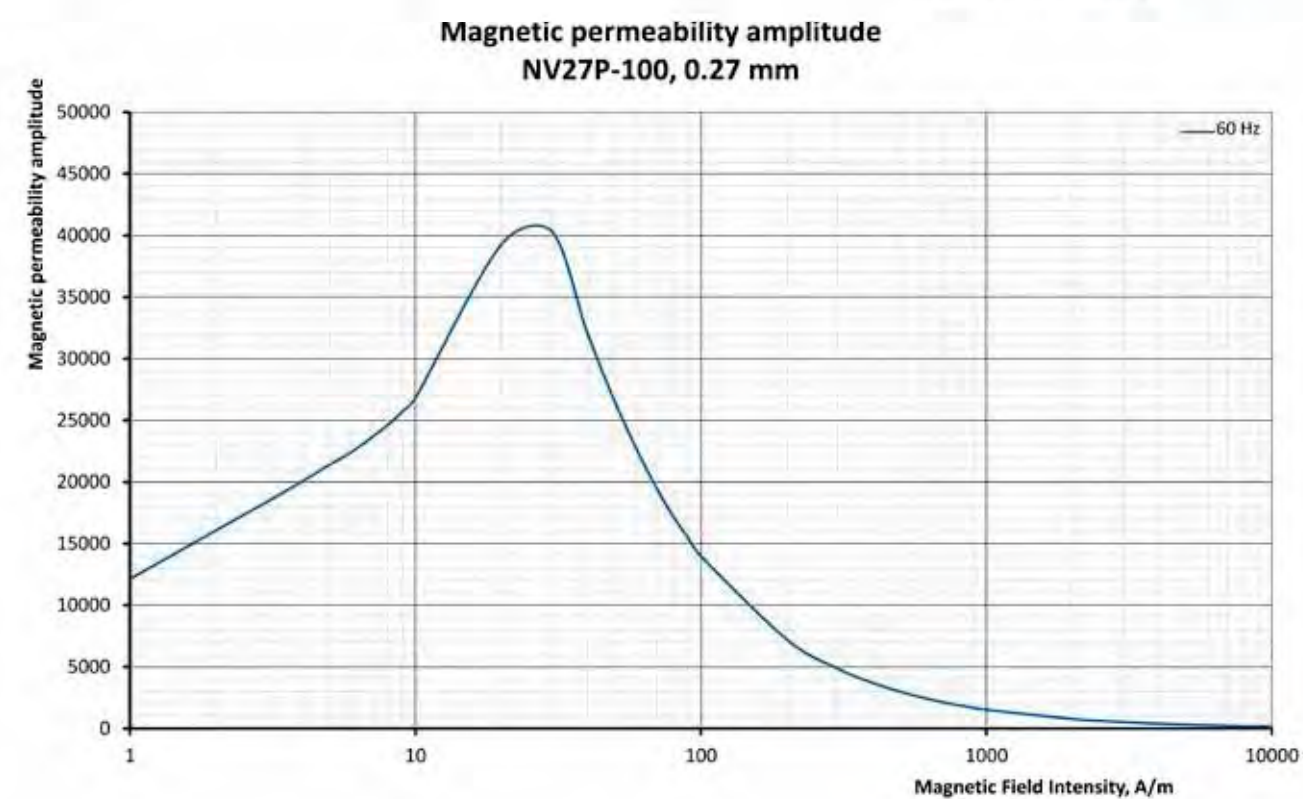
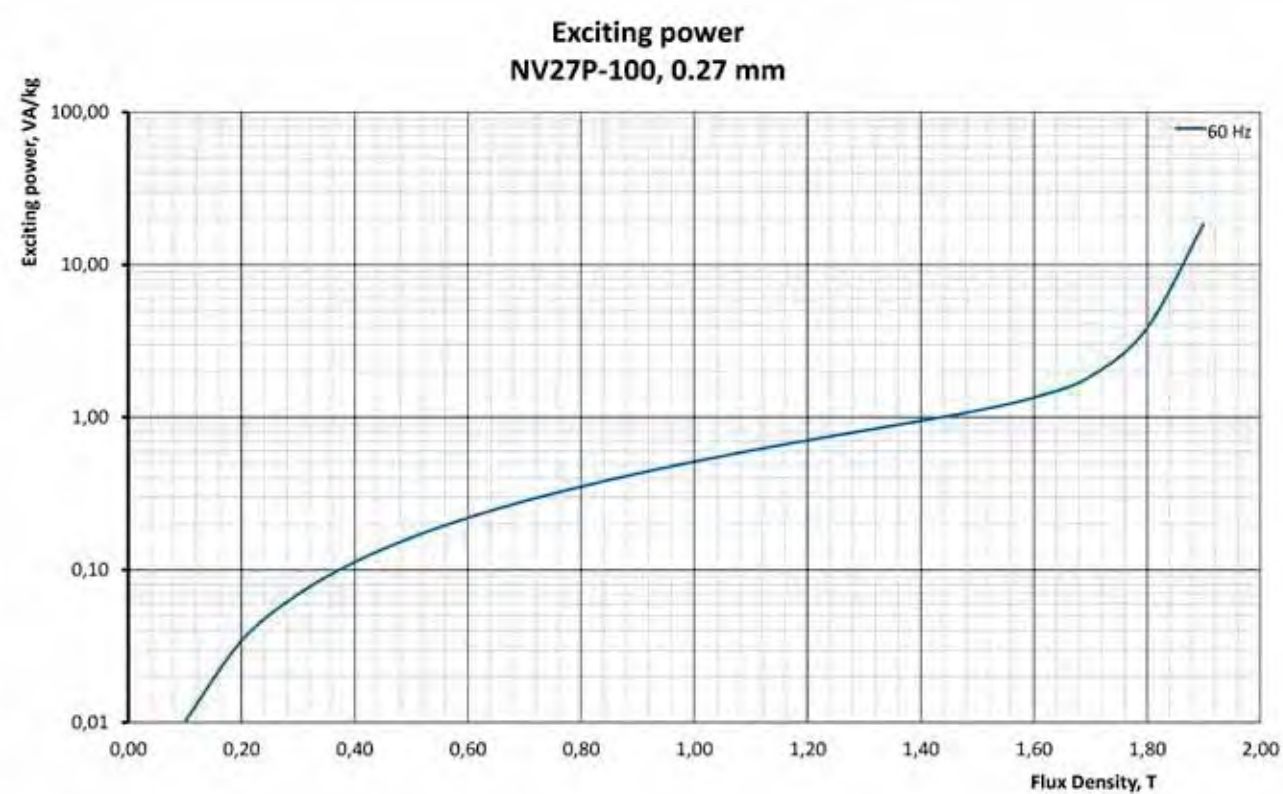
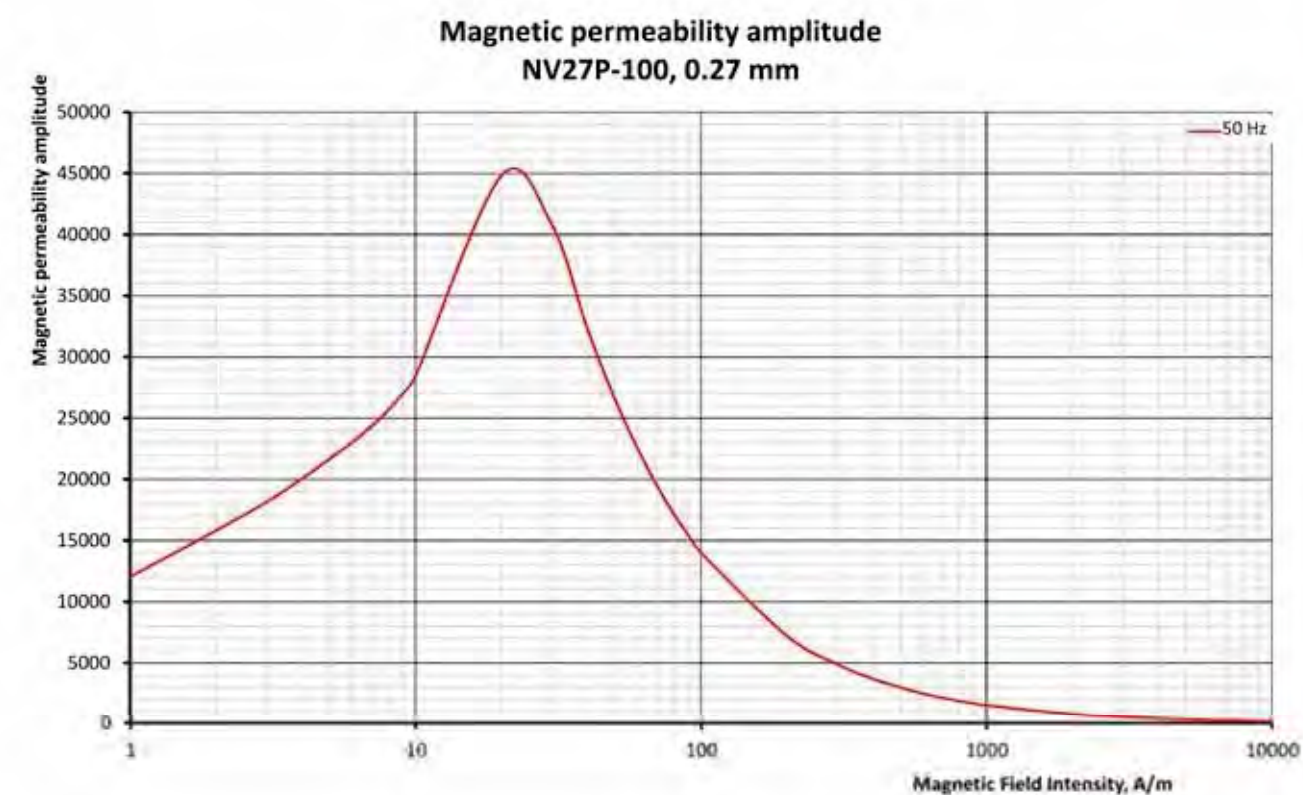
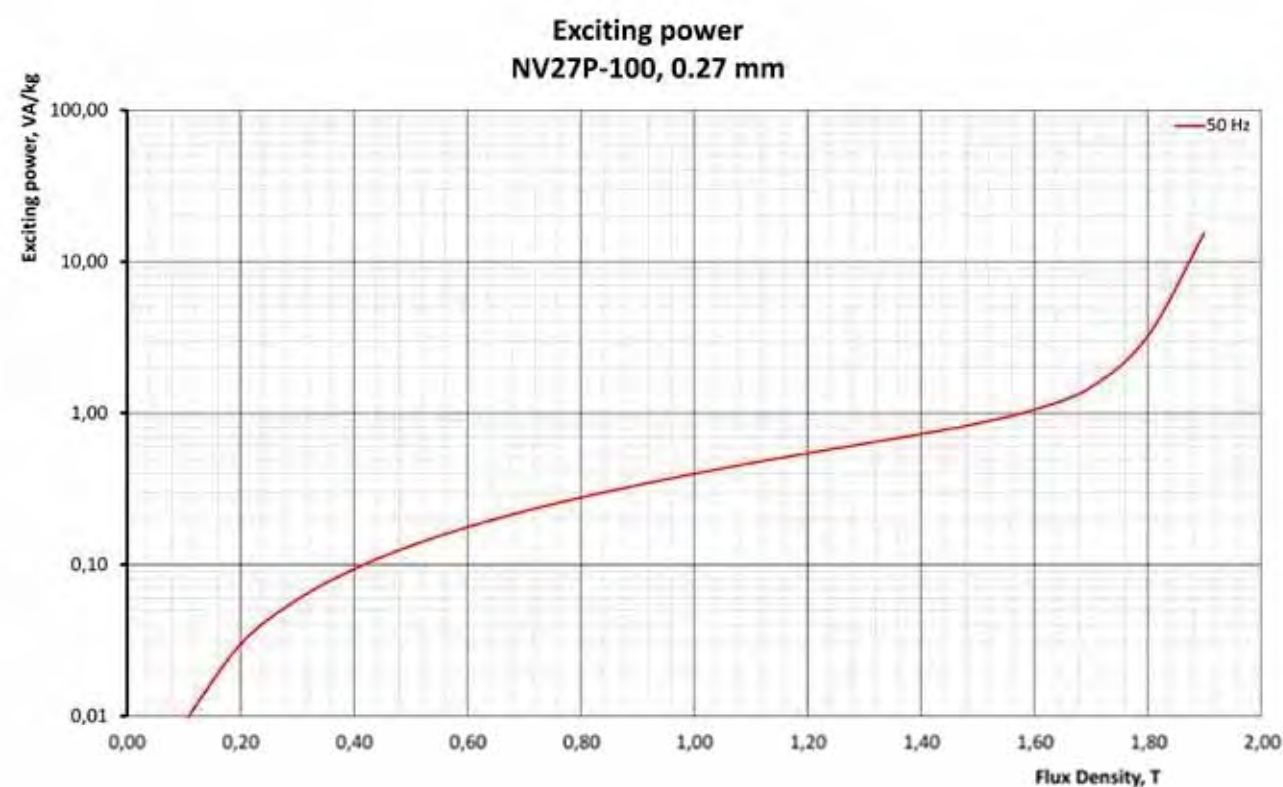


Specific core loss
NV27P-100, 0.27 mm

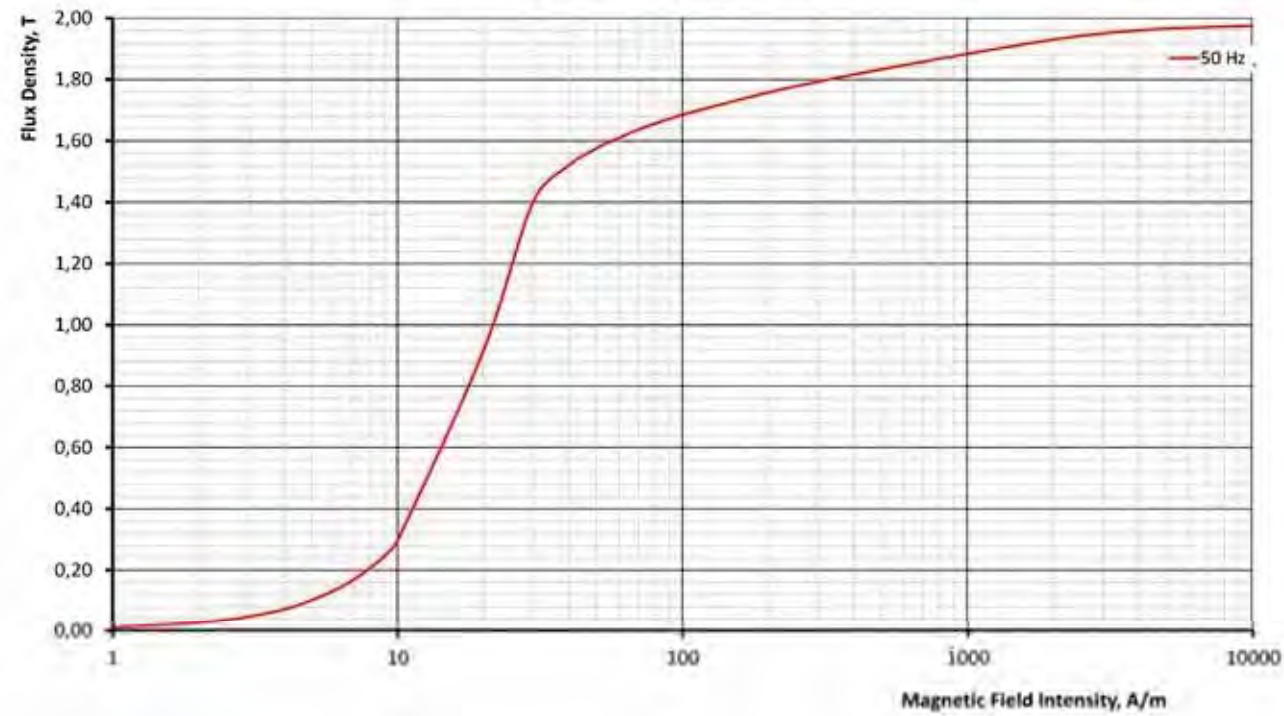


Hysteresis loop
NV27P-100, 0.27 mm

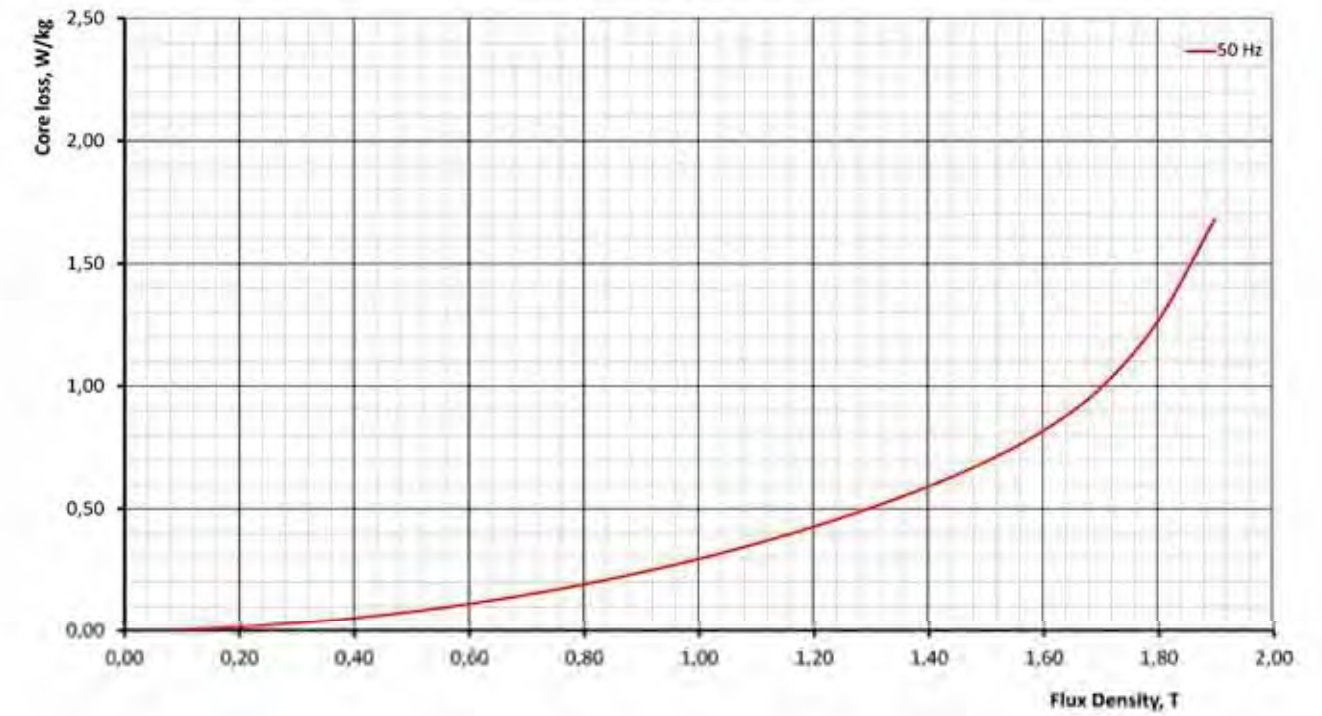




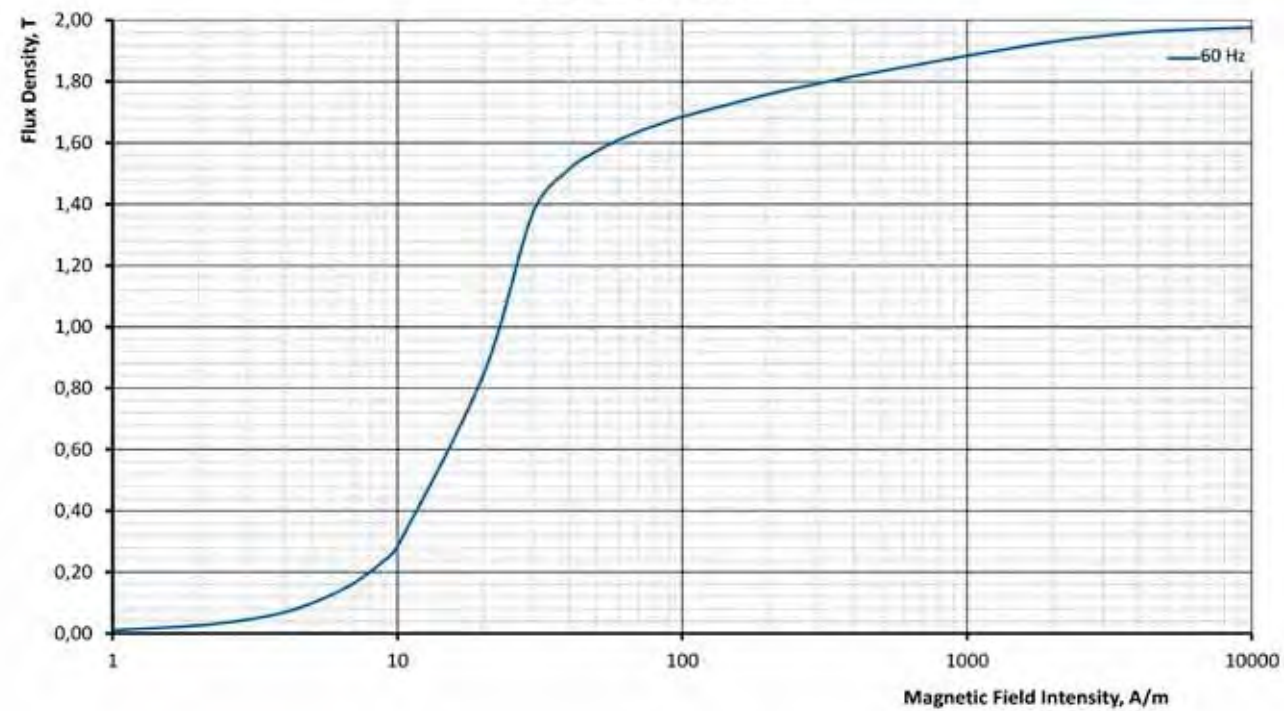
**Magnetization curve
NV27S-100L, 0.27 mm**



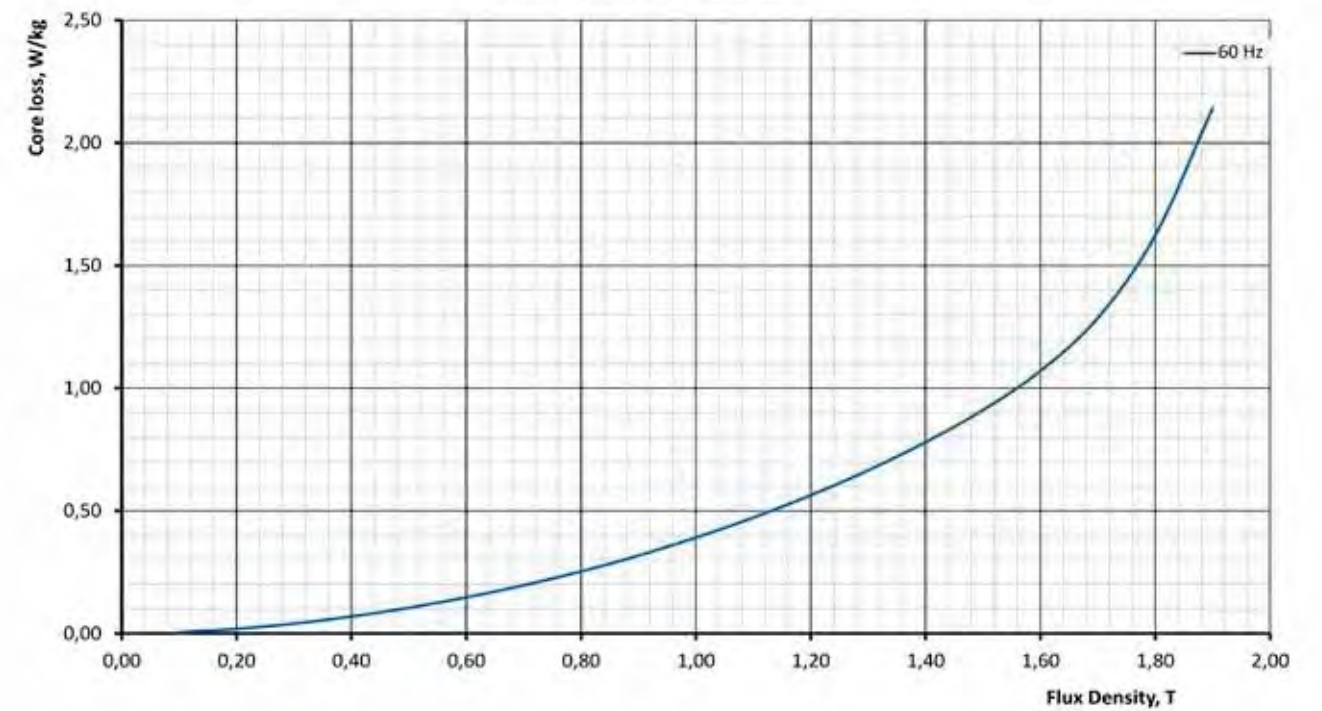
**Specific core loss
NV27S-100L, 0.27 mm**



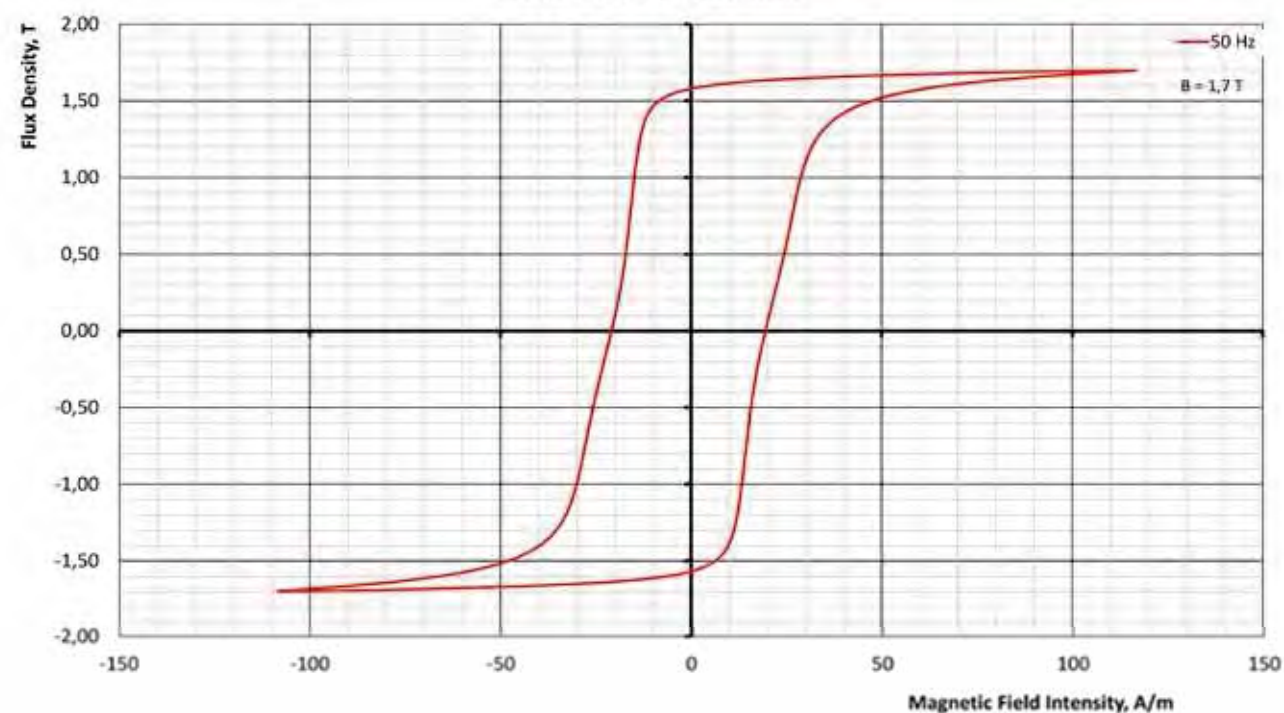
**Magnetization curve
NV27S-100L, 0.27 mm**



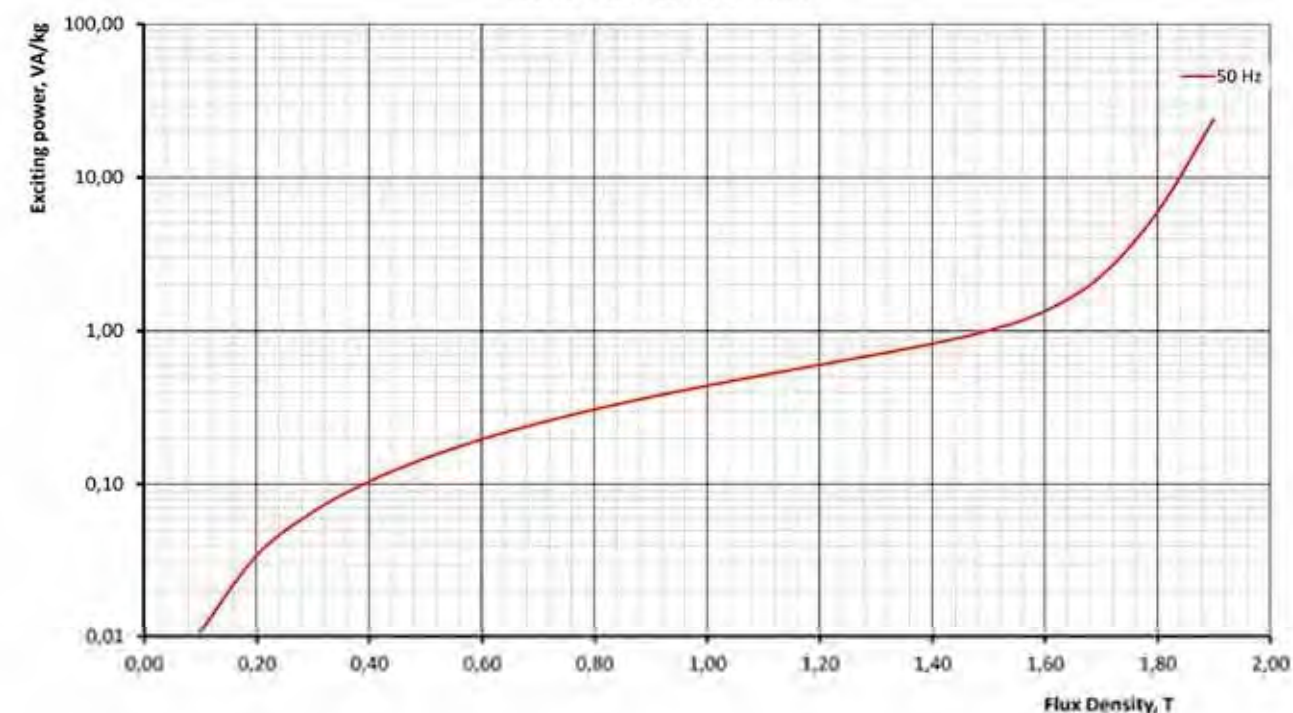
**Specific core loss
NV27S-100L, 0.27 mm**



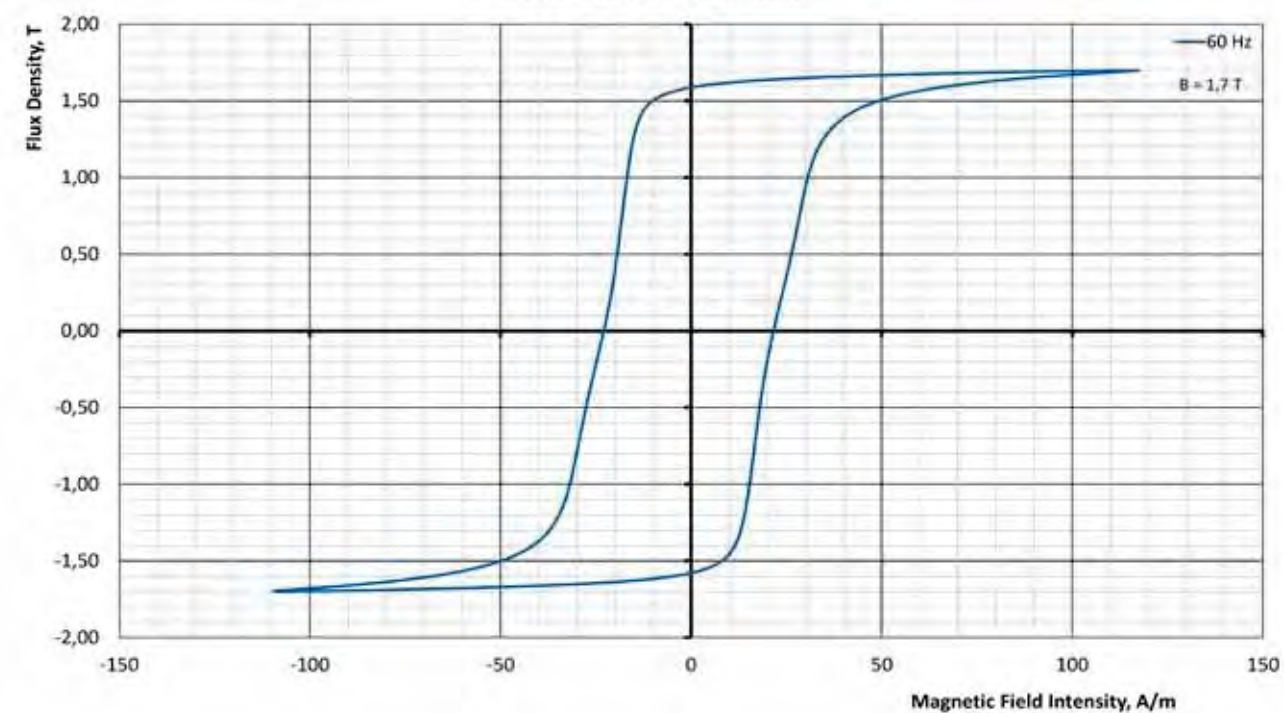
Hysteresis loop
NV27S-100L, 0.27 mm



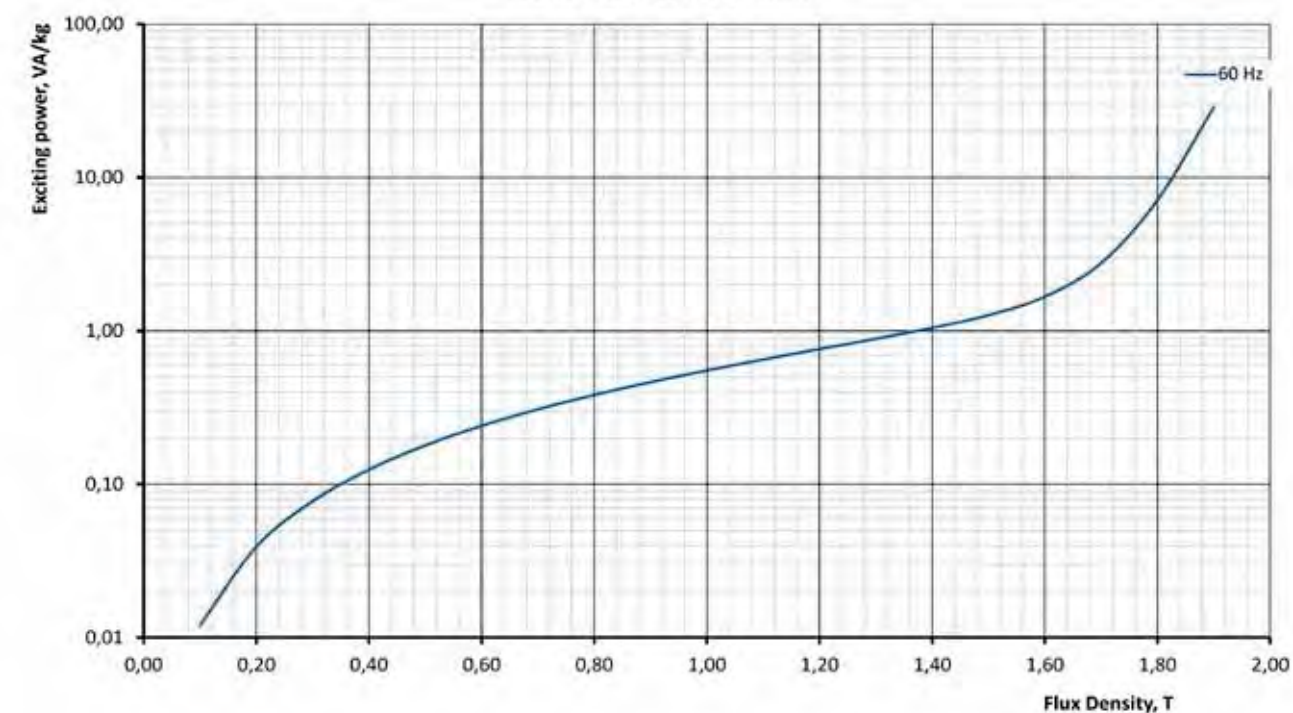
Exciting power
NV27S-100L, 0.27 mm



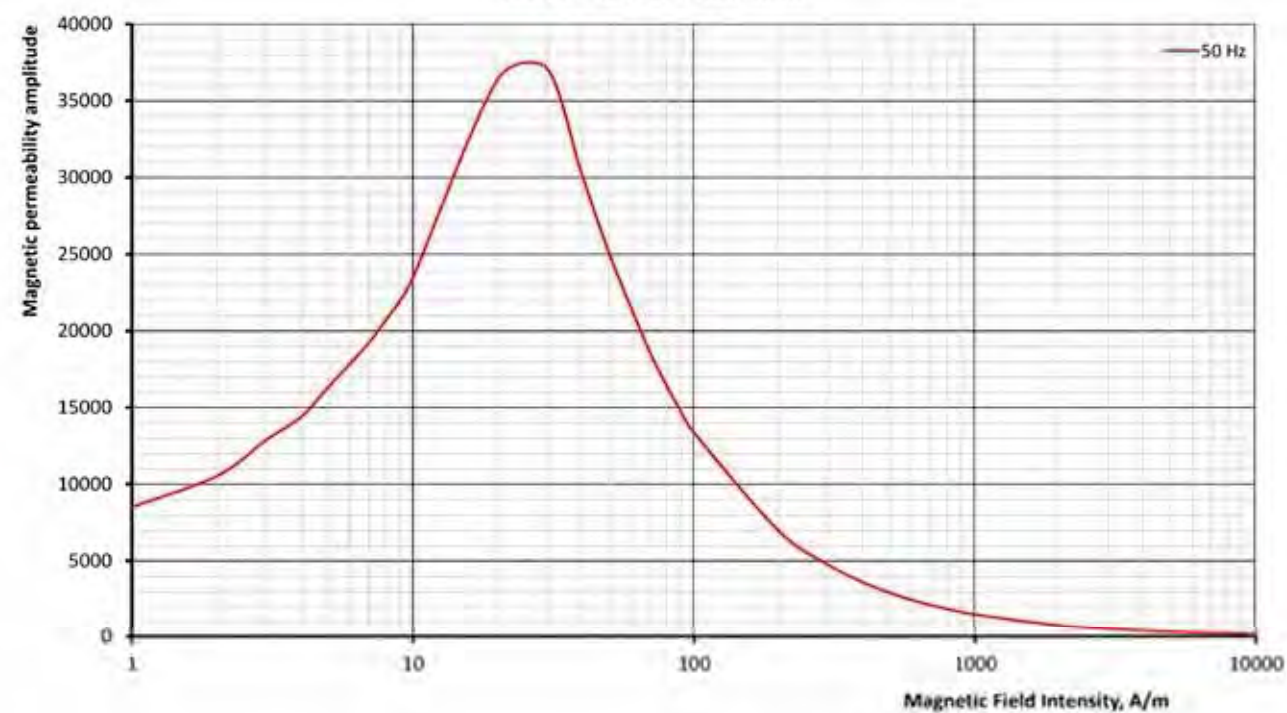
Hysteresis loop
NV27S-100L, 0.27 mm



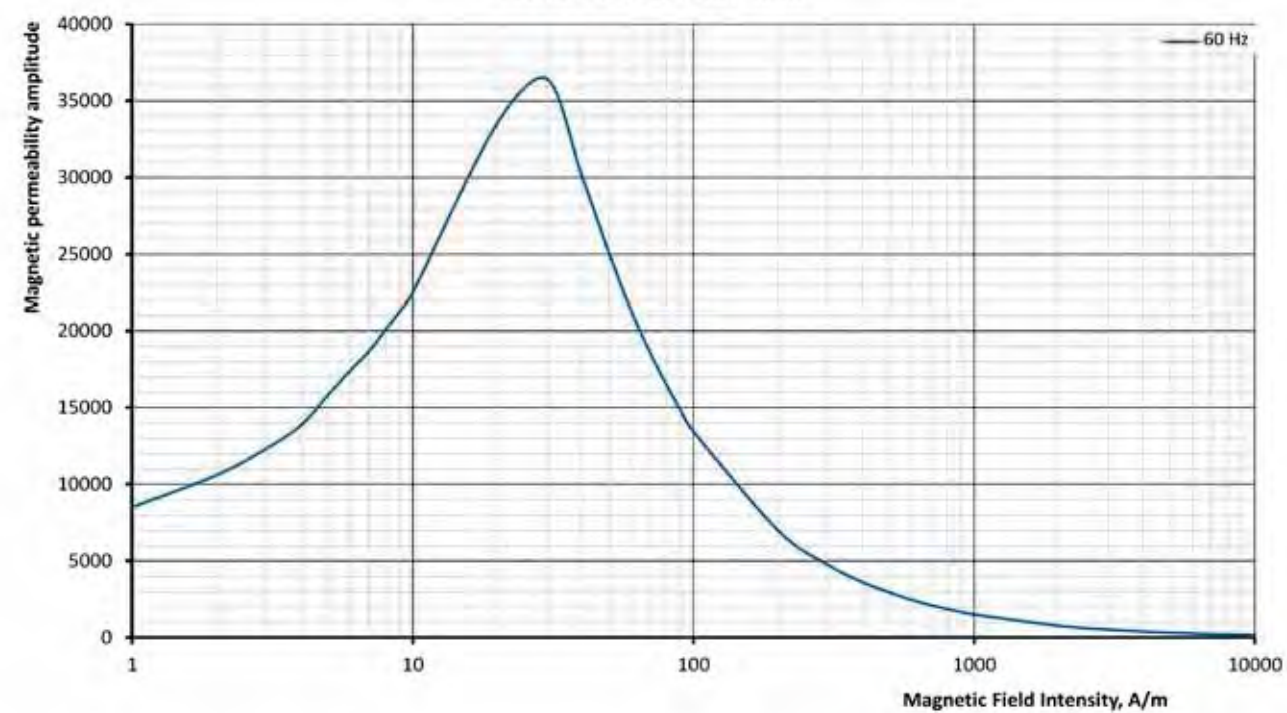
Exciting power
NV27S-100L, 0.27 mm



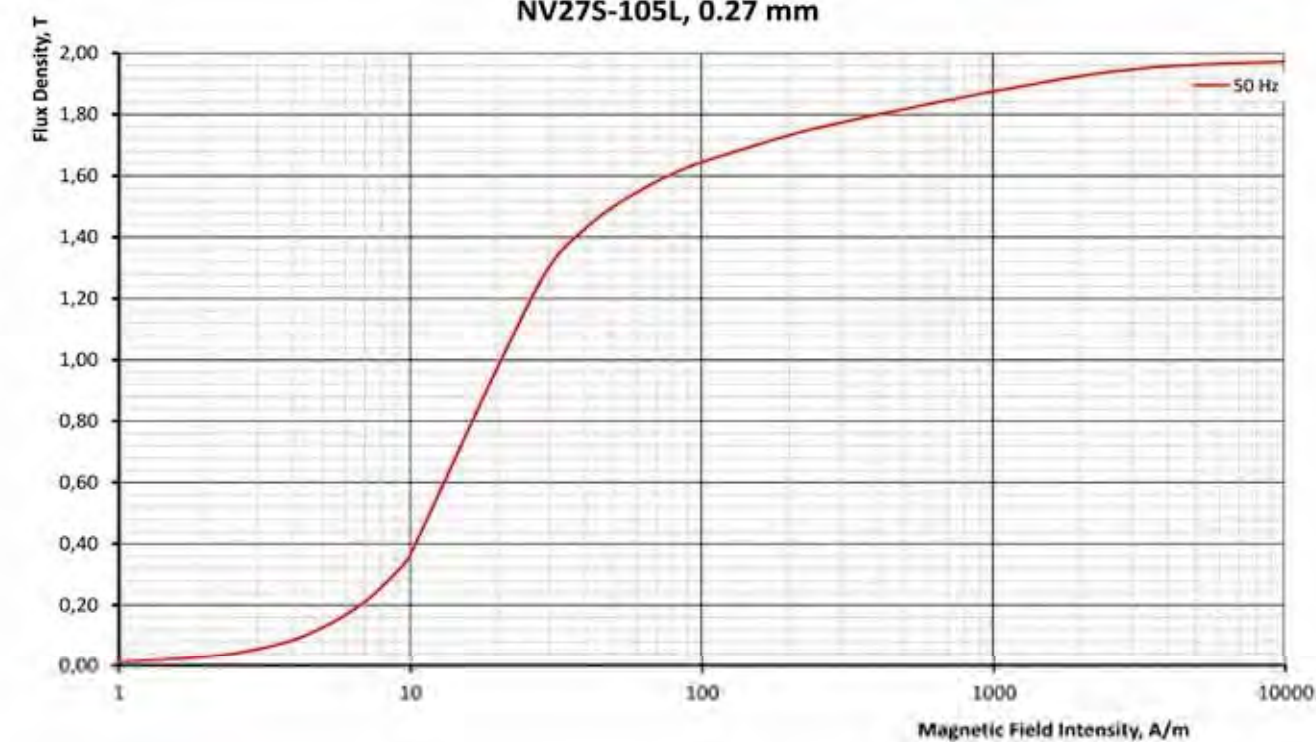
**Magnetic permeability amplitude
NV27S-100L, 0.27 mm**



**Magnetic permeability amplitude
NV27S-100L, 0.27 mm**

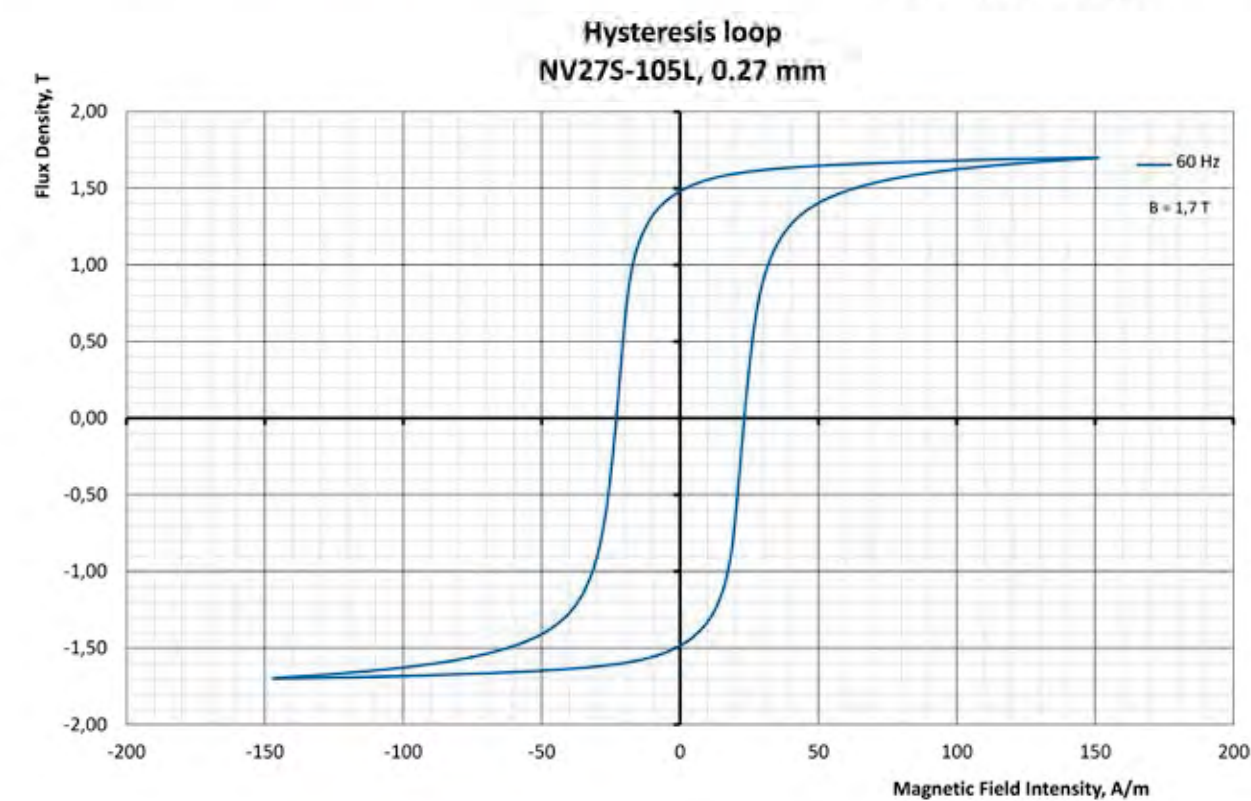
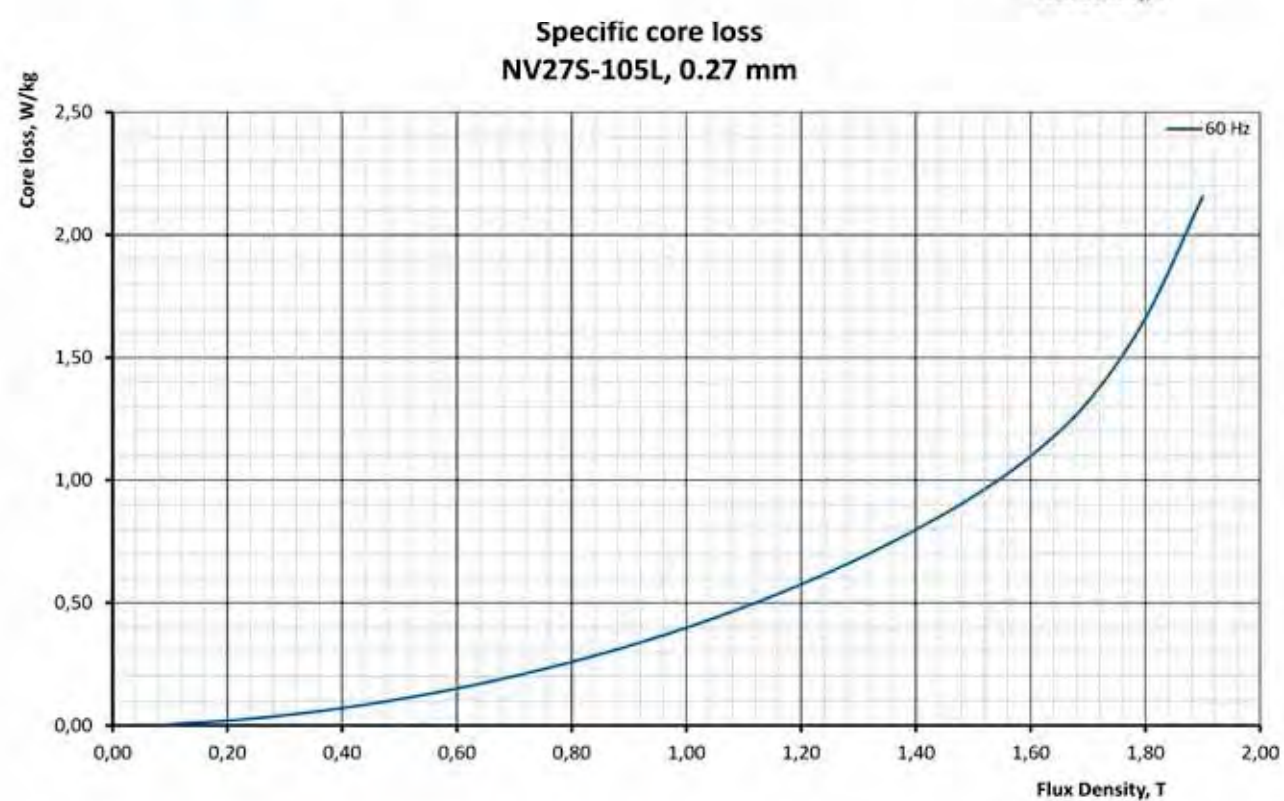
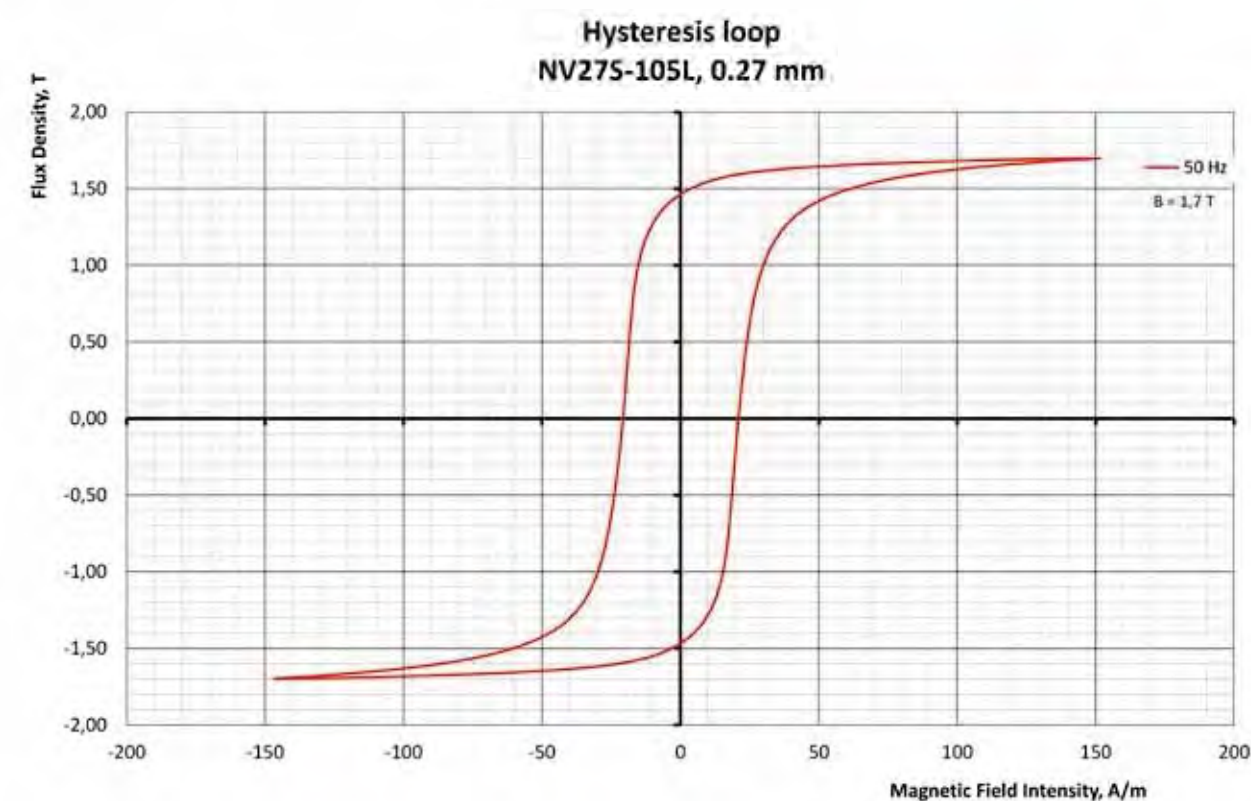


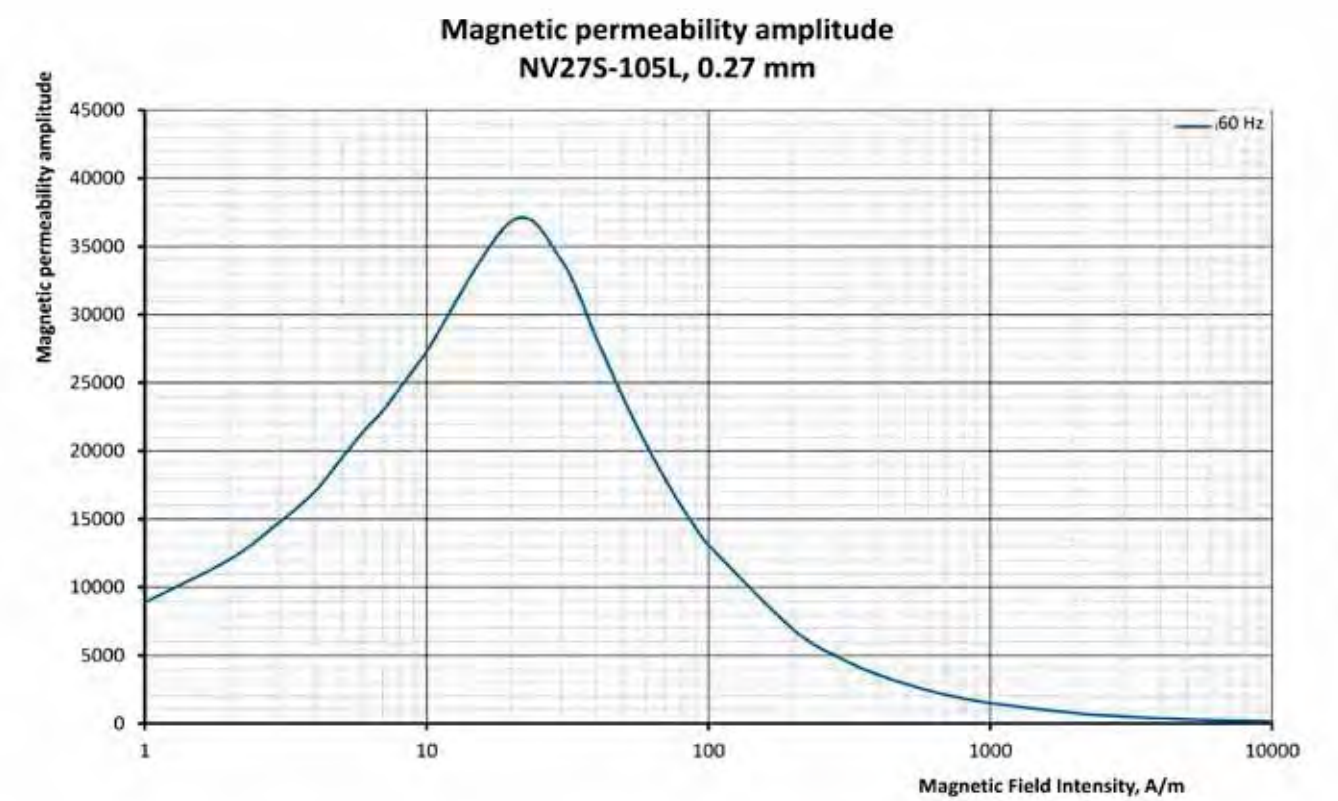
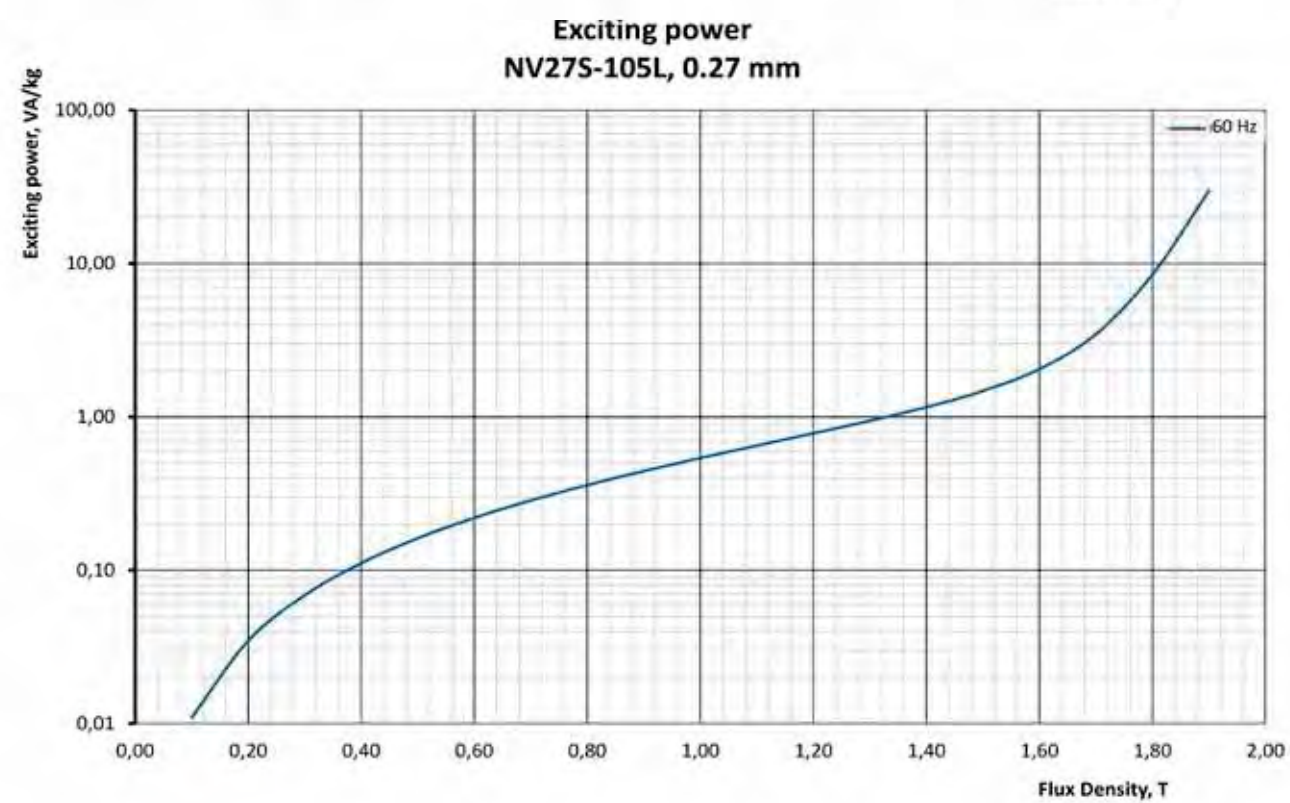
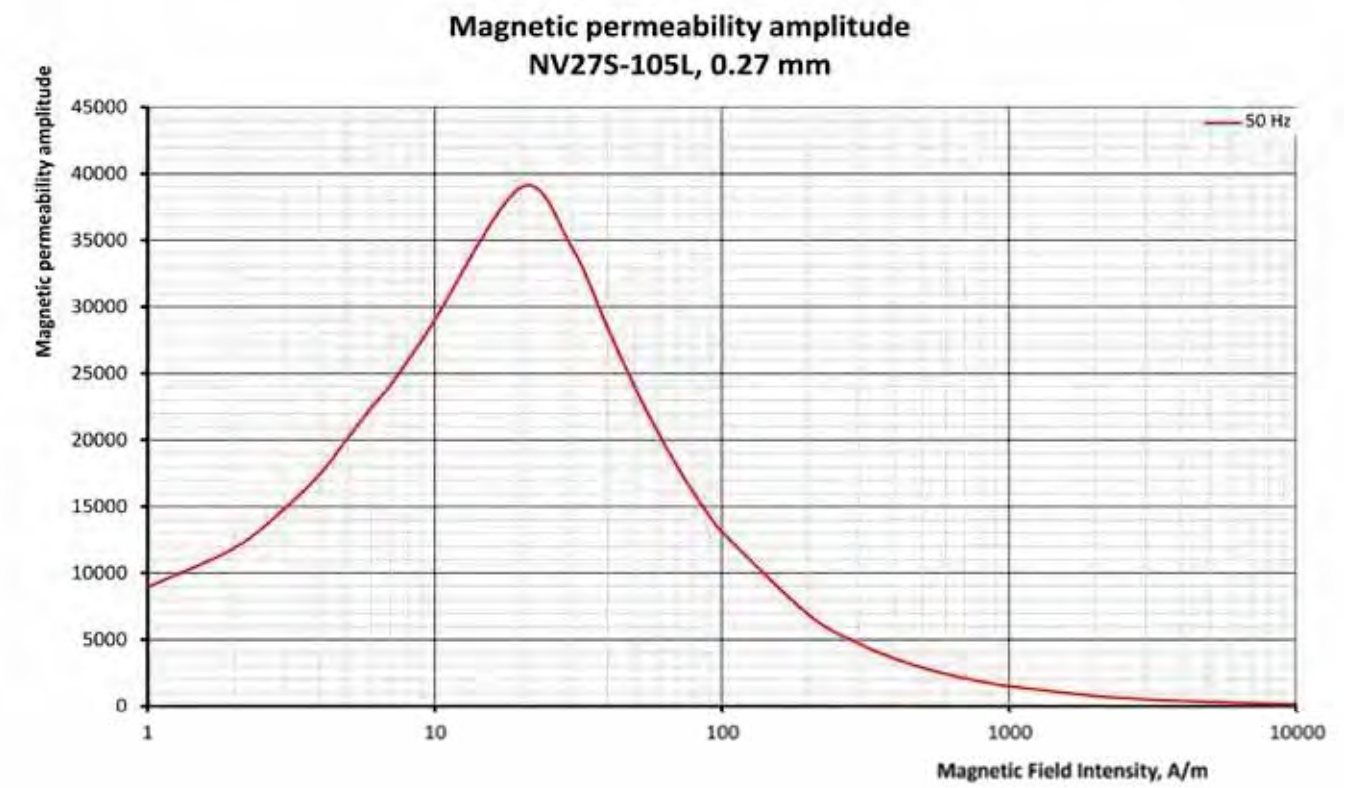
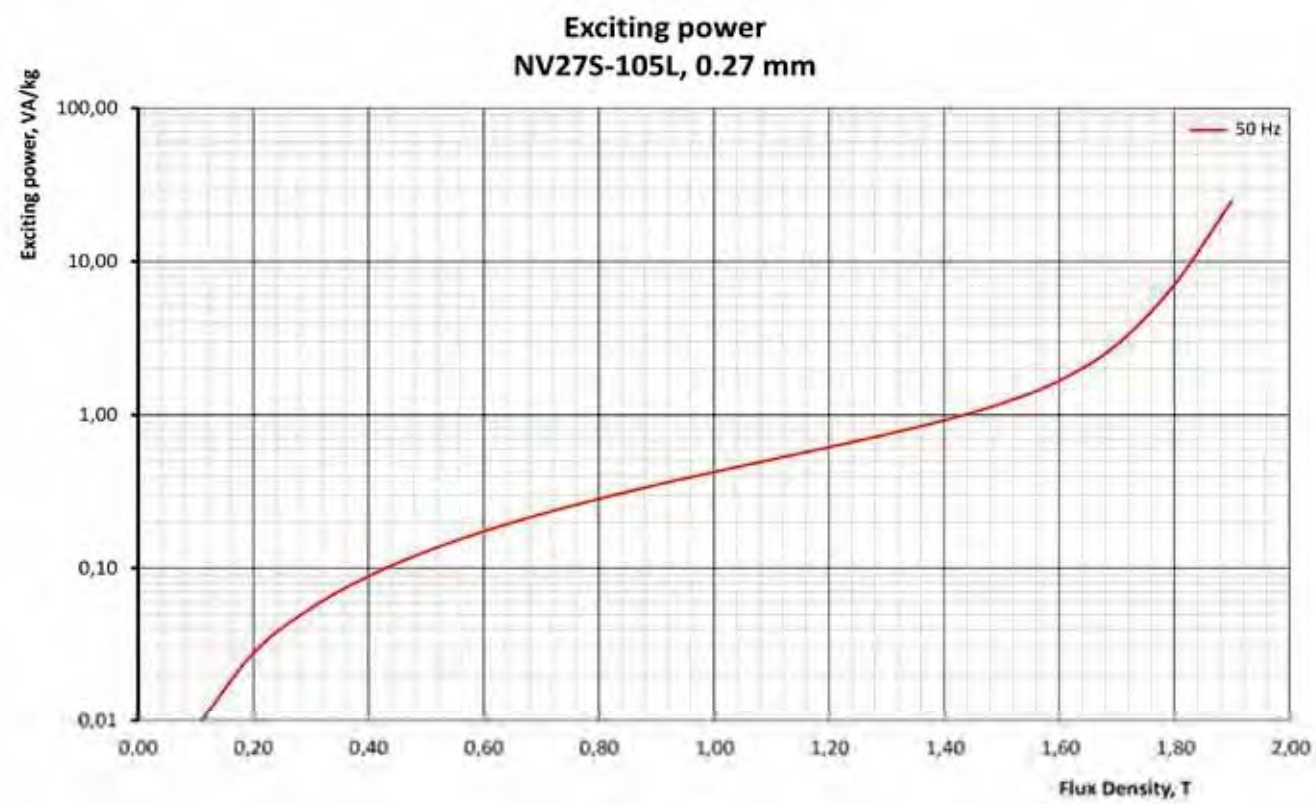
**Magnetization curve
NV27S-105L, 0.27 mm**



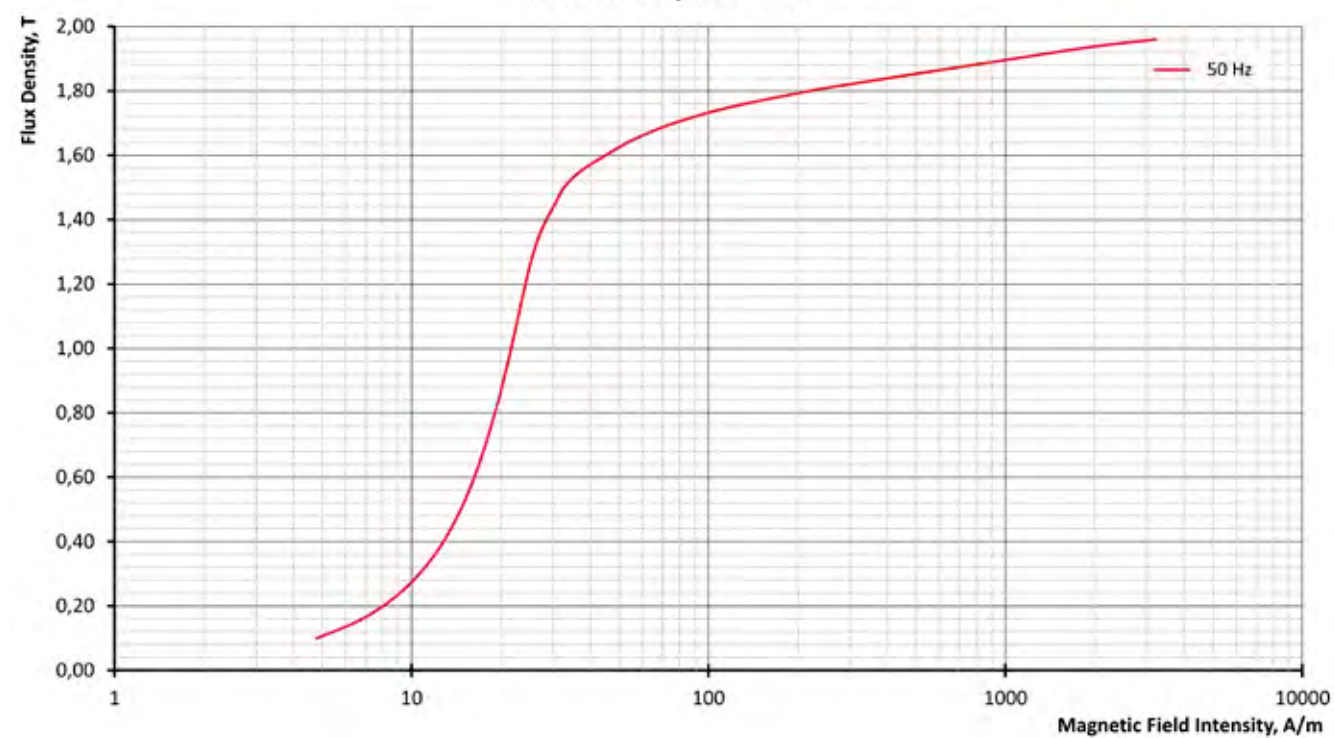
**Magnetization curve
NV27S-105L, 0.27 mm**



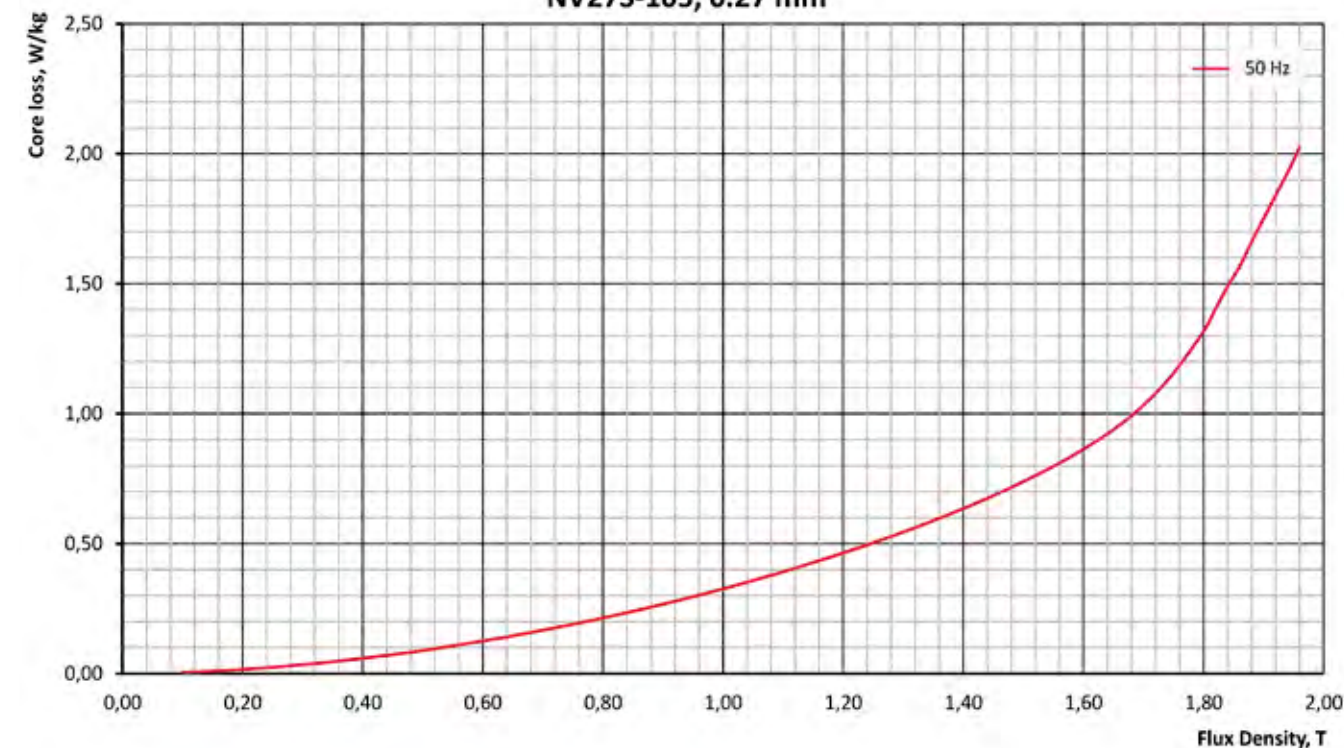




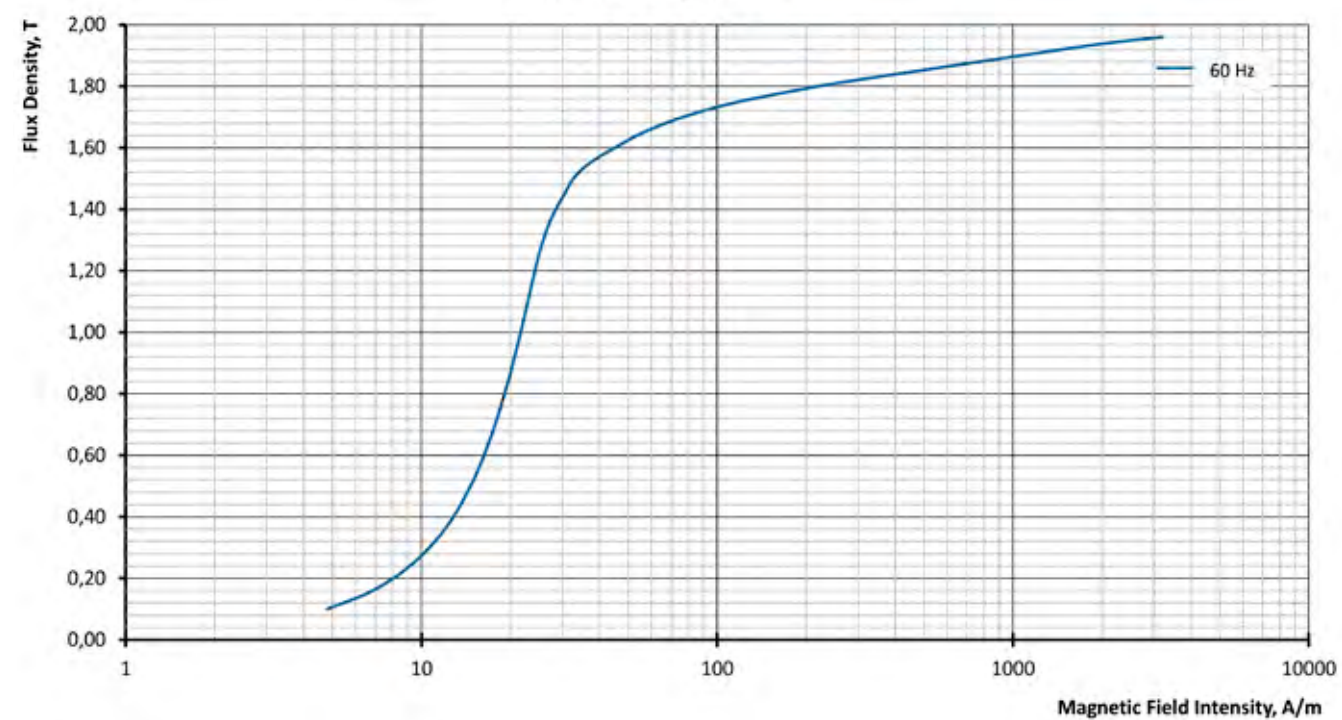
**Magnetization curve
NV27S-105, 0.27 mm**



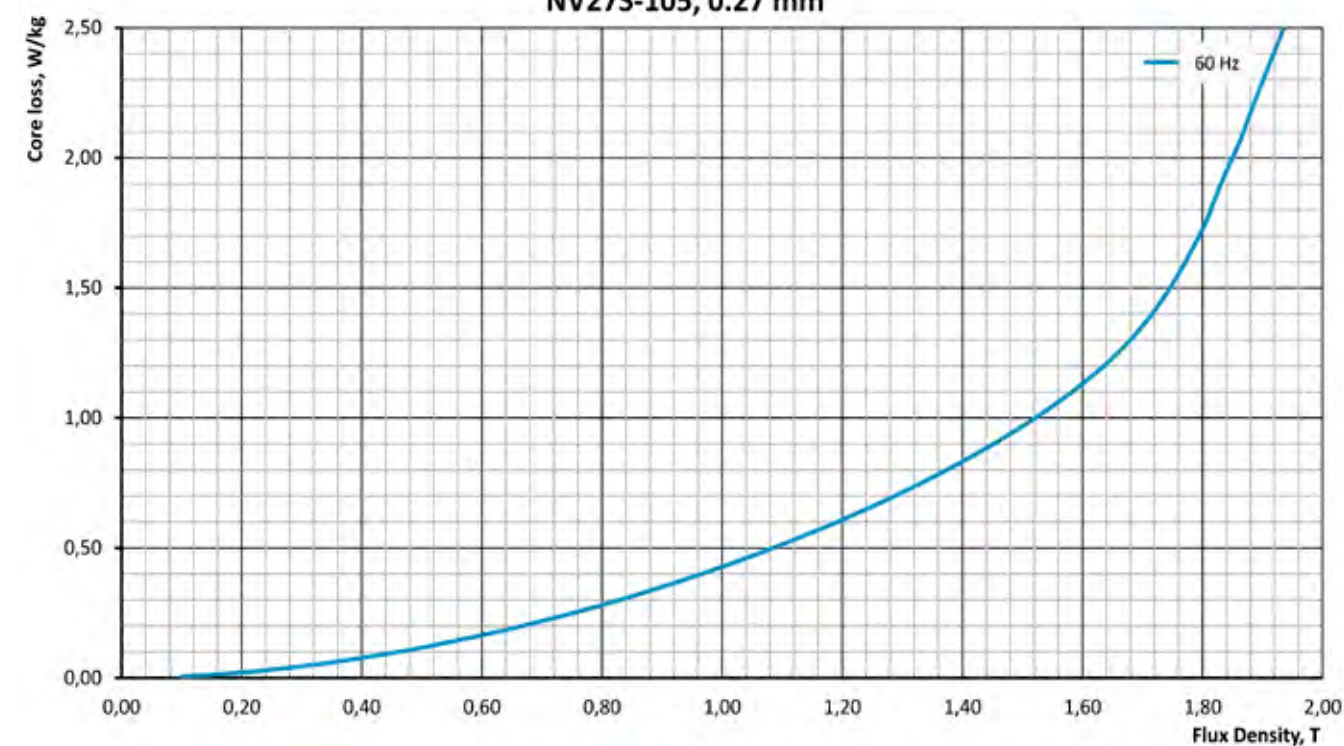
**Specific core loss
NV27S-105, 0.27 mm**



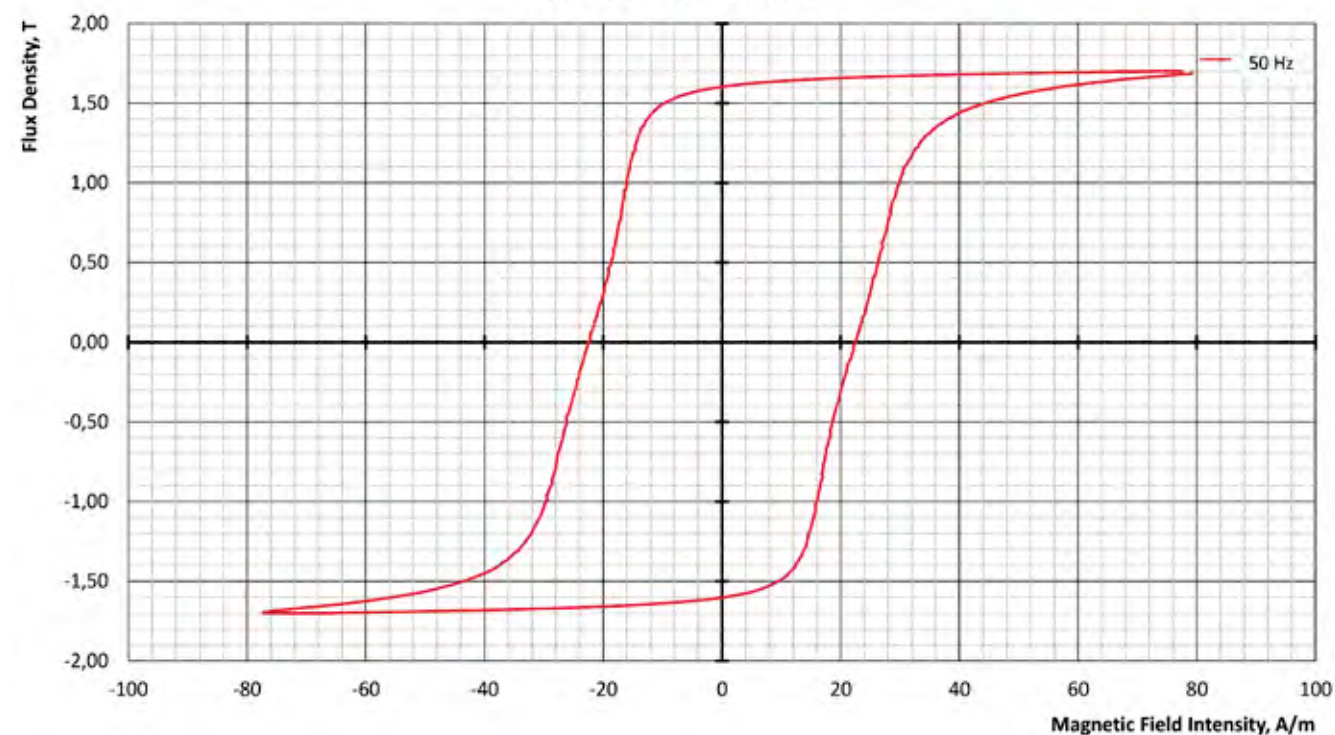
**Magnetization curve
NV27S-105, 0.27 mm**



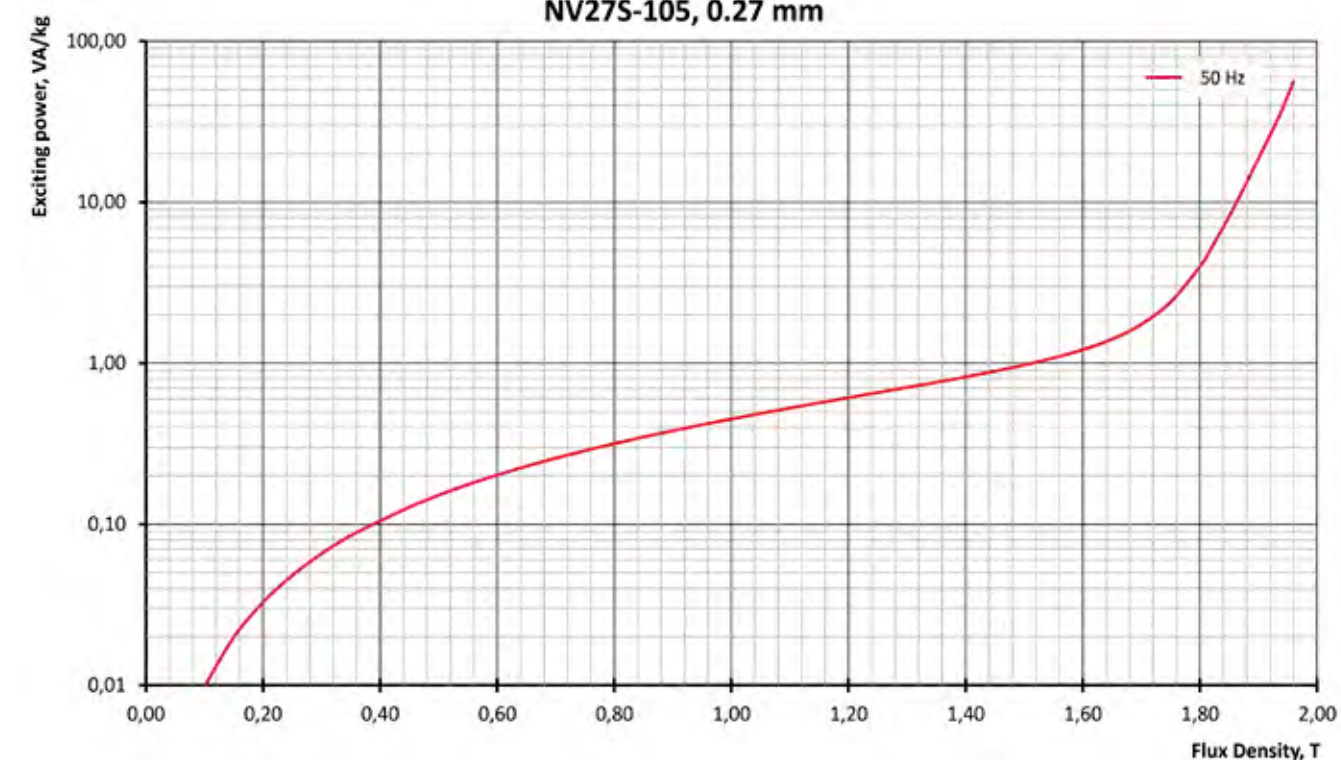
**Specific core loss
NV27S-105, 0.27 mm**



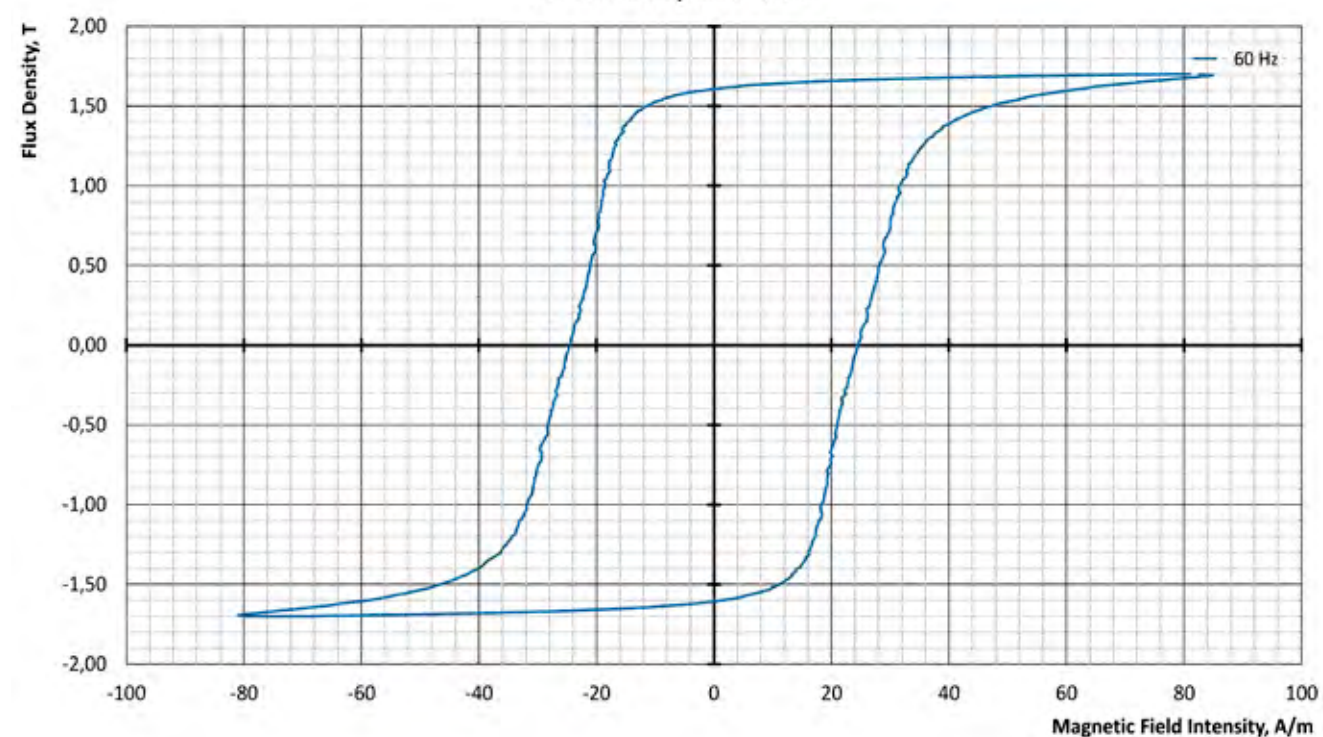
Hysteresis loop
NV27S-105, 0.27 mm



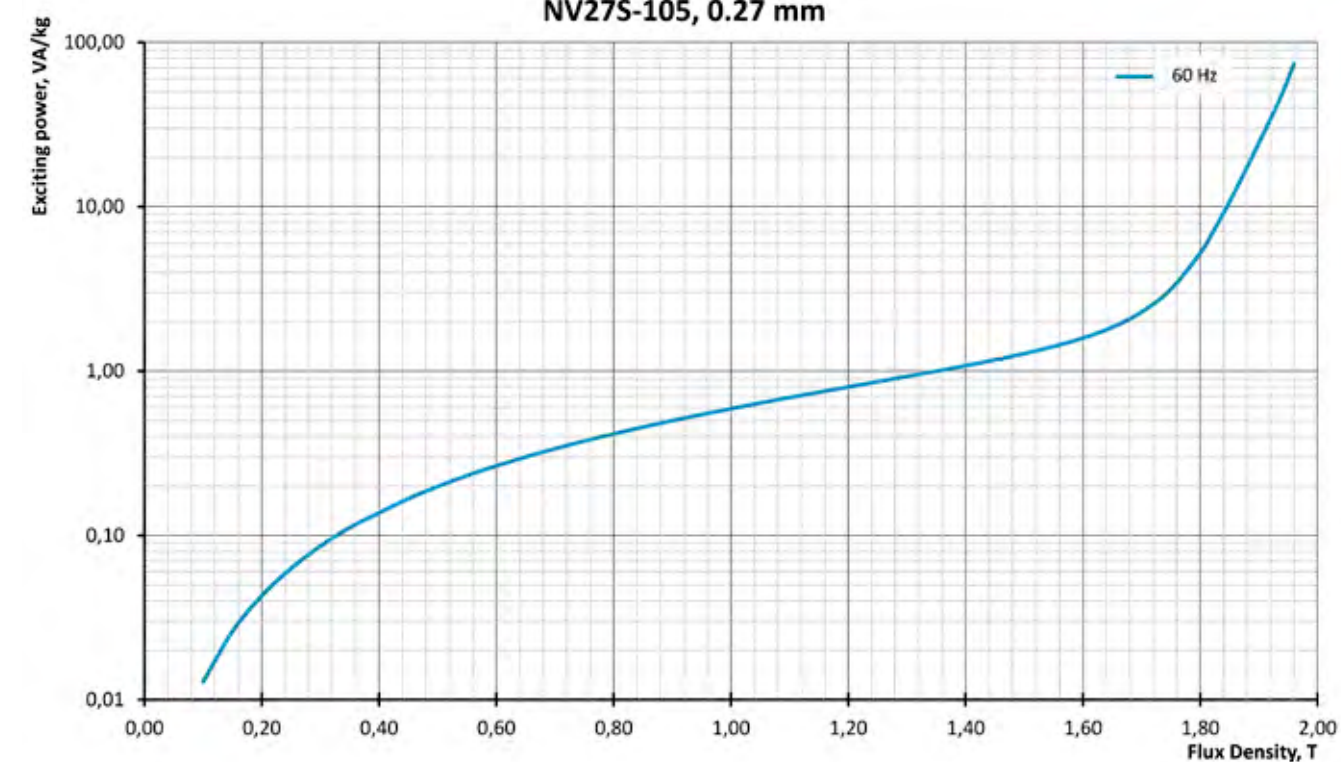
Exciting power
NV27S-105, 0.27 mm



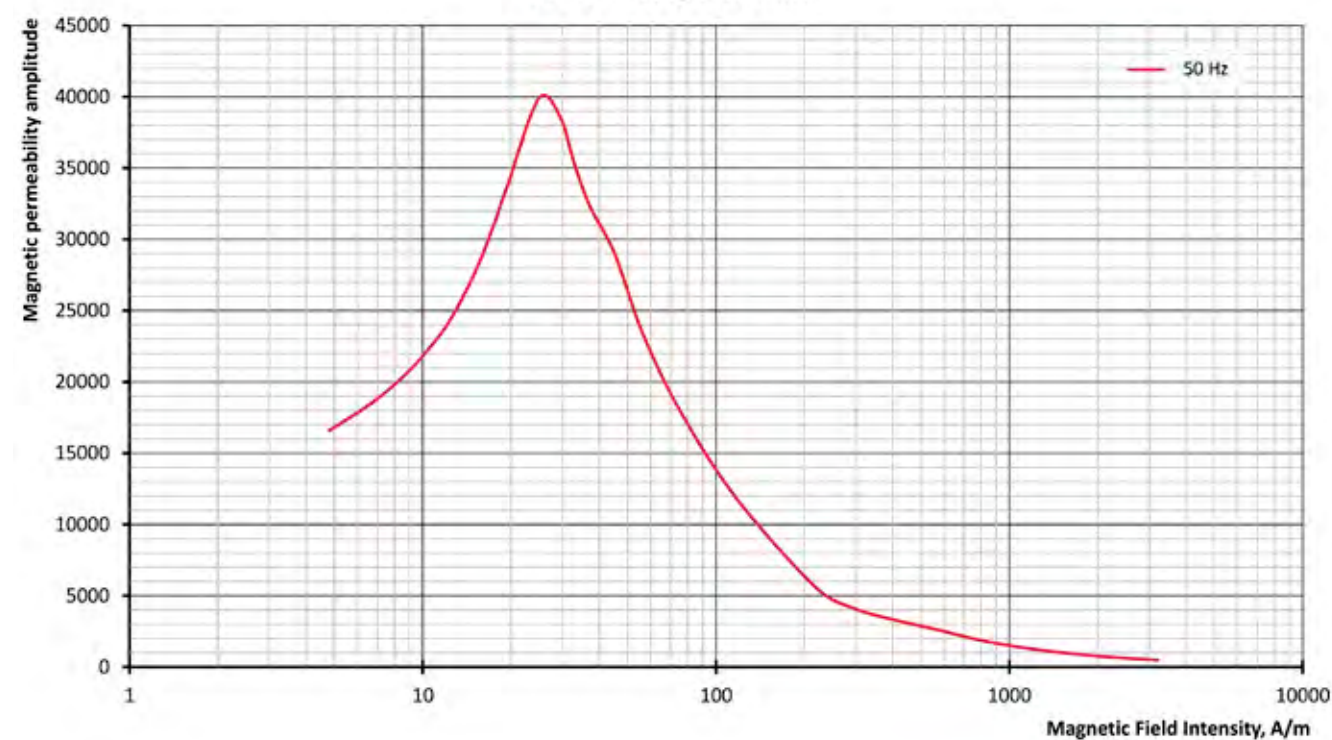
Hysteresis loop
NV27S-105, 0.27 mm



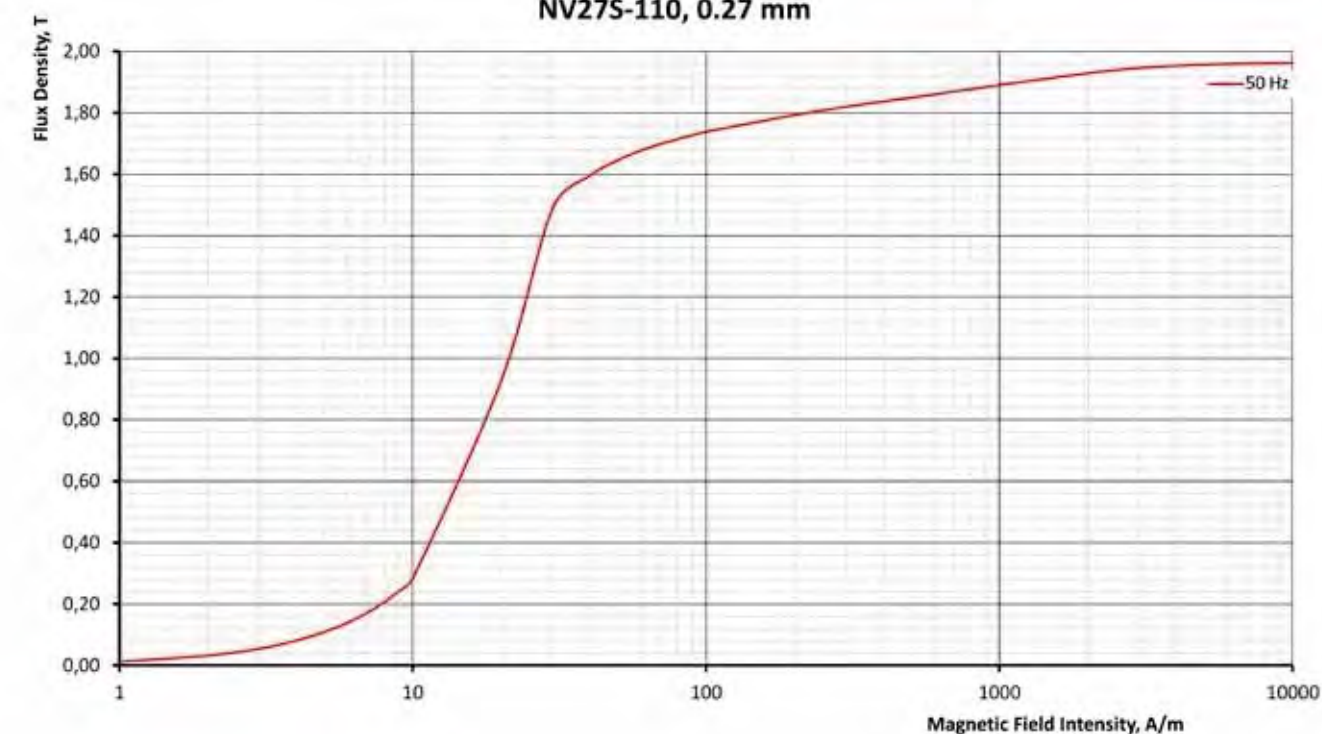
Exciting power
NV27S-105, 0.27 mm



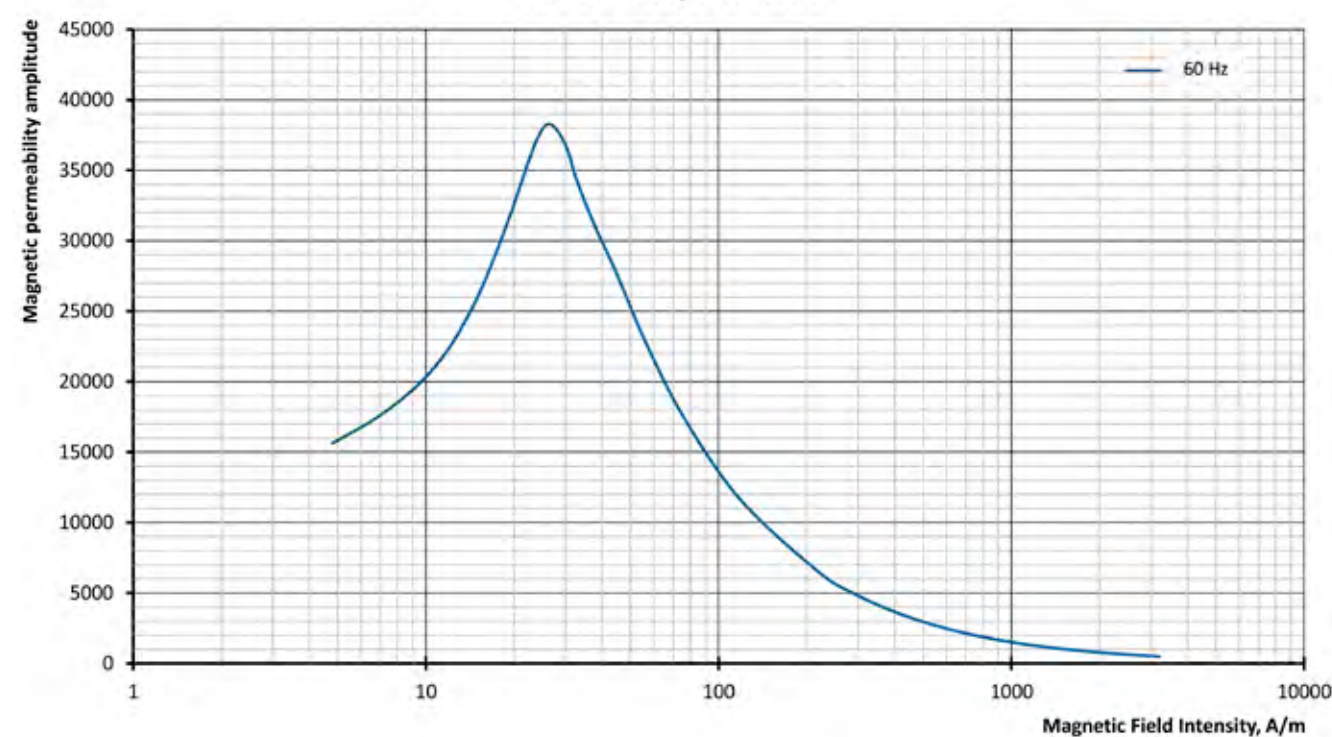
Magnetic permeability amplitude
NV27S-105, 0.27 mm



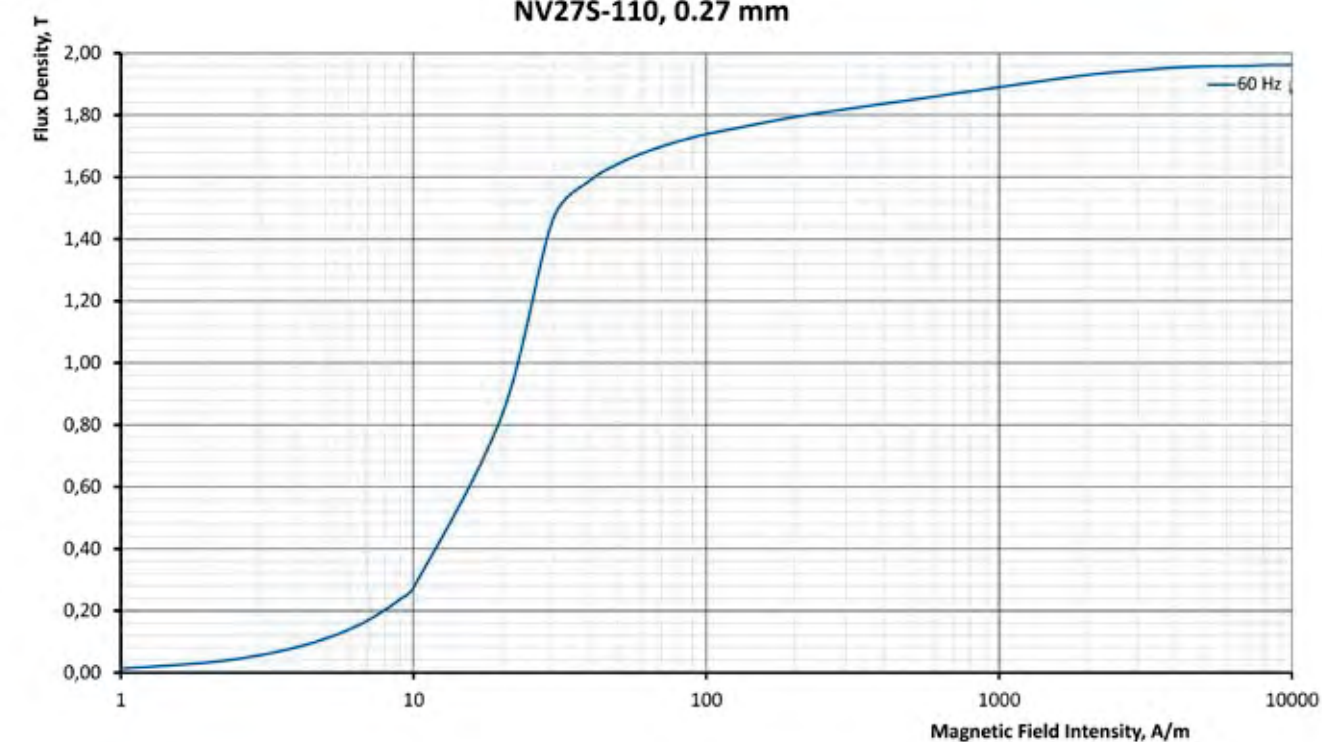
Magnetization curve
NV27S-110, 0.27 mm



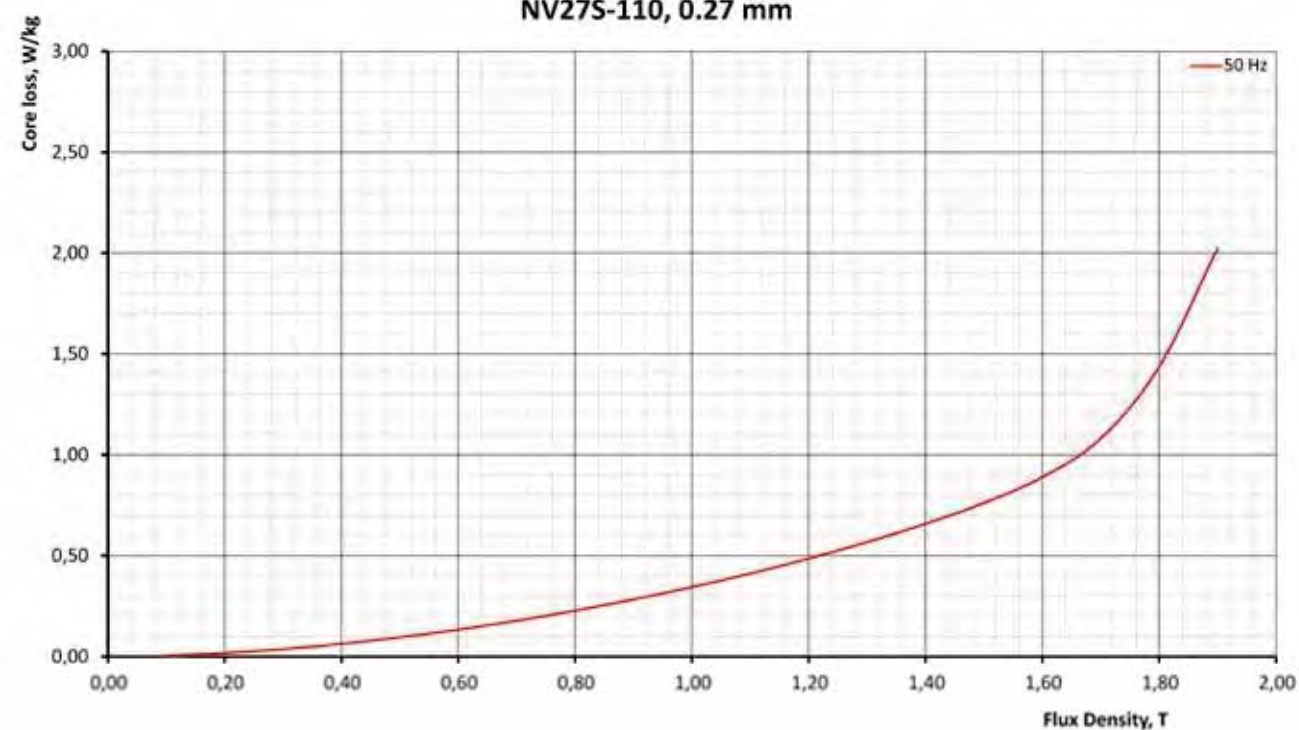
Magnetic permeability amplitude
NV27S-105, 0.27 mm



Magnetization curve
NV27S-110, 0.27 mm



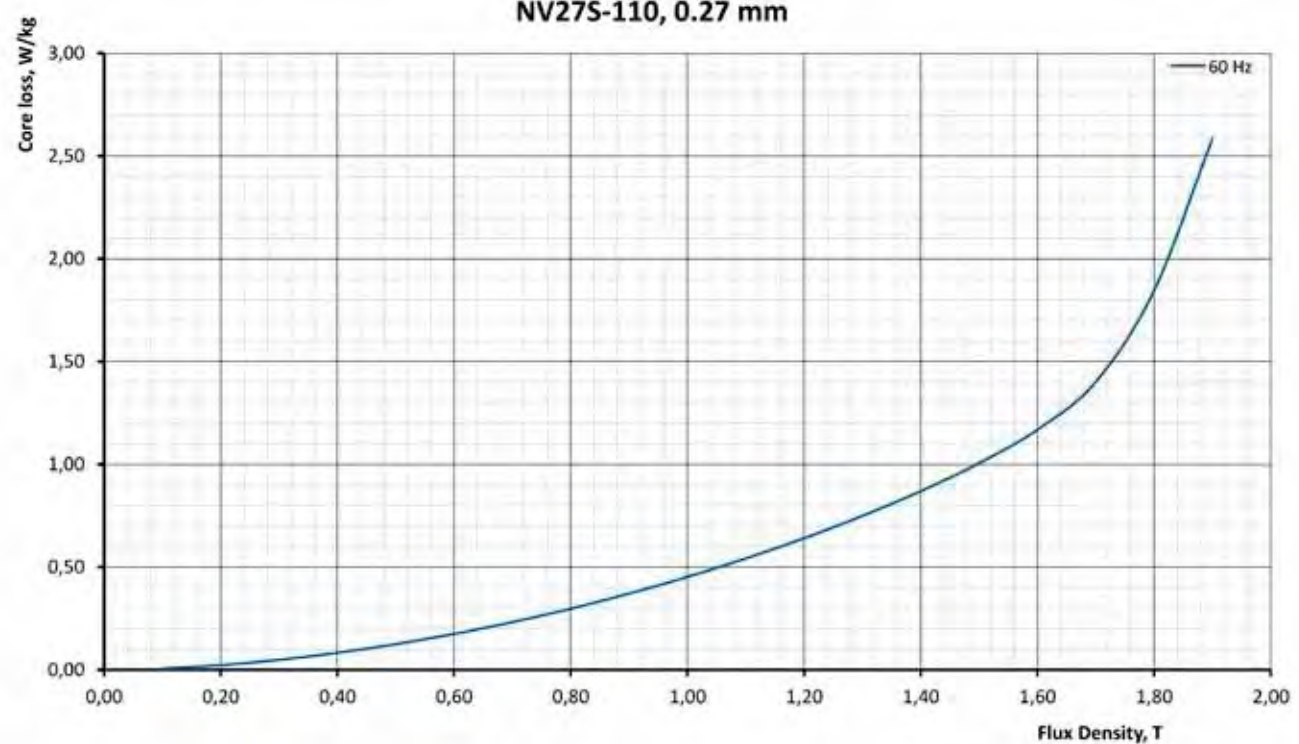
Specific core loss
NV27S-110, 0.27 mm



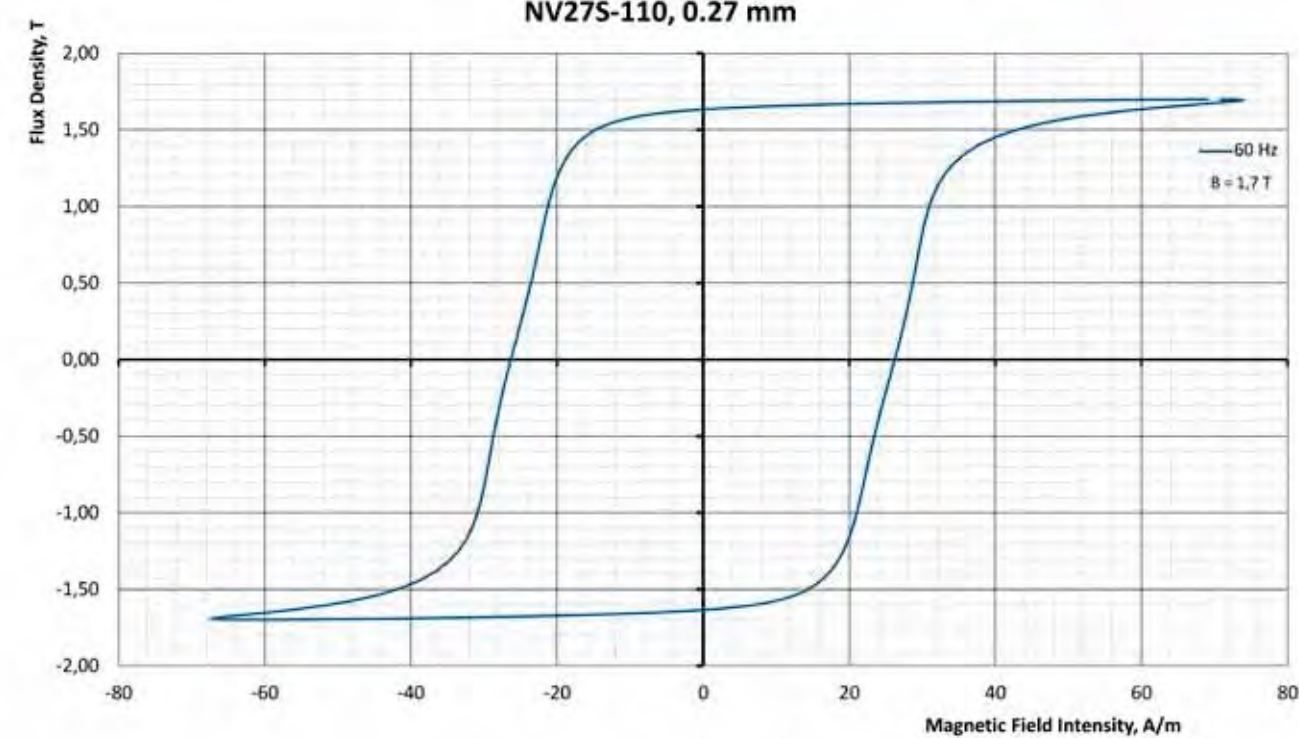
Hysteresis loop
NV27S-110, 0.27 mm

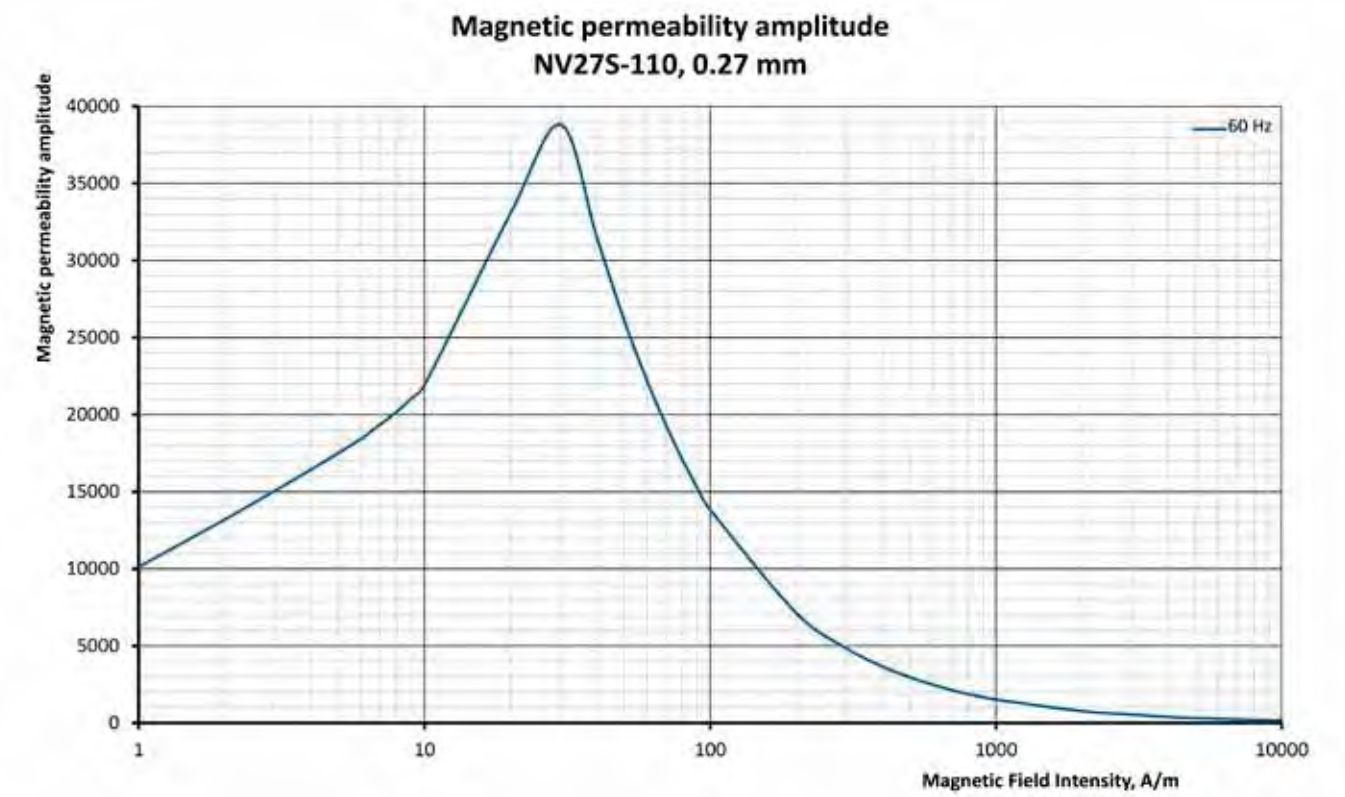
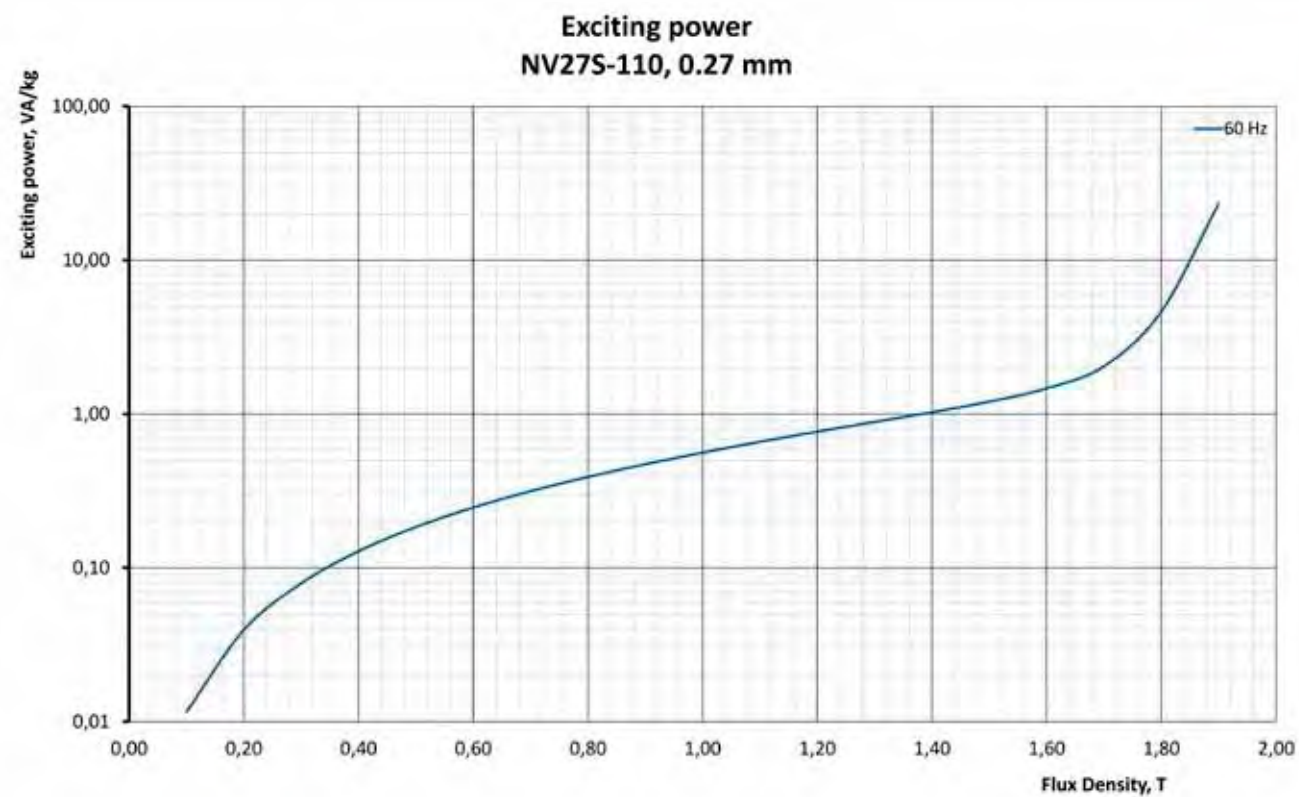
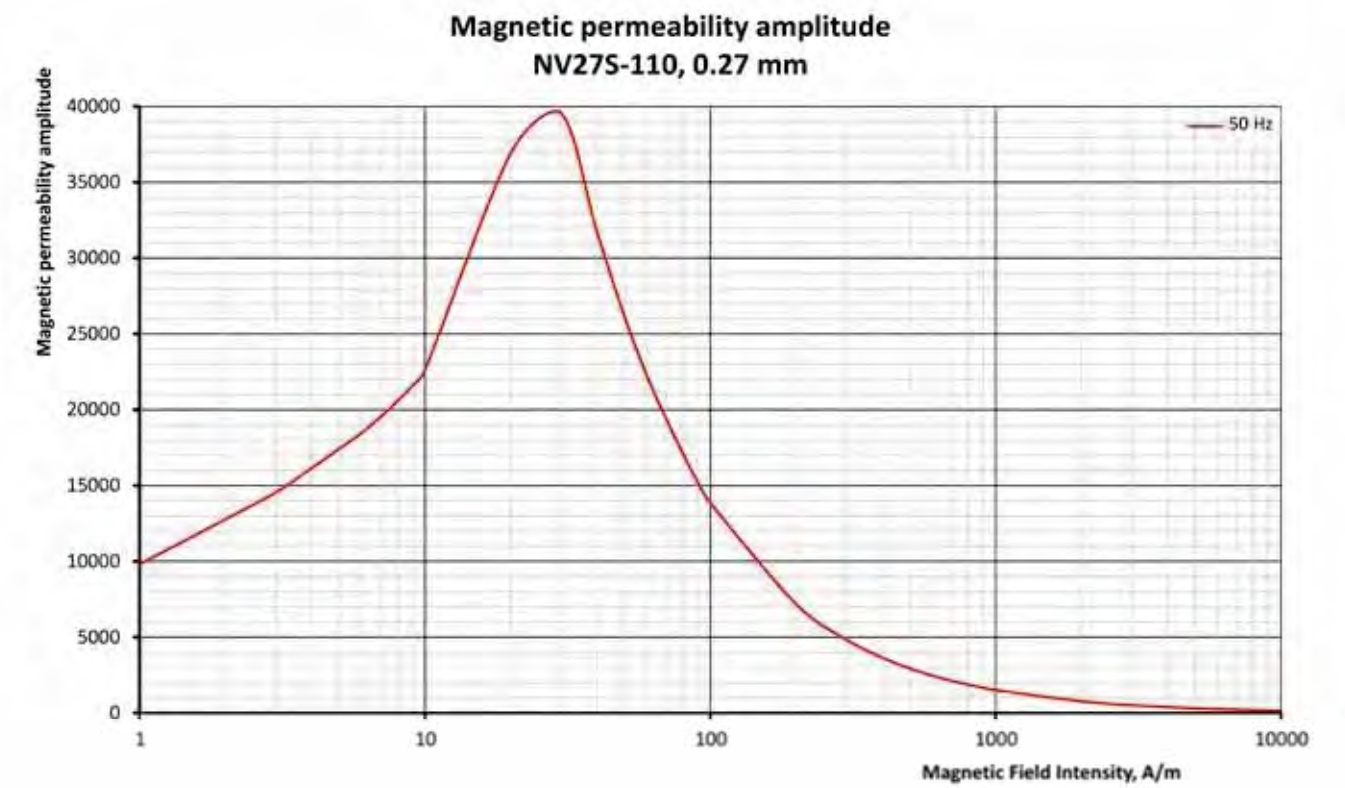
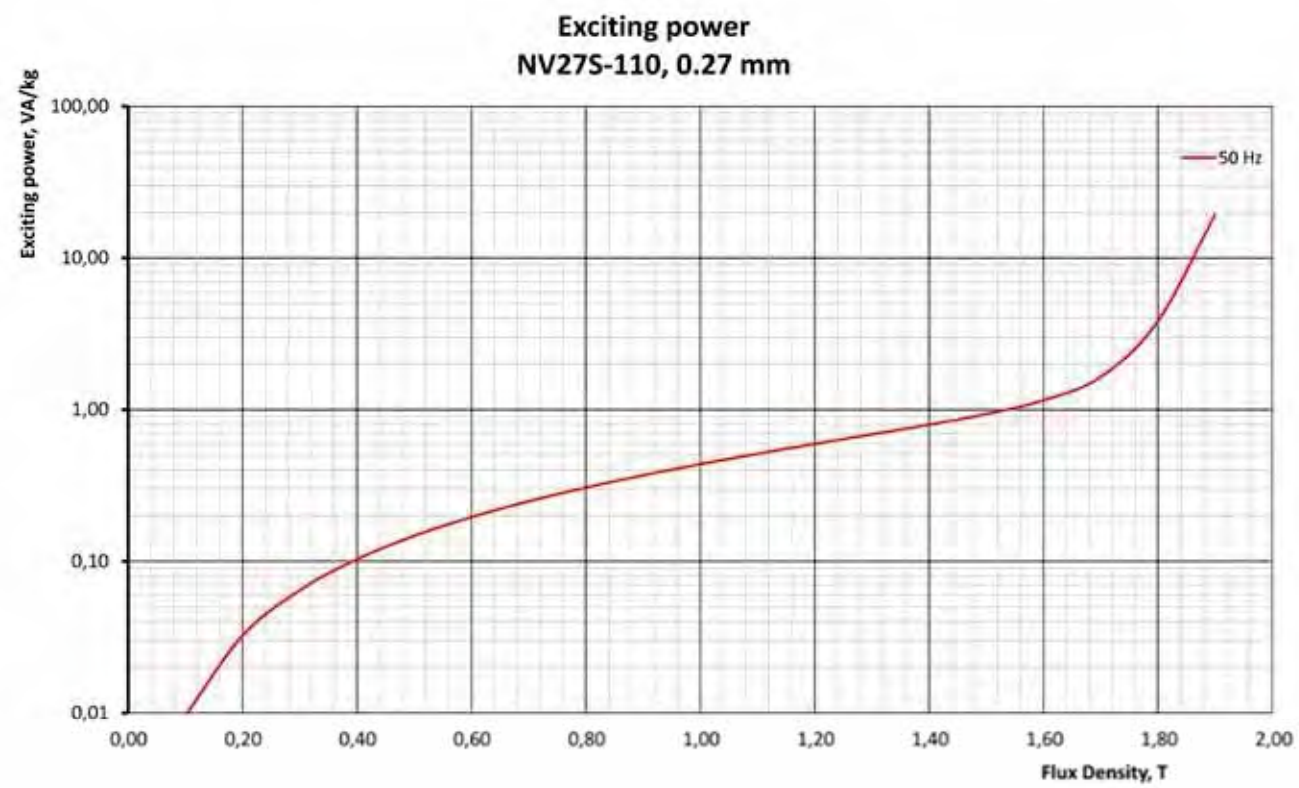


Specific core loss
NV27S-110, 0.27 mm



Hysteresis loop
NV27S-110, 0.27 mm





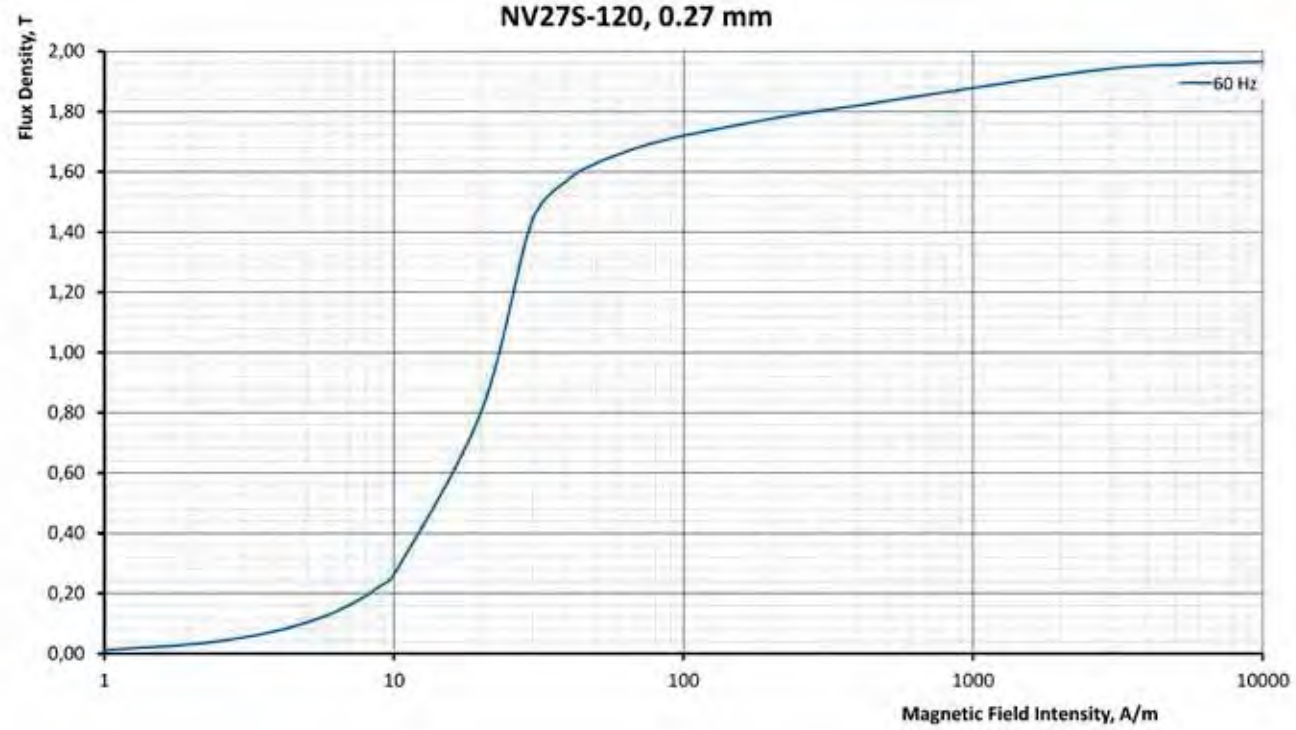
**Magnetization curve
NV27S-120, 0.27 mm**



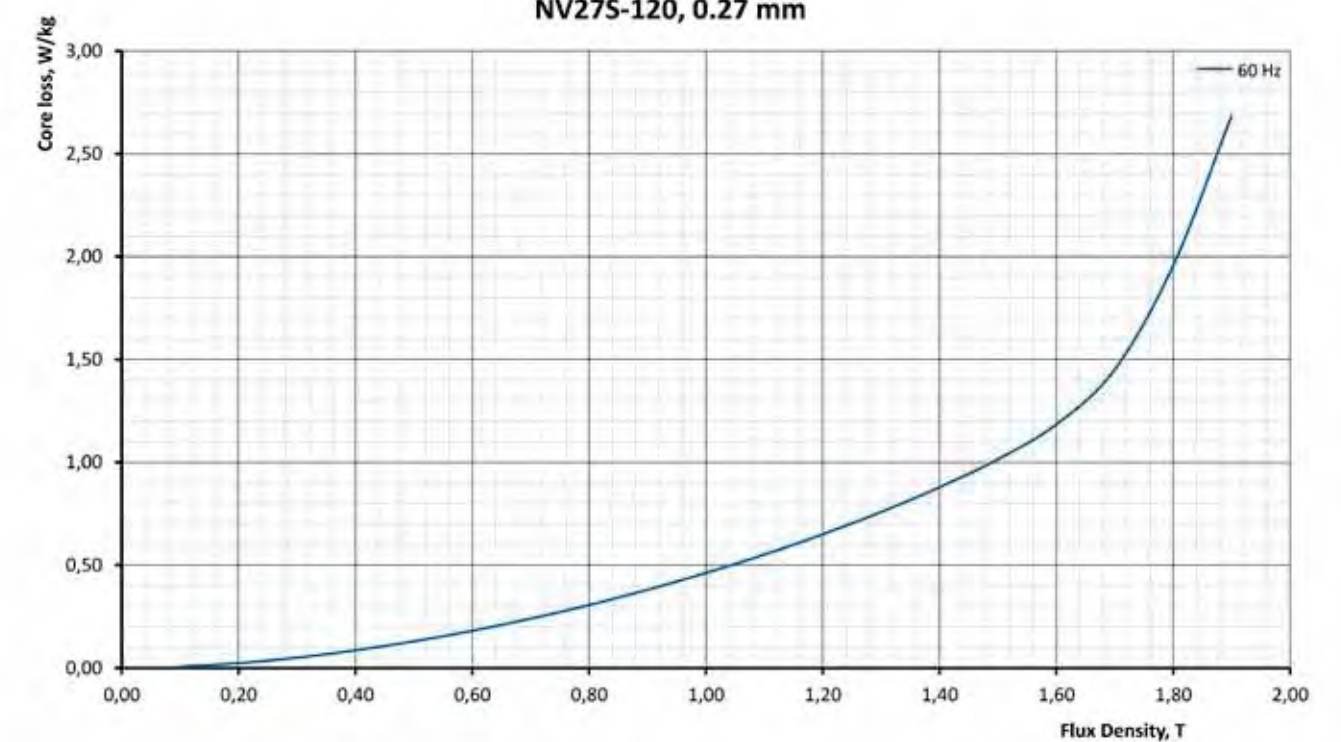
**Specific core loss
NV27S-120, 0.27 mm**

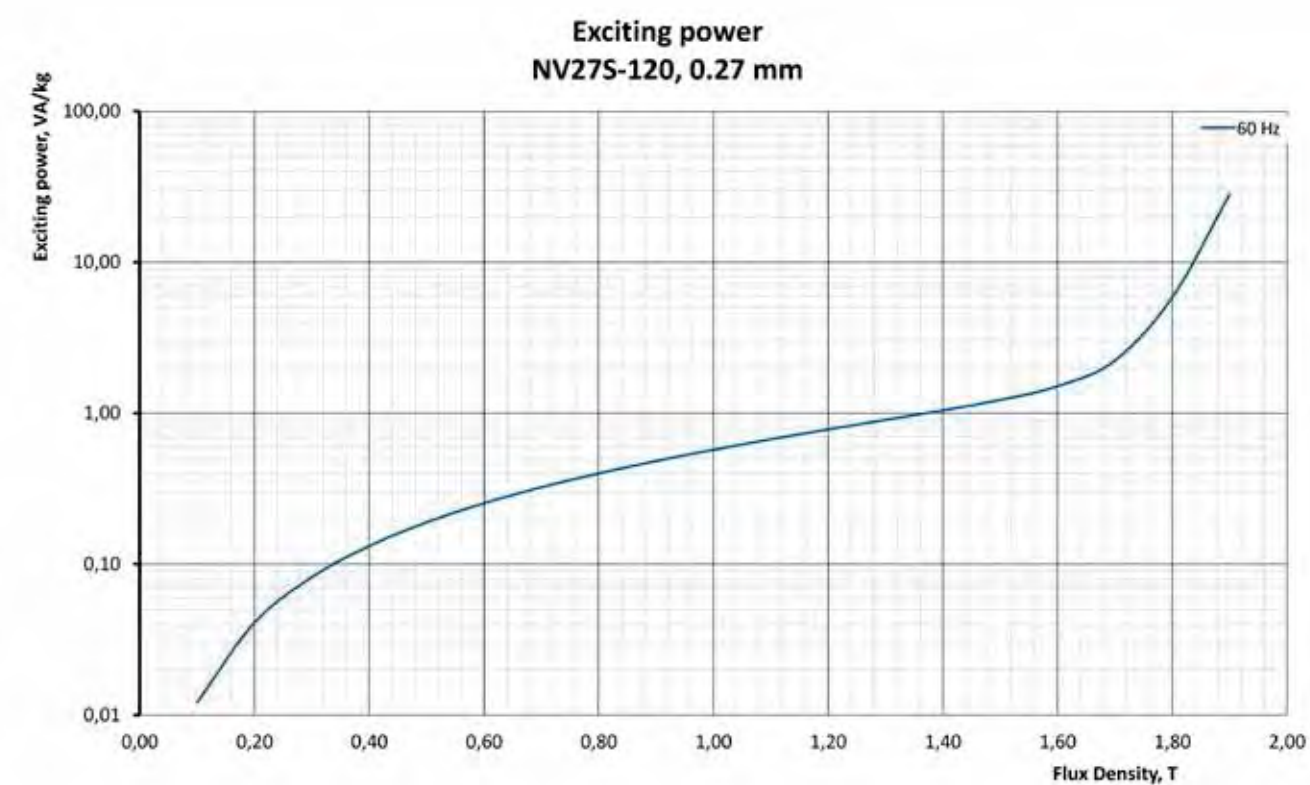
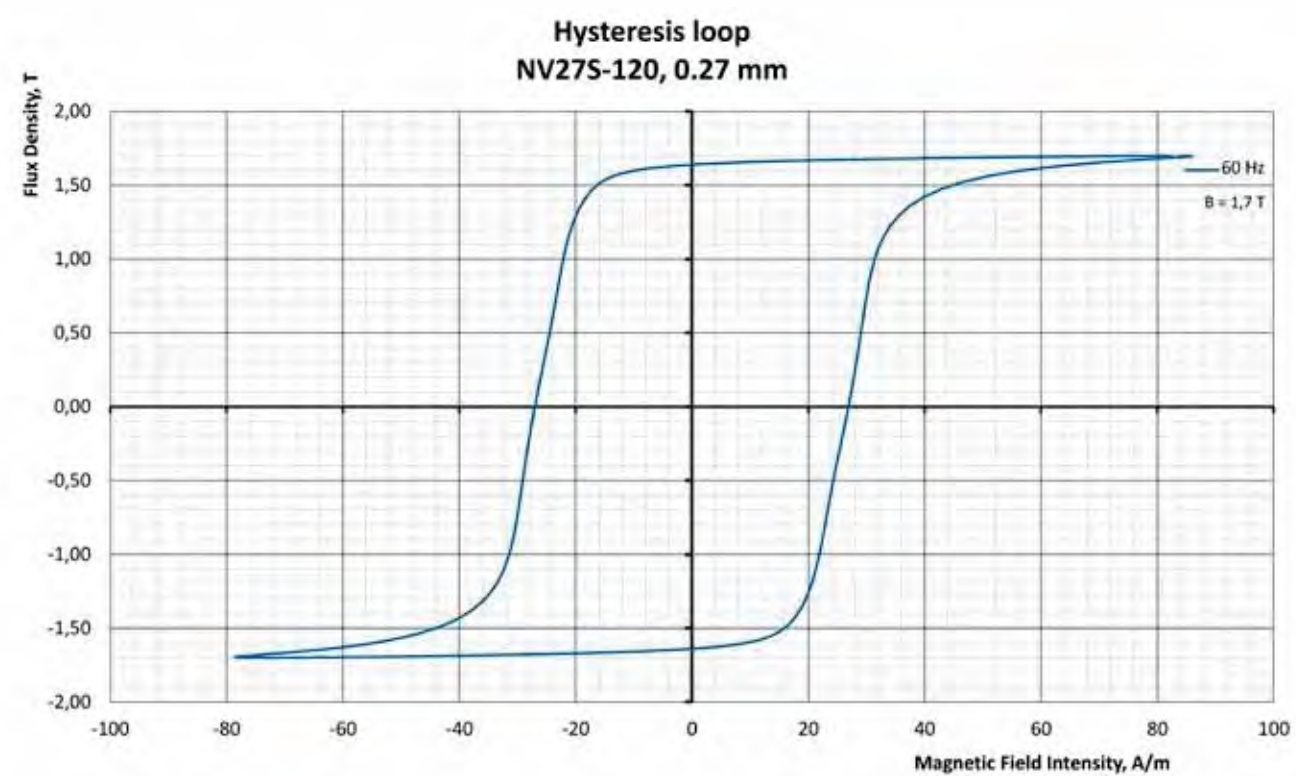
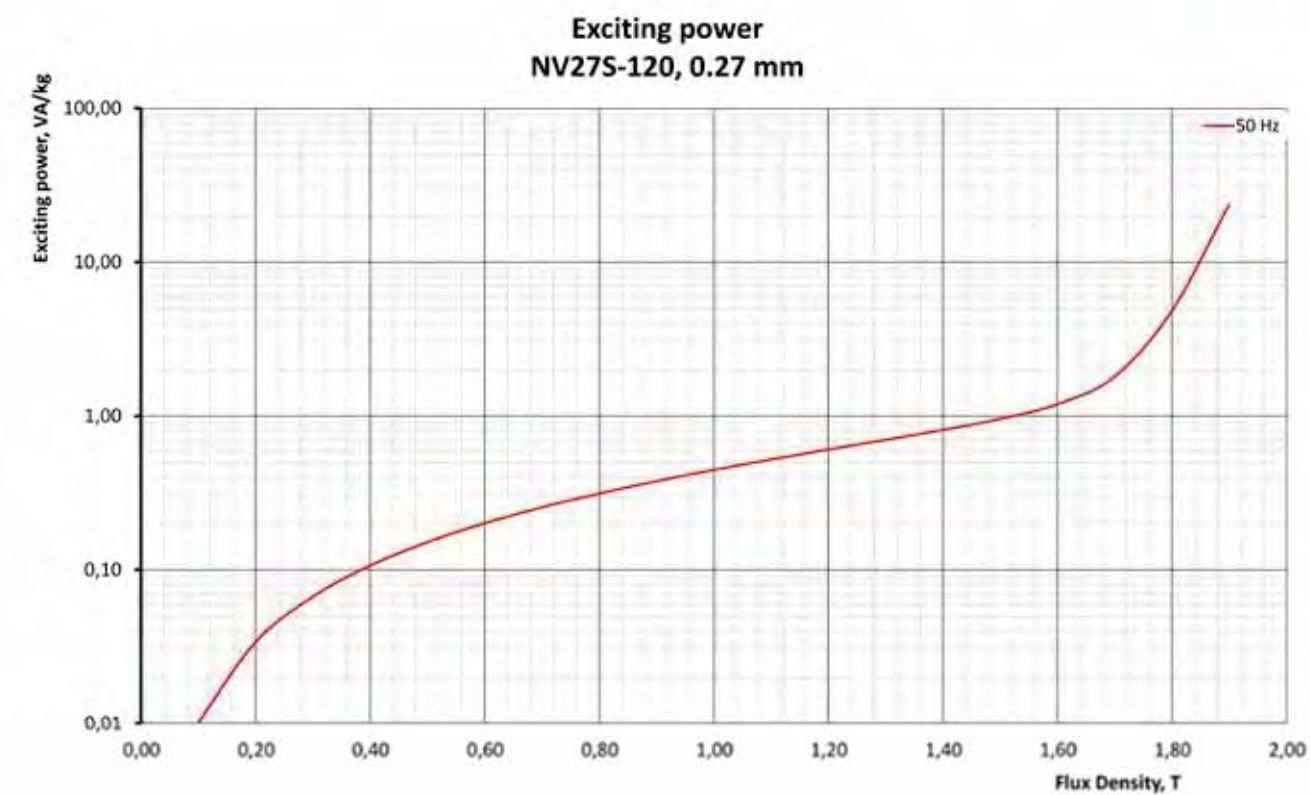
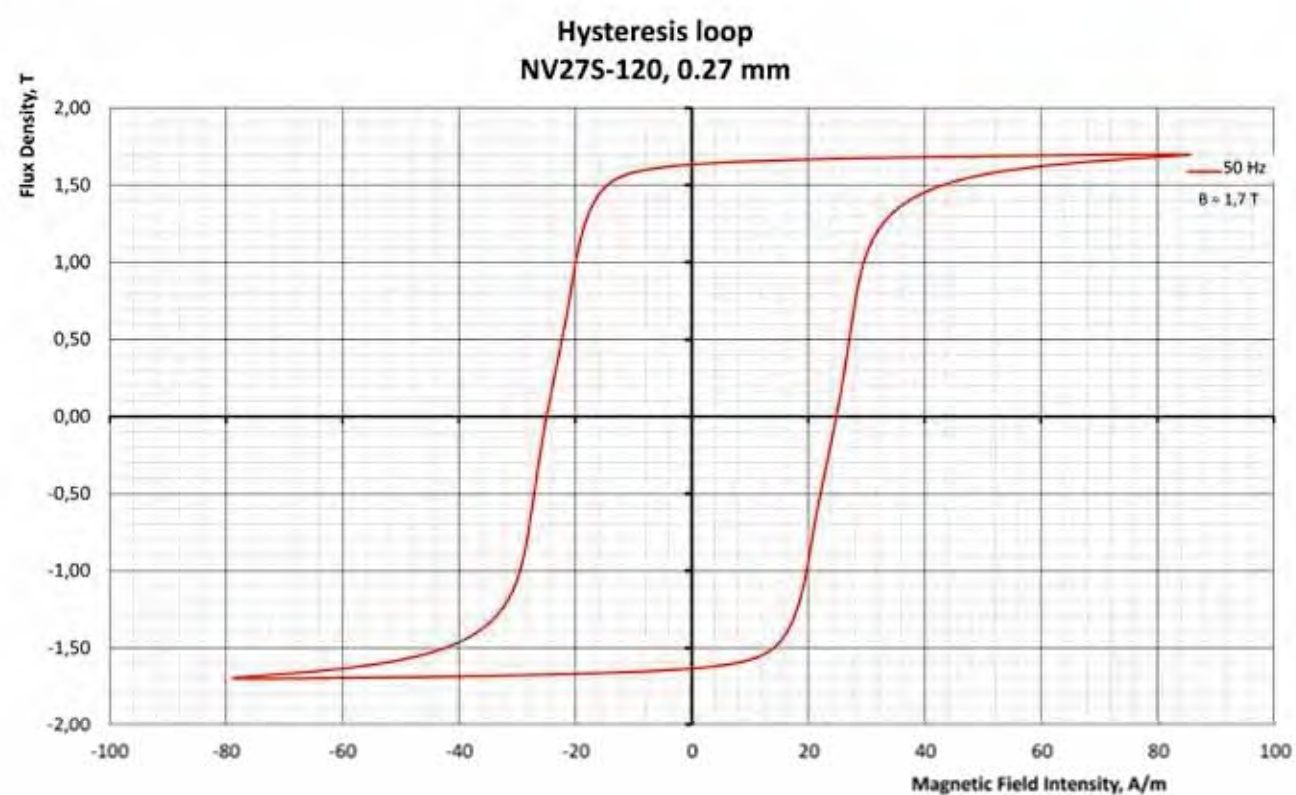


**Magnetization curve
NV27S-120, 0.27 mm**

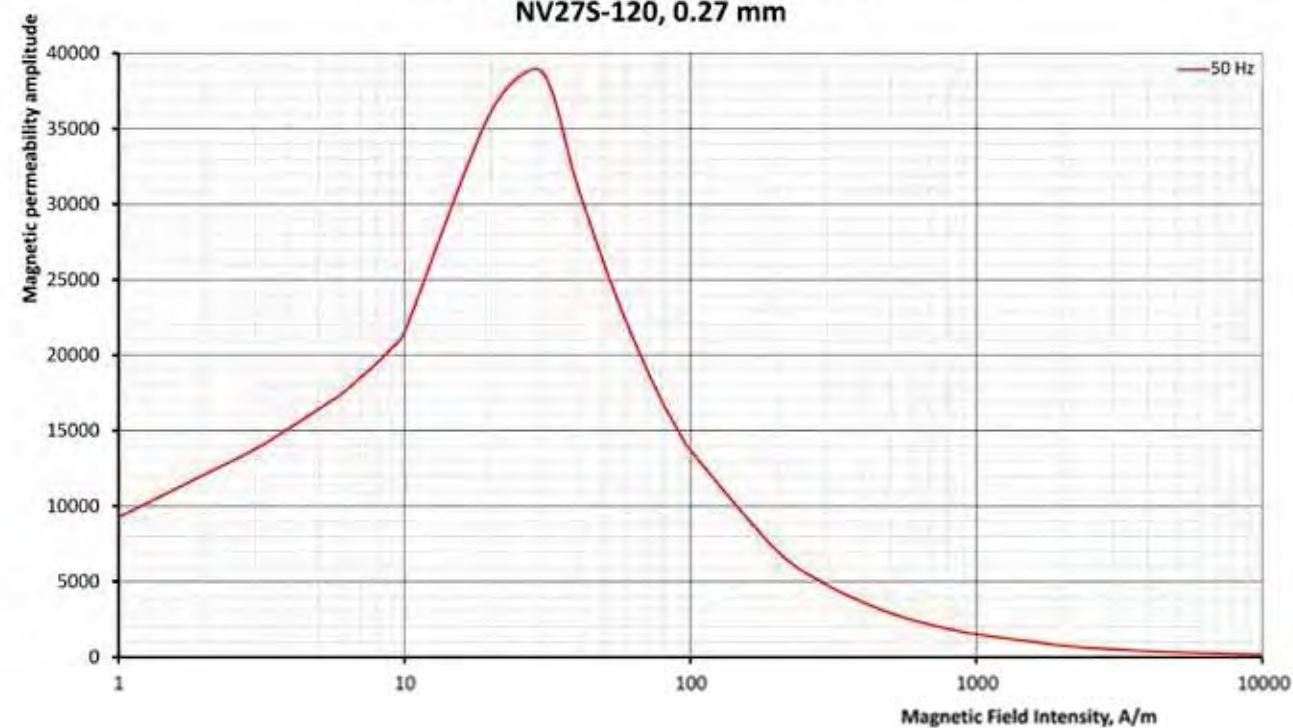


**Specific core loss
NV27S-120, 0.27 mm**

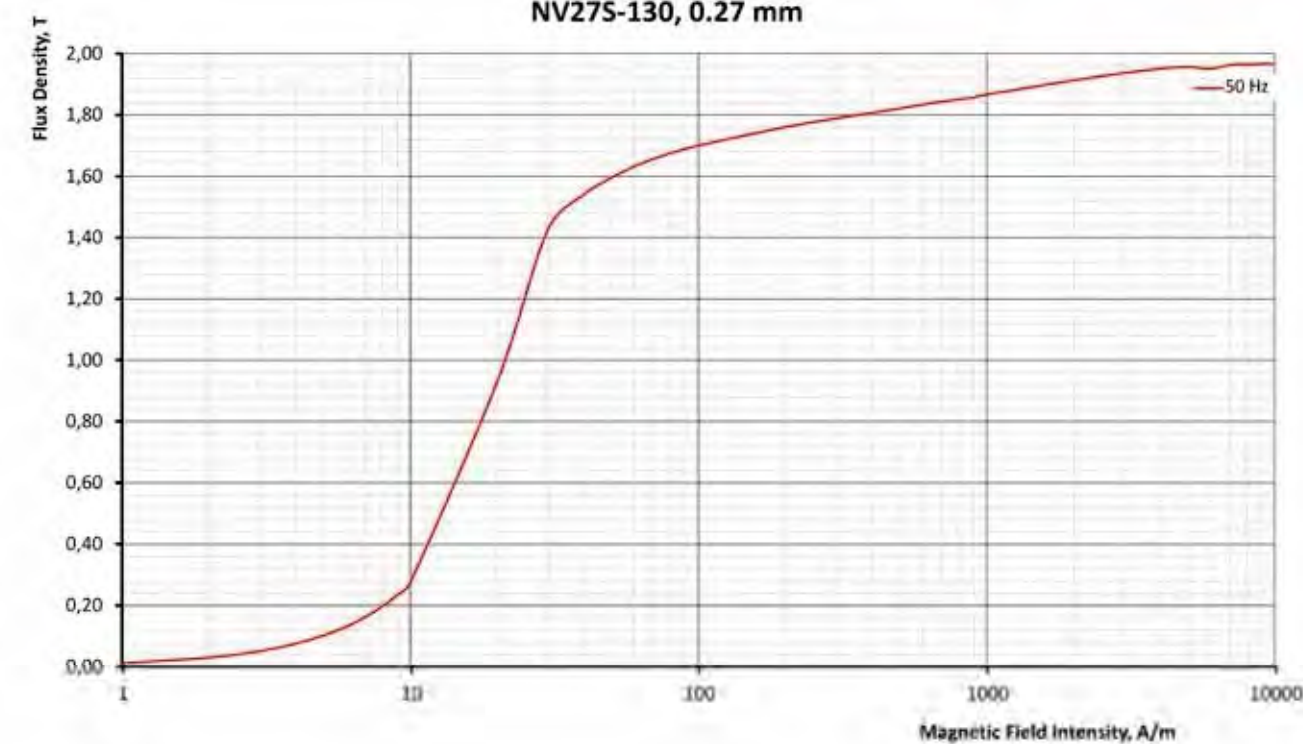




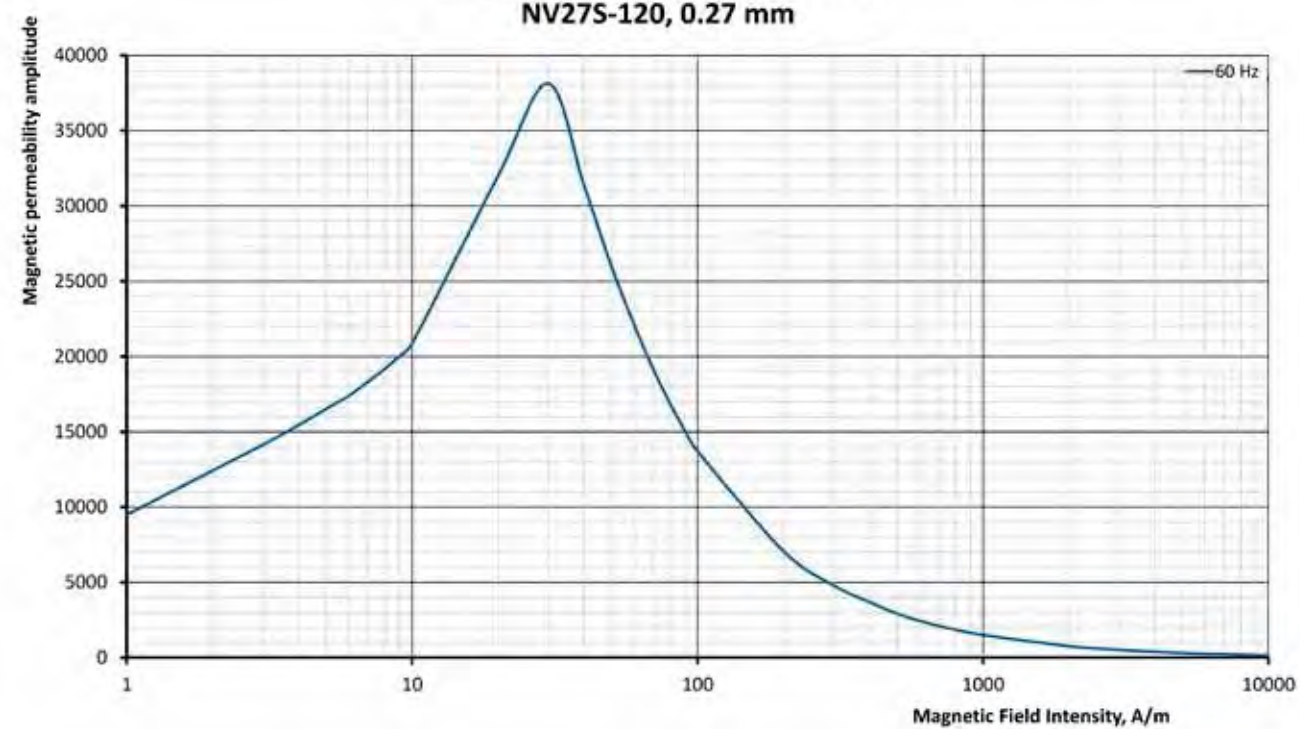
Magnetic permeability amplitude
NV27S-120, 0.27 mm



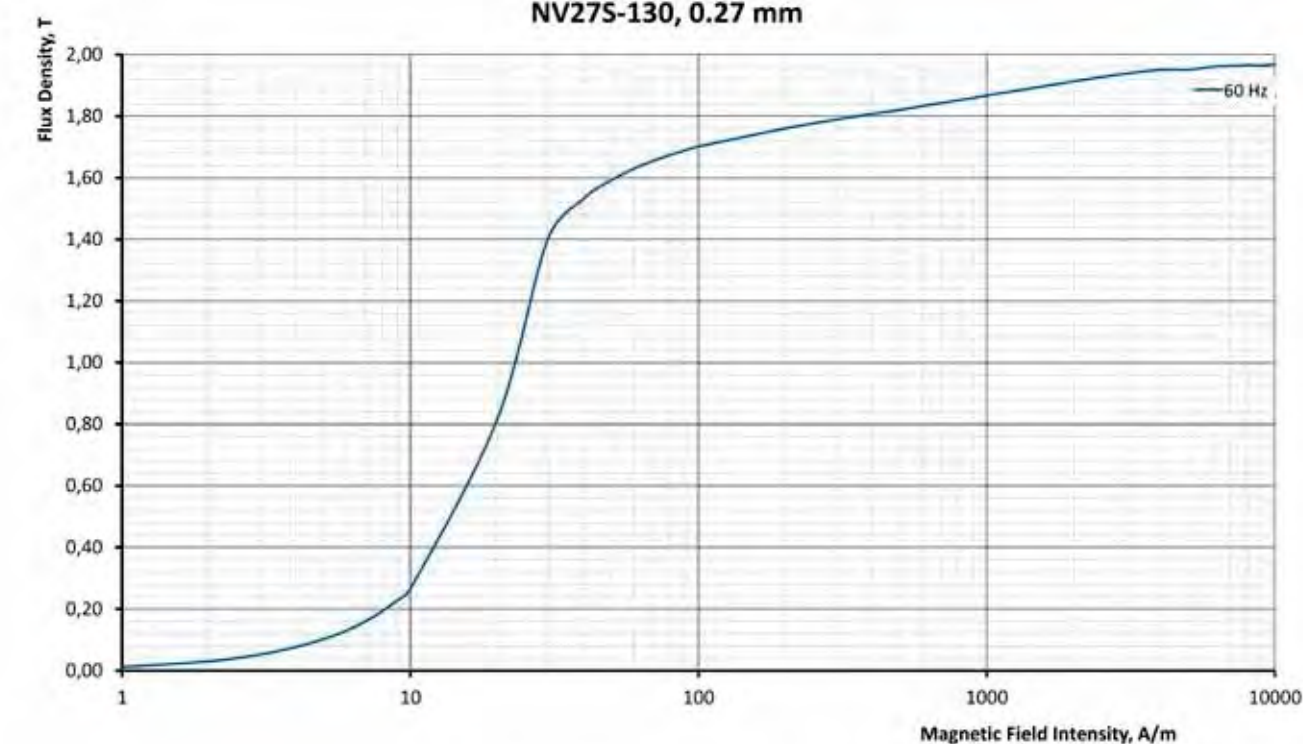
Magnetization curve
NV27S-130, 0.27 mm

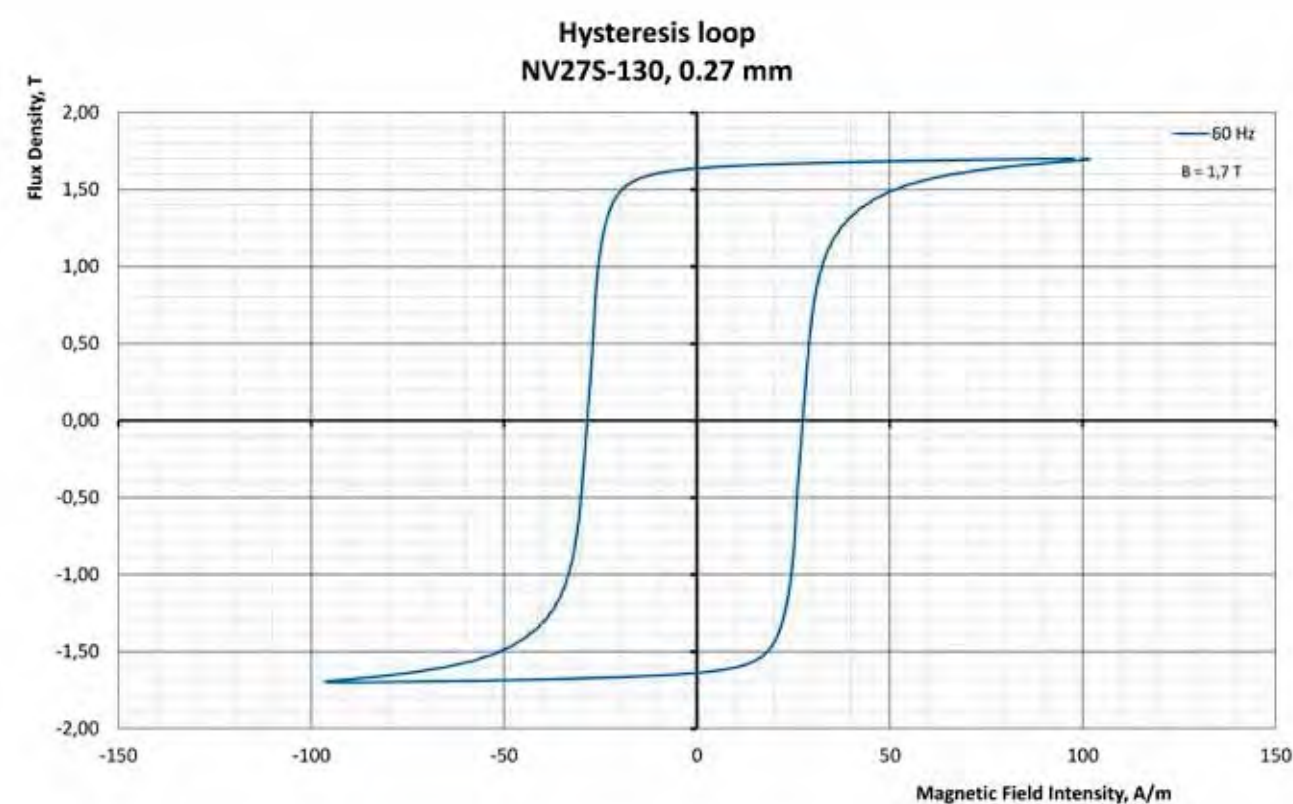
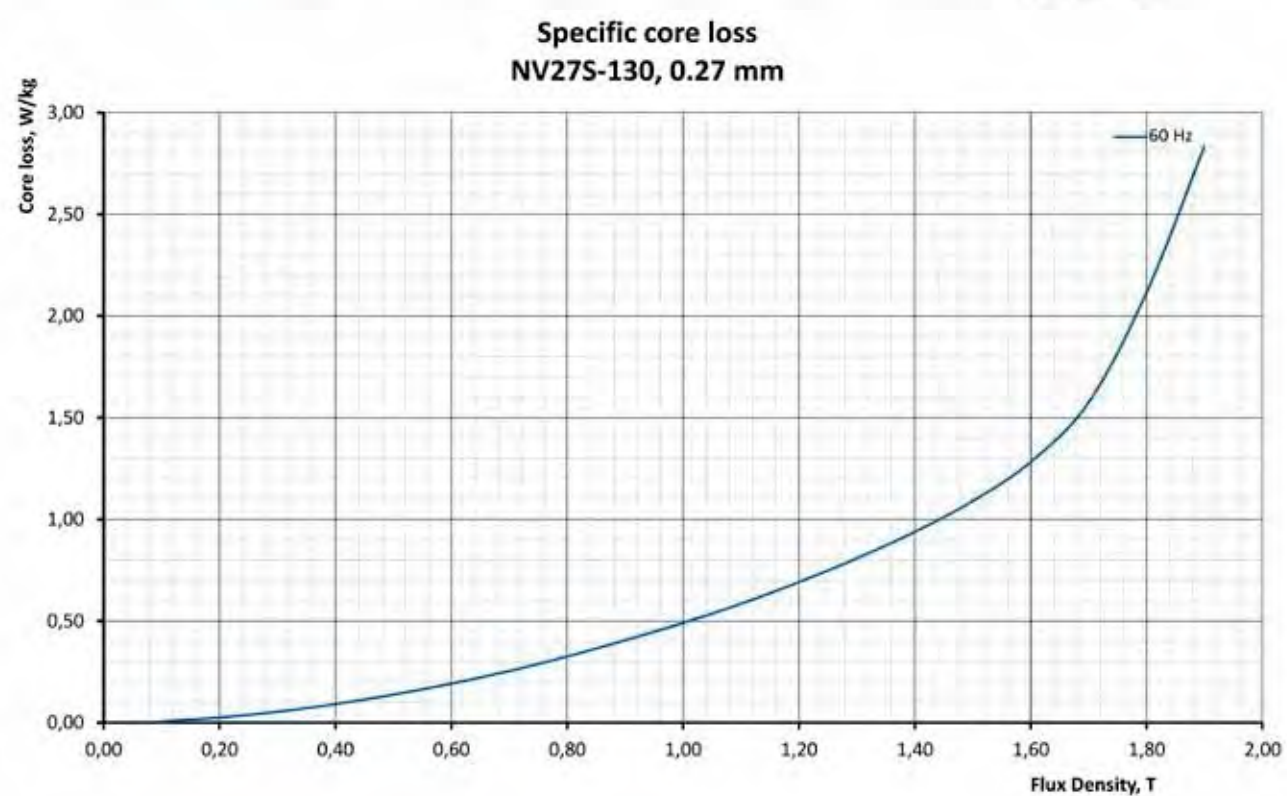
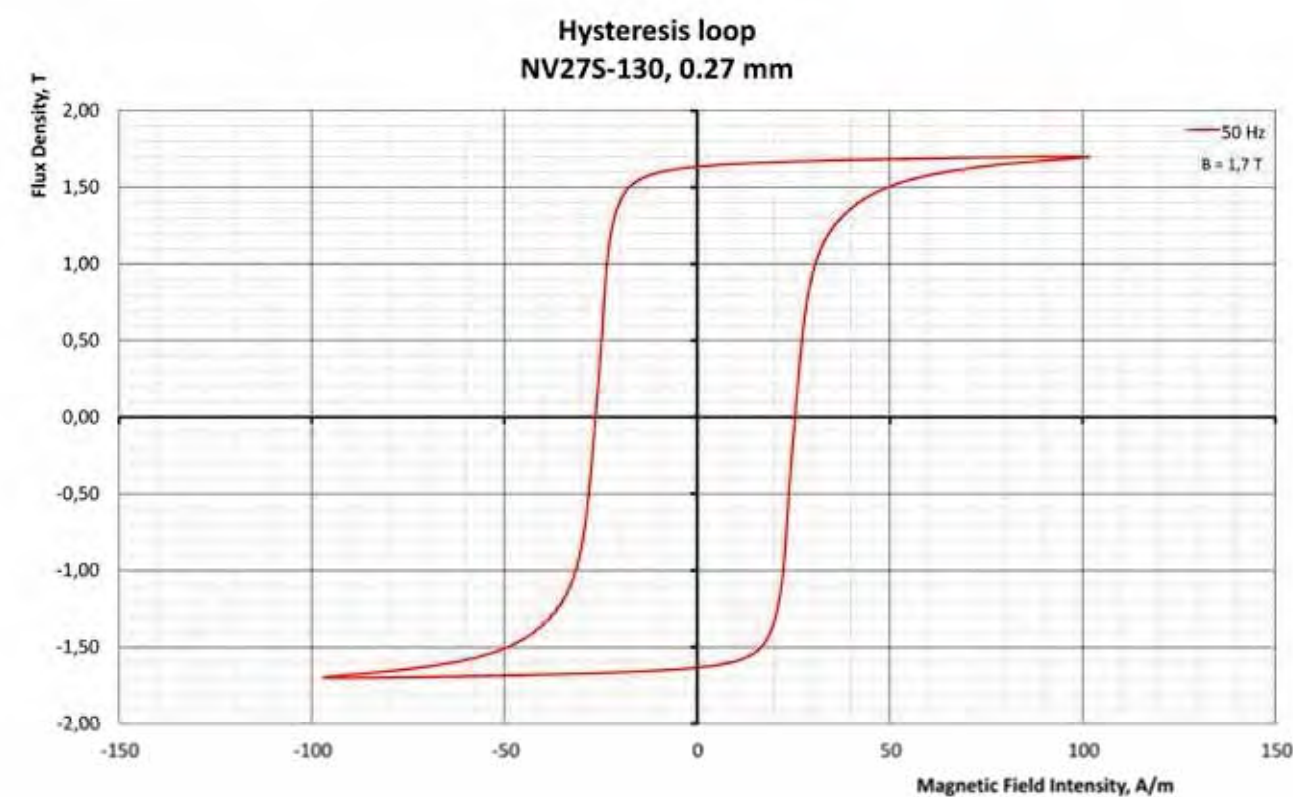
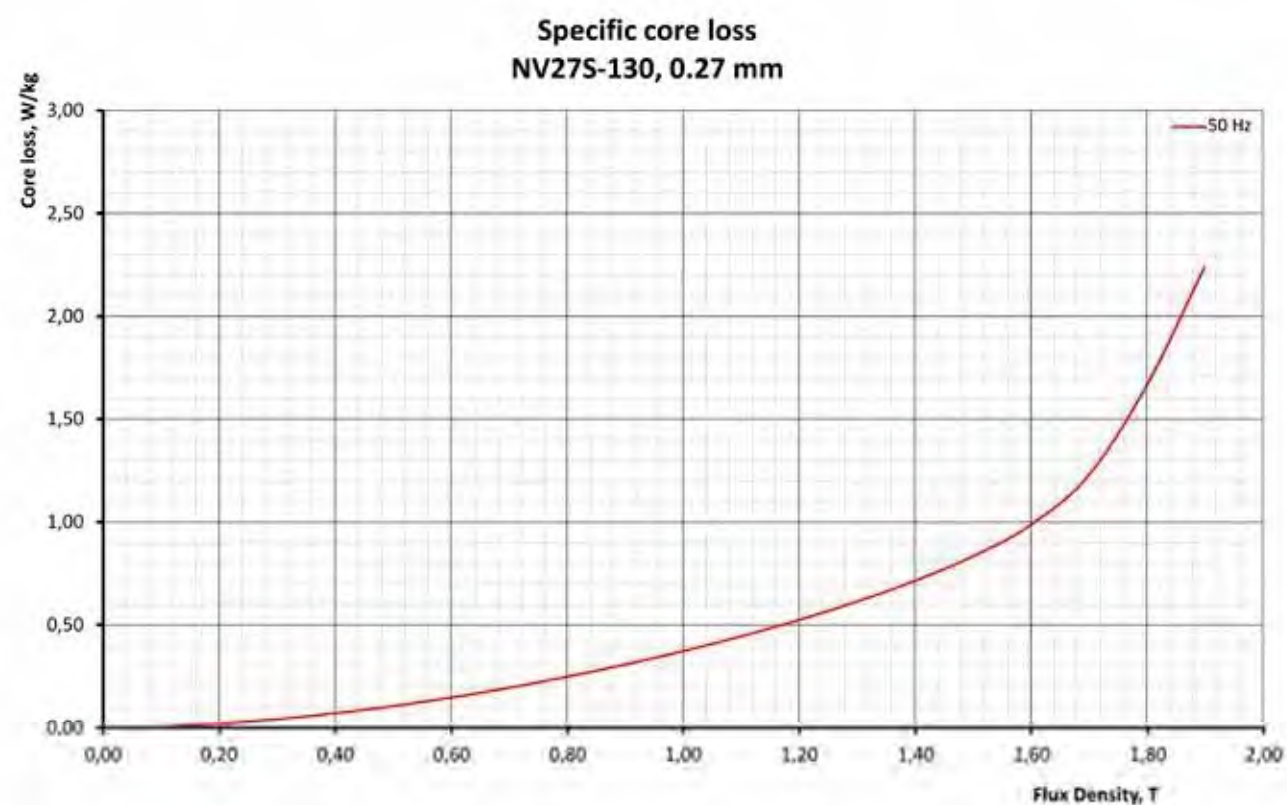


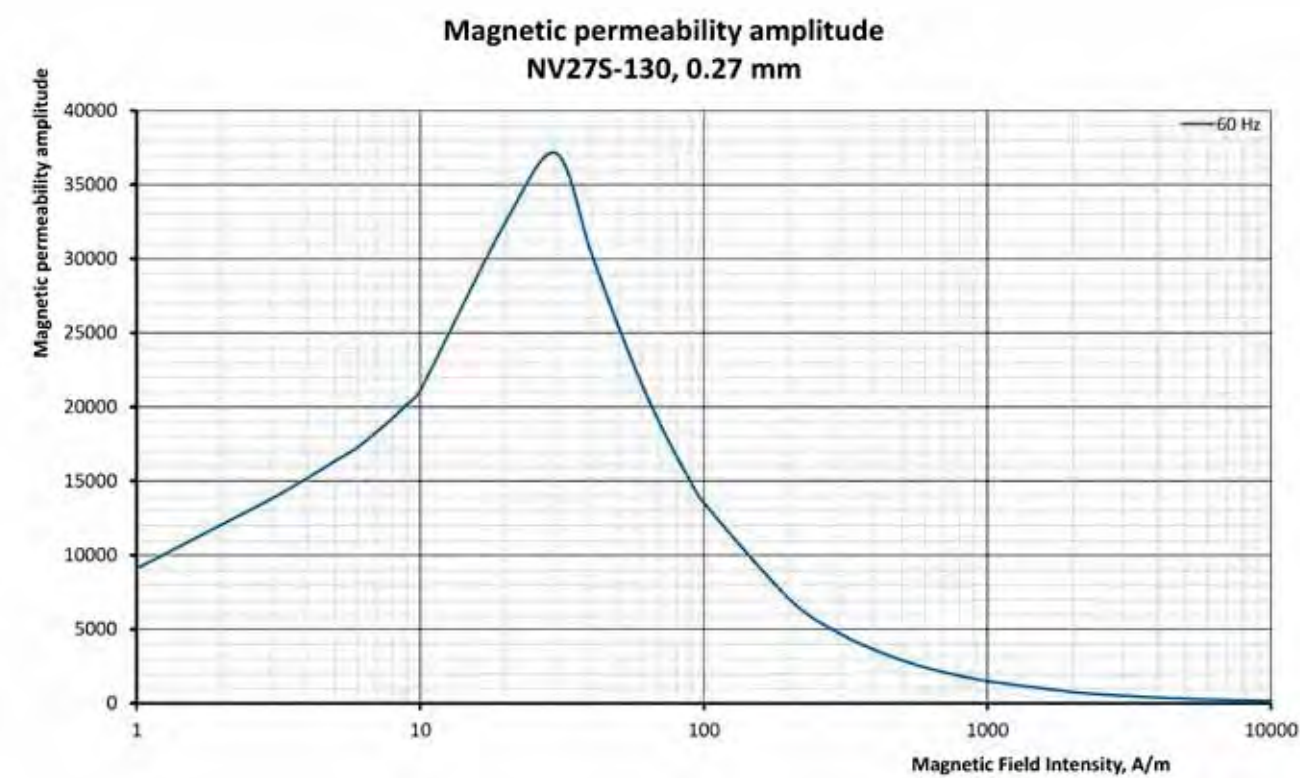
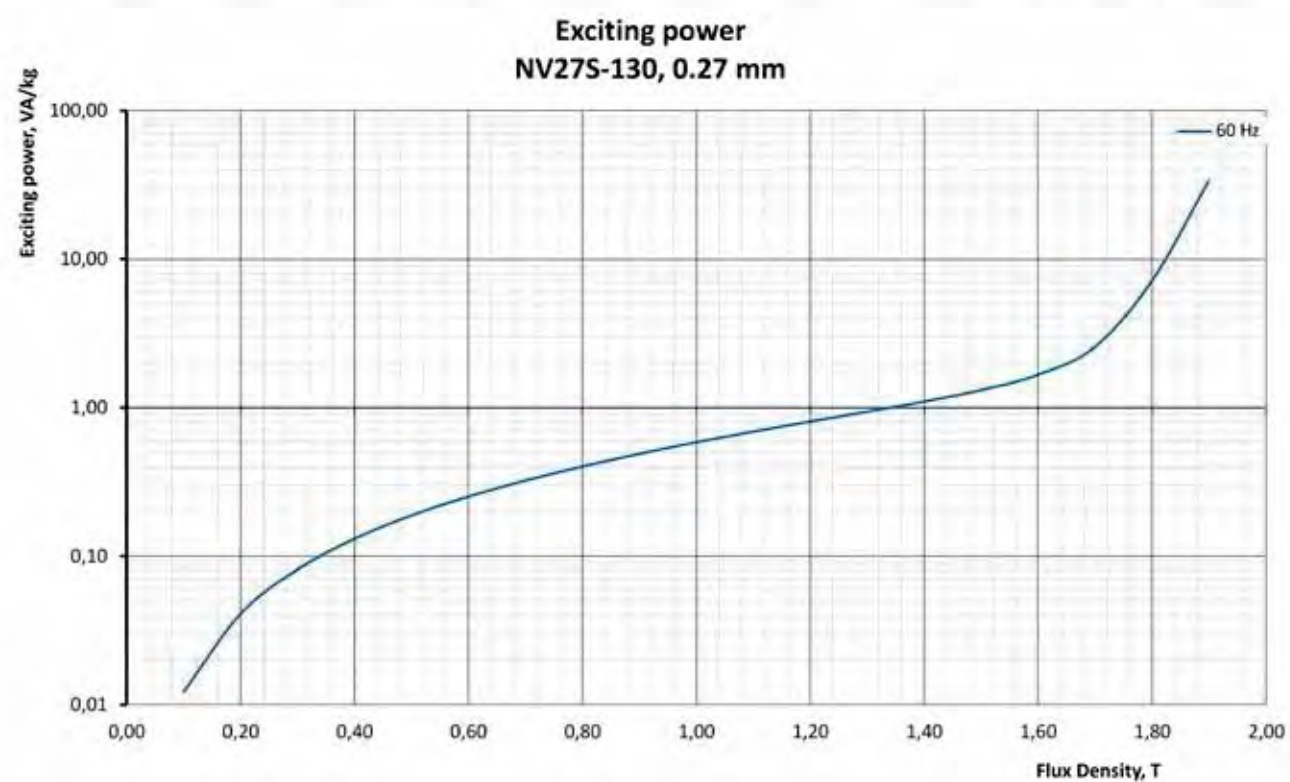
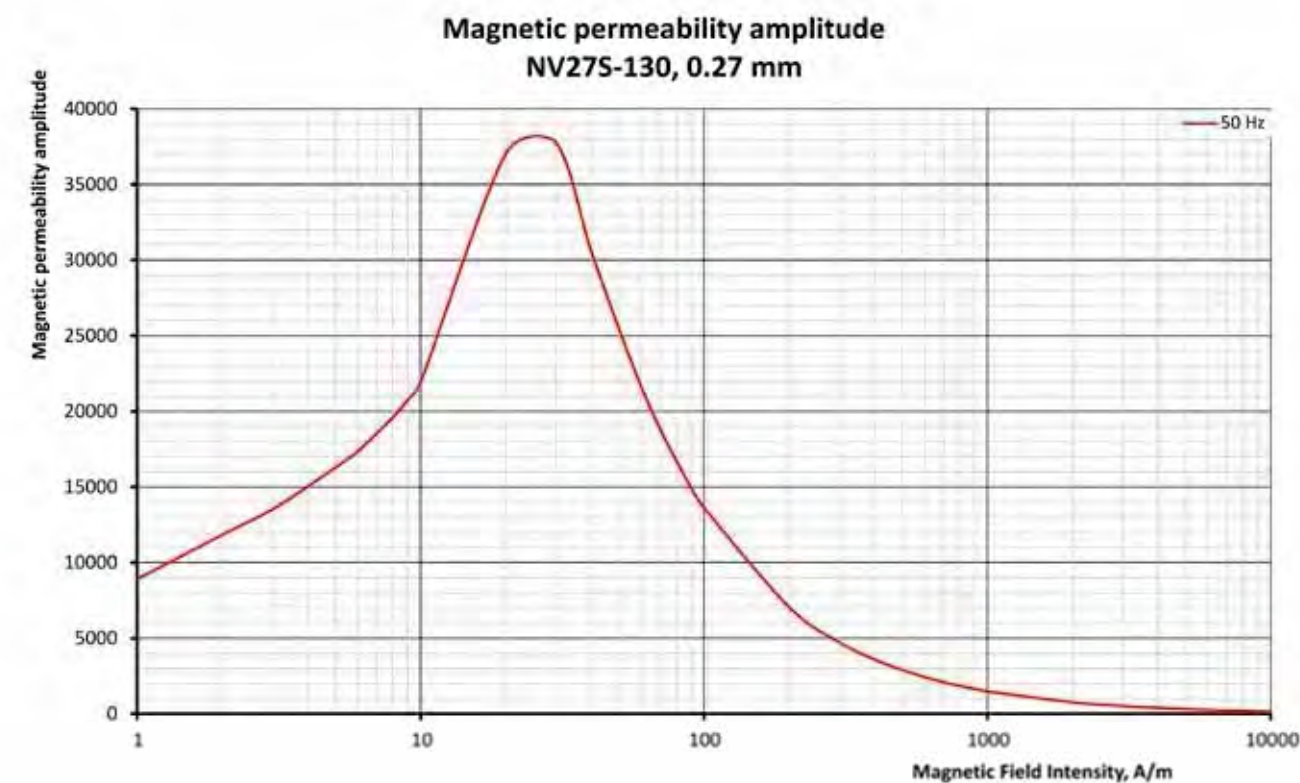
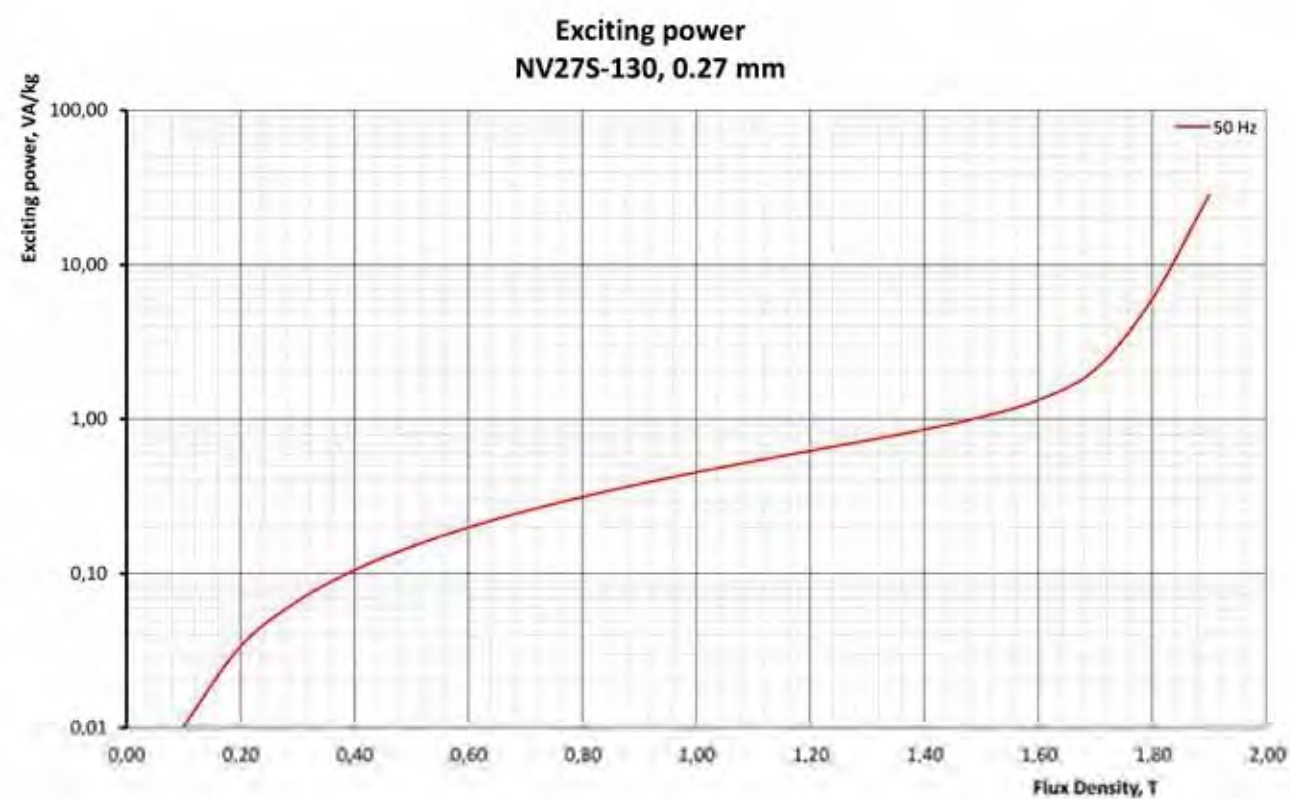
Magnetic permeability amplitude
NV27S-120, 0.27 mm



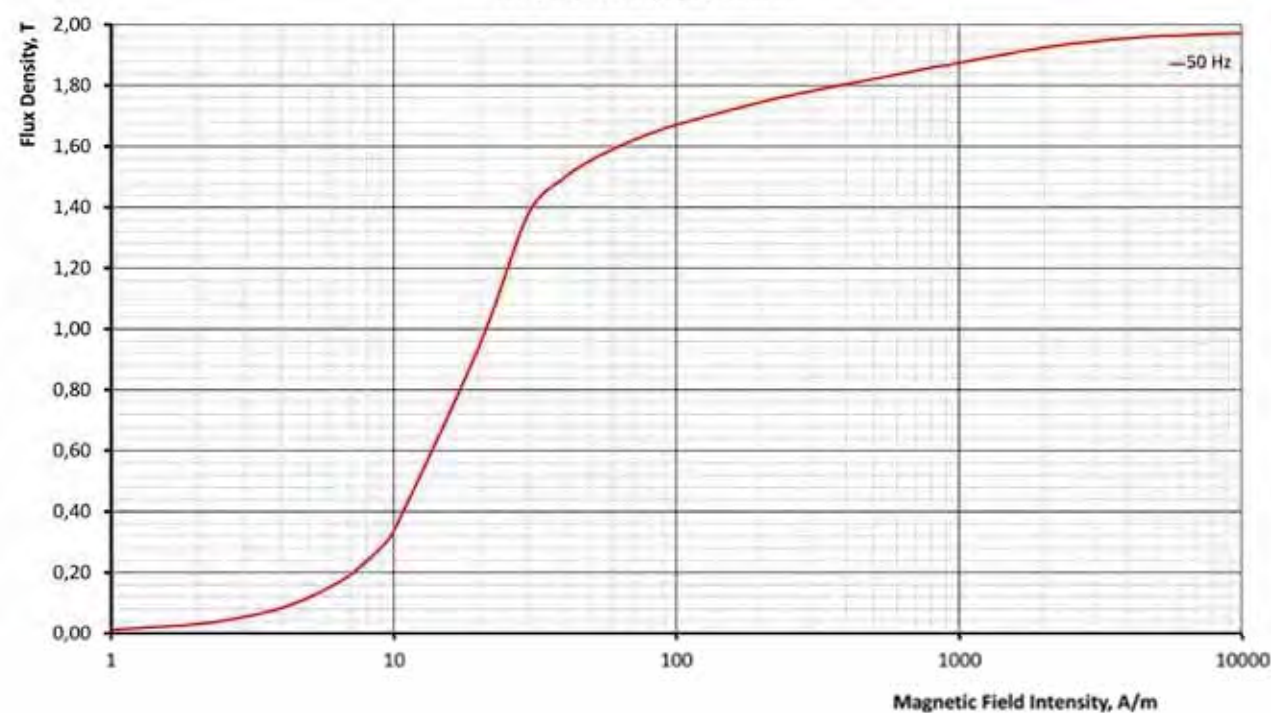
Magnetization curve
NV27S-130, 0.27 mm



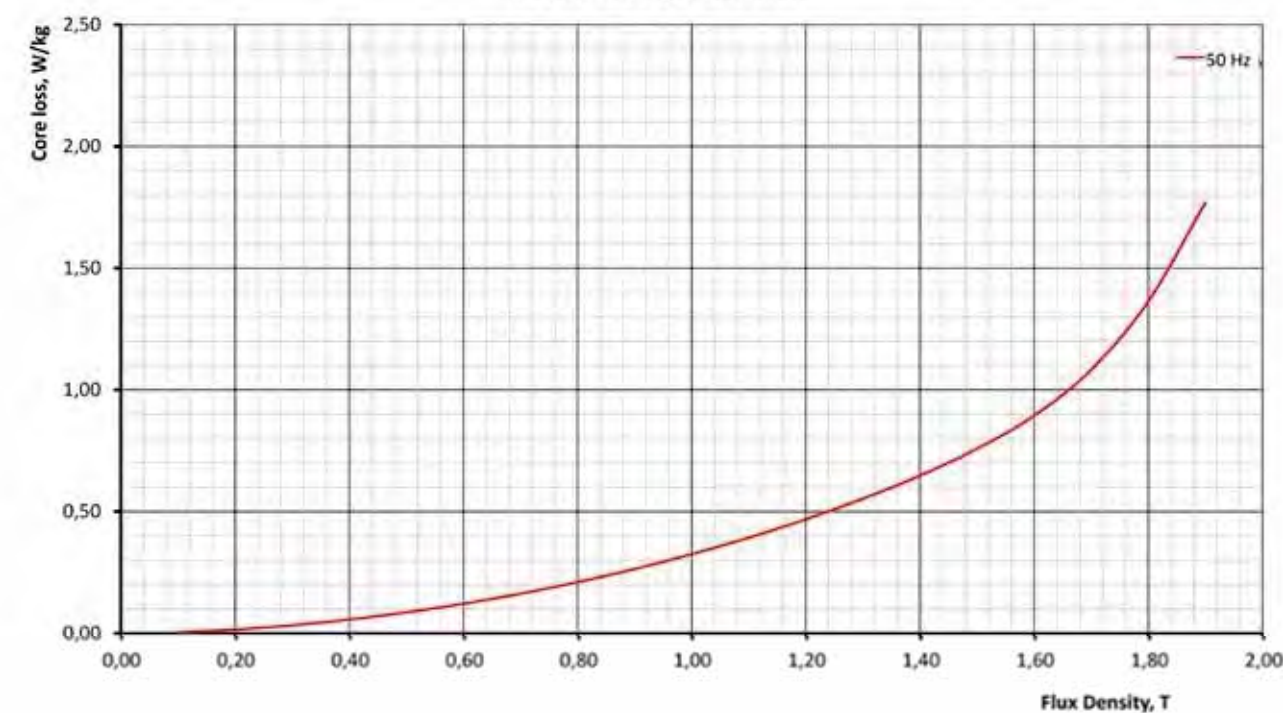




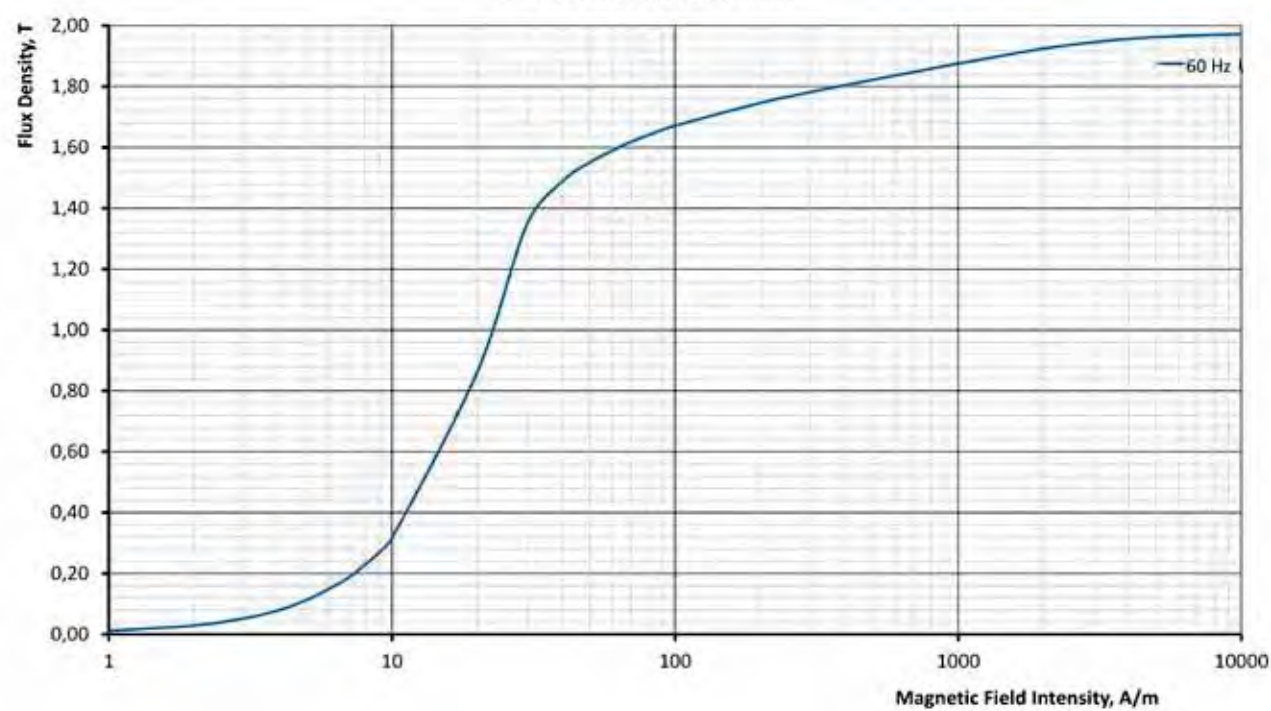
**Magnetization curve
NV30S-110L, 0.30 mm**



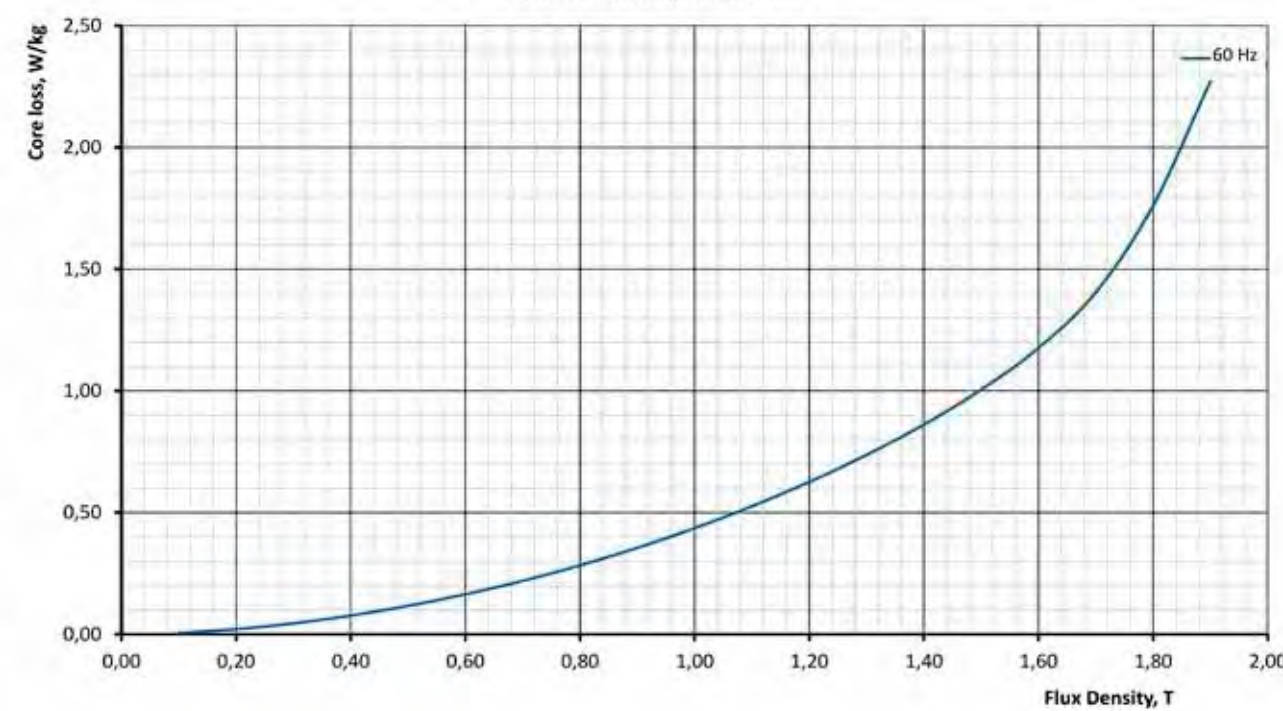
**Specific core loss
NV30S-110L, 0.30 mm**



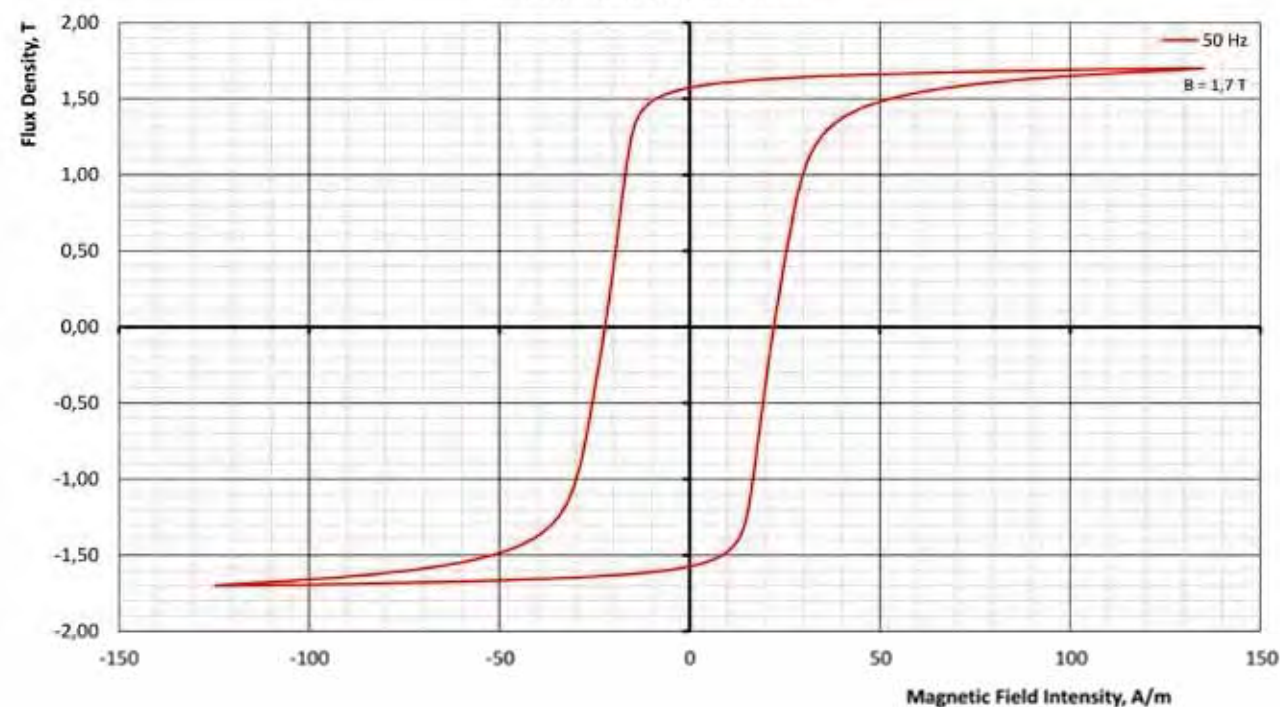
**Magnetization curve
NV30S-110L, 0.30 mm**



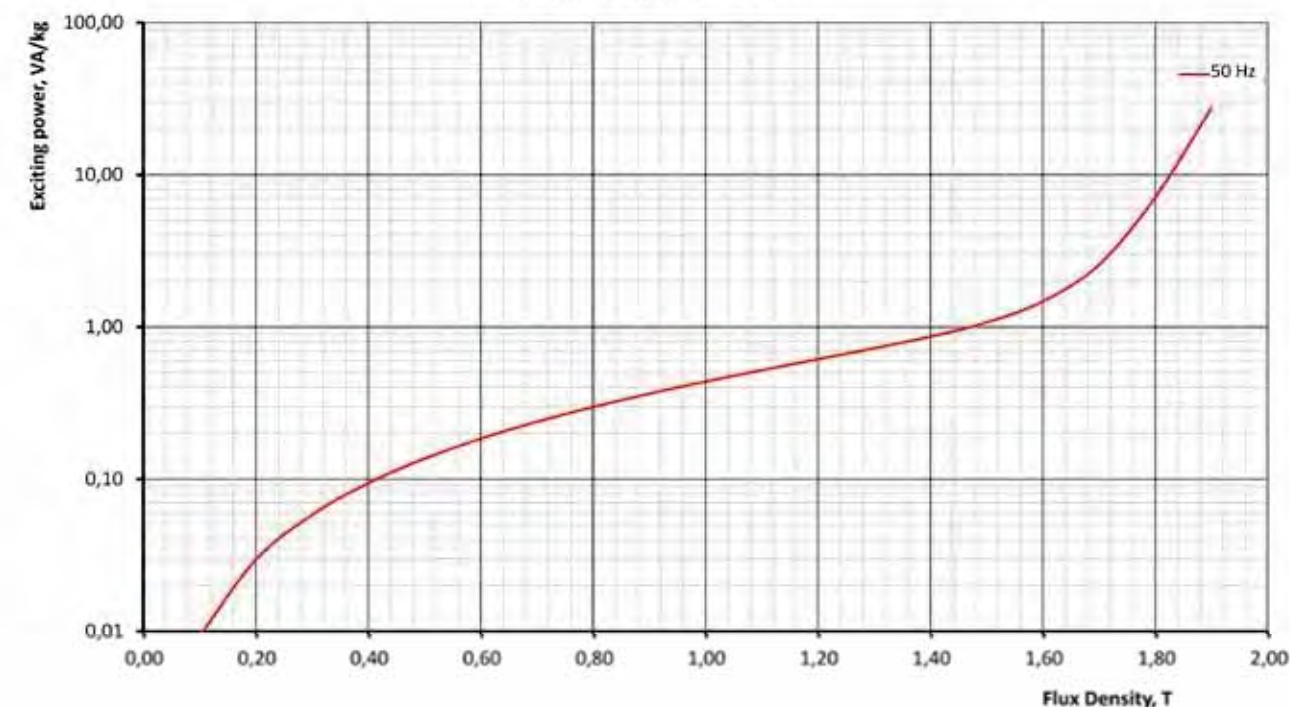
**Specific core loss
NV30S-110L, 0.30 mm**



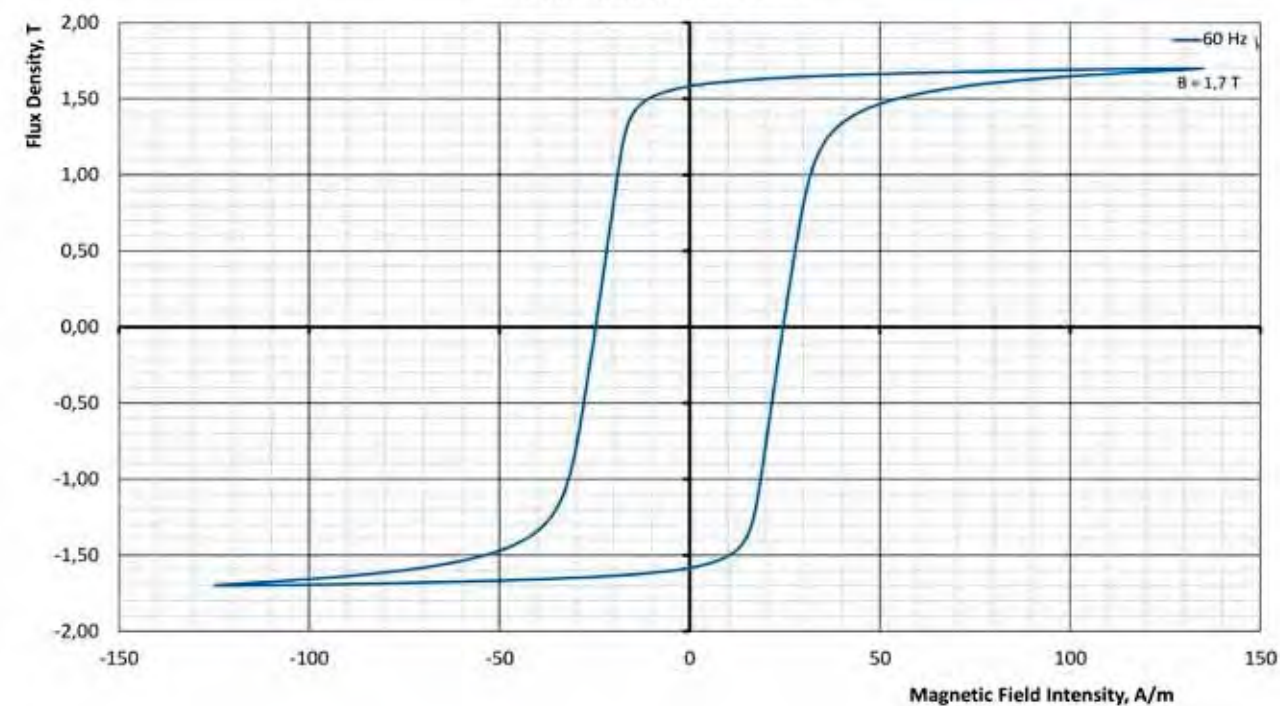
Hysteresis loop
NV30S-110L, 0.30 mm



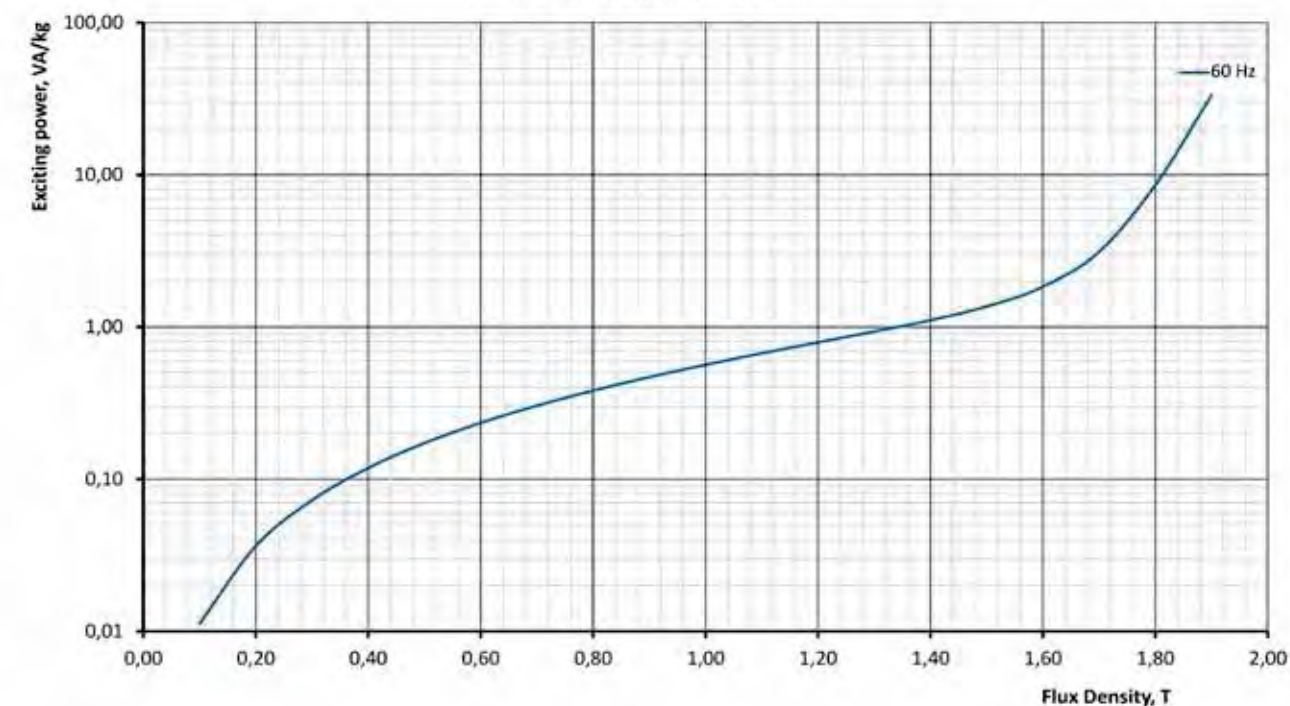
Exciting power
NV30S-110L, 0.30 mm



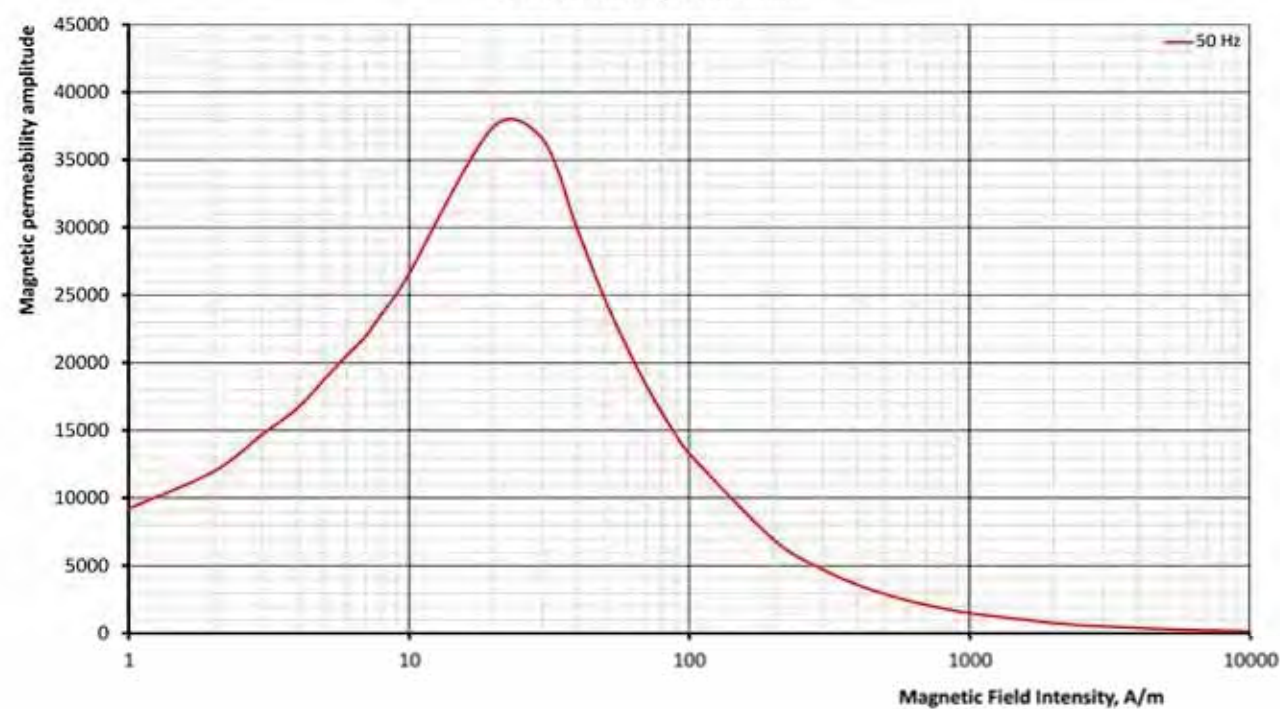
Hysteresis loop
NV30S-110L, 0.30 mm



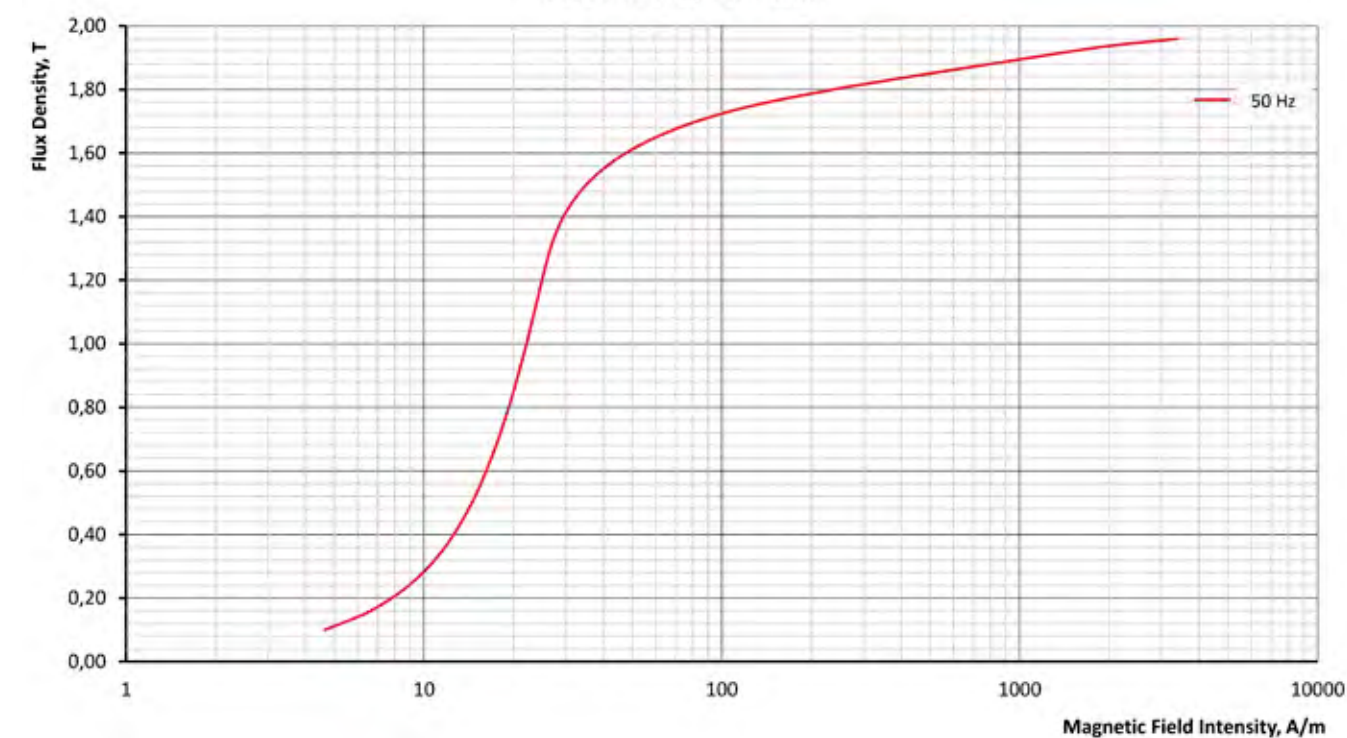
Exciting power
NV30S-110L, 0.30 mm



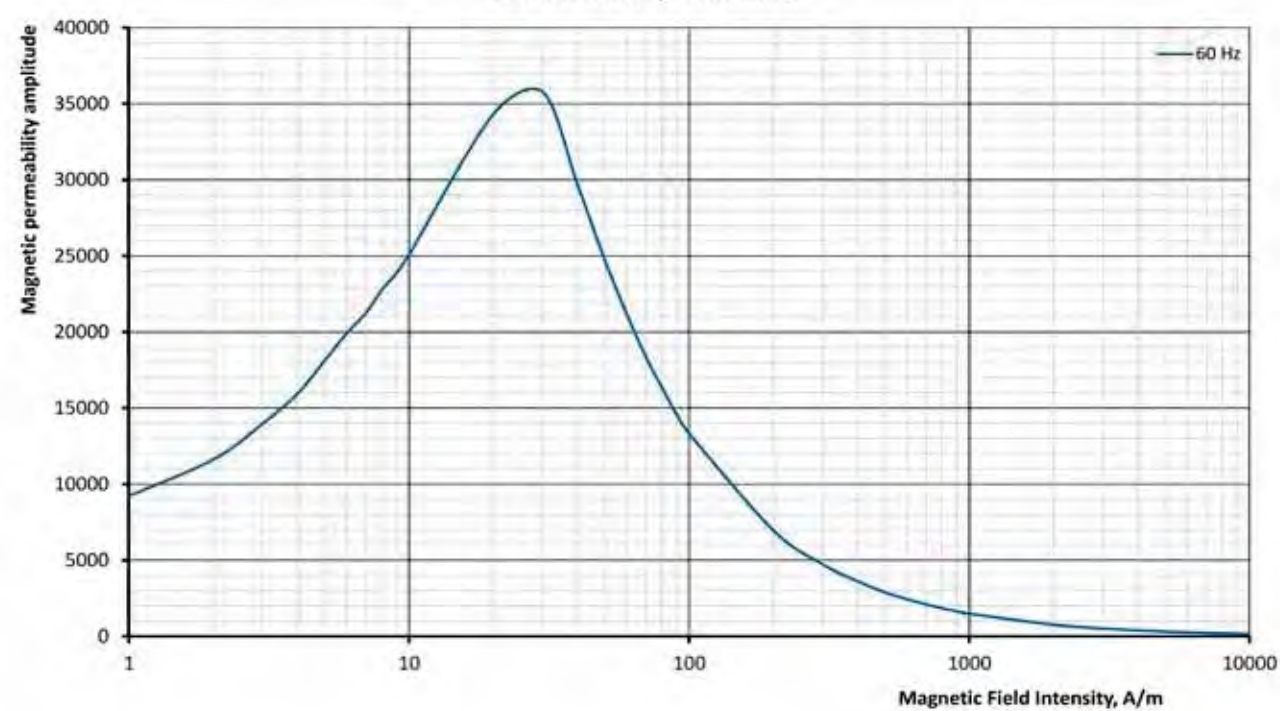
**Magnetic permeability amplitude
NV30S-110L, 0.30 mm**



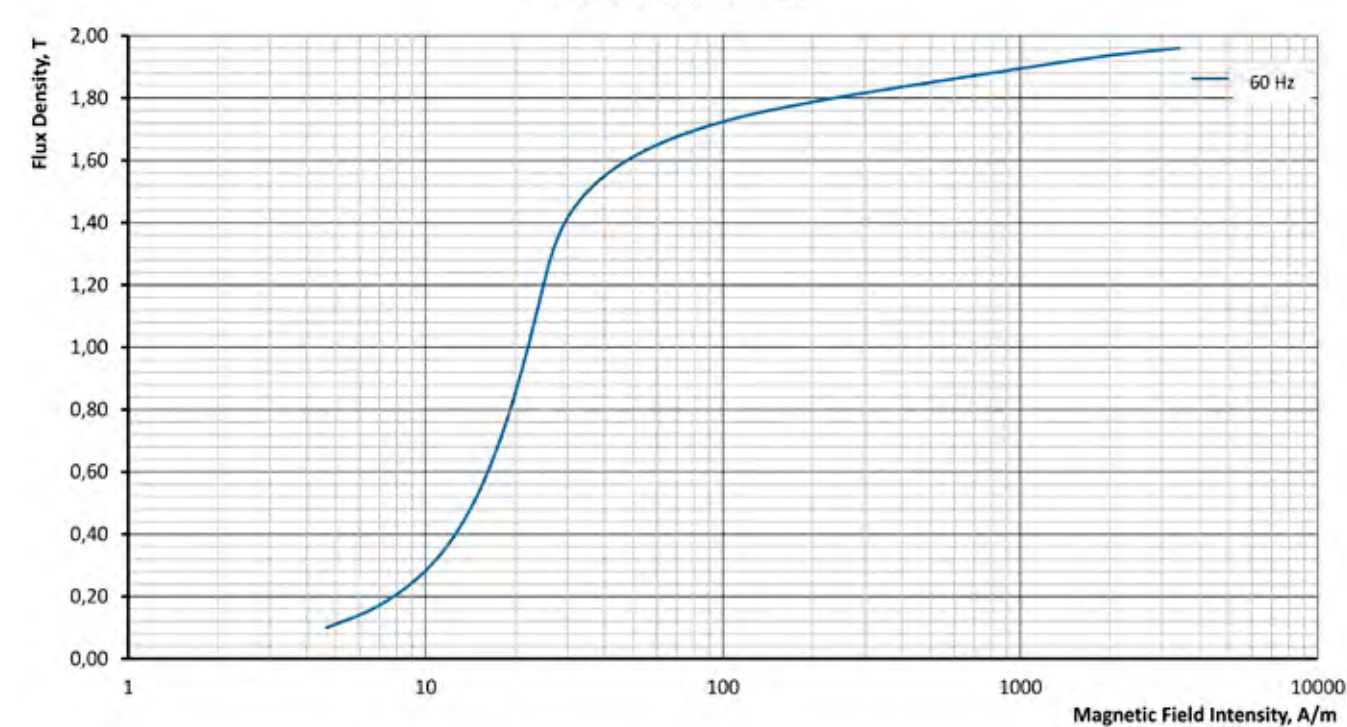
**Magnetization curve
NV30S-110, 0.30 mm**



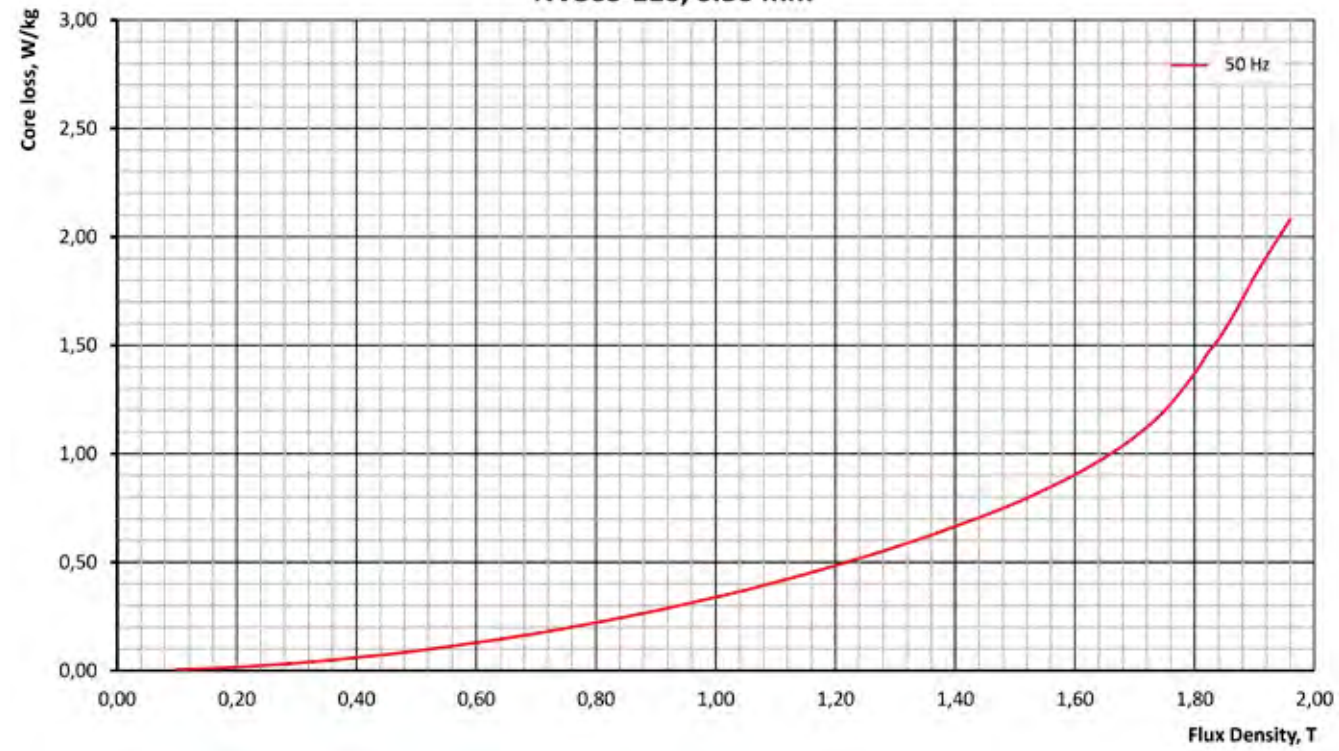
**Magnetic permeability amplitude
NV30S-110L, 0.30 mm**



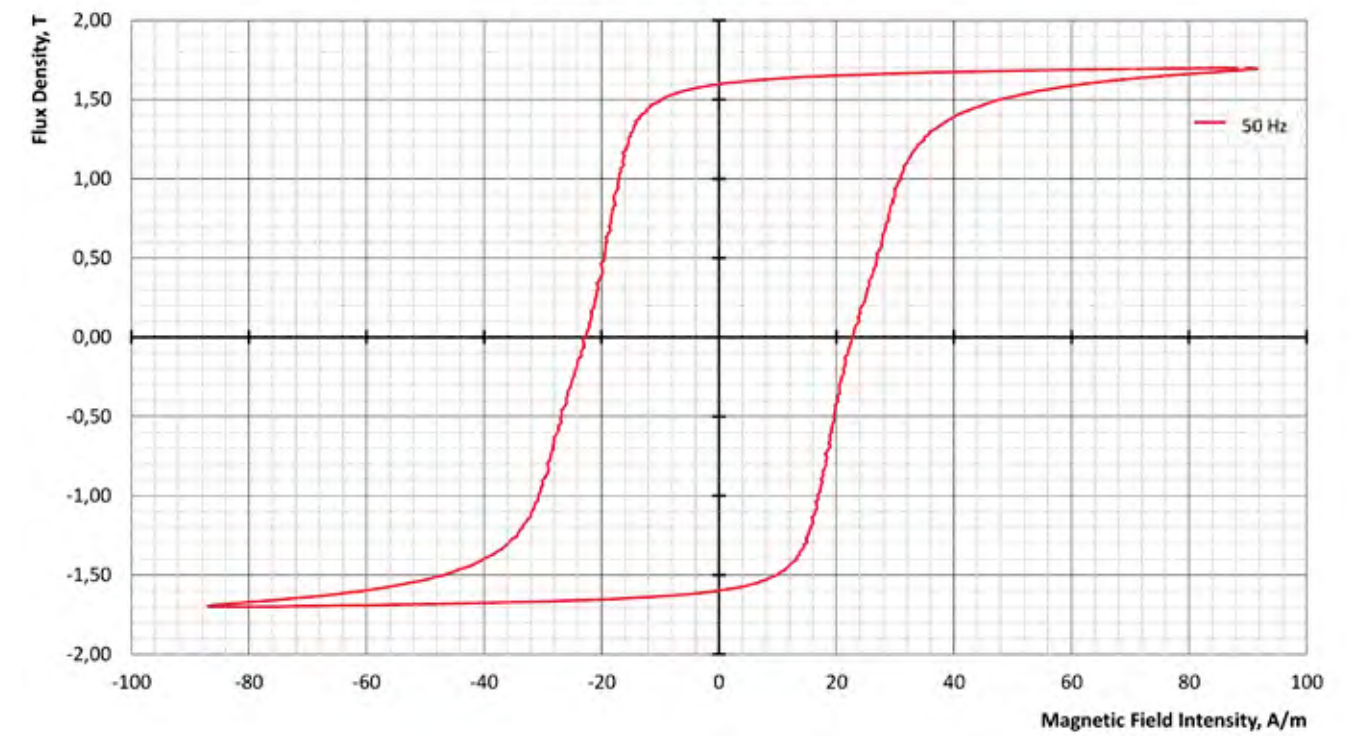
**Magnetization curve
NV30S-110, 0.30 mm**



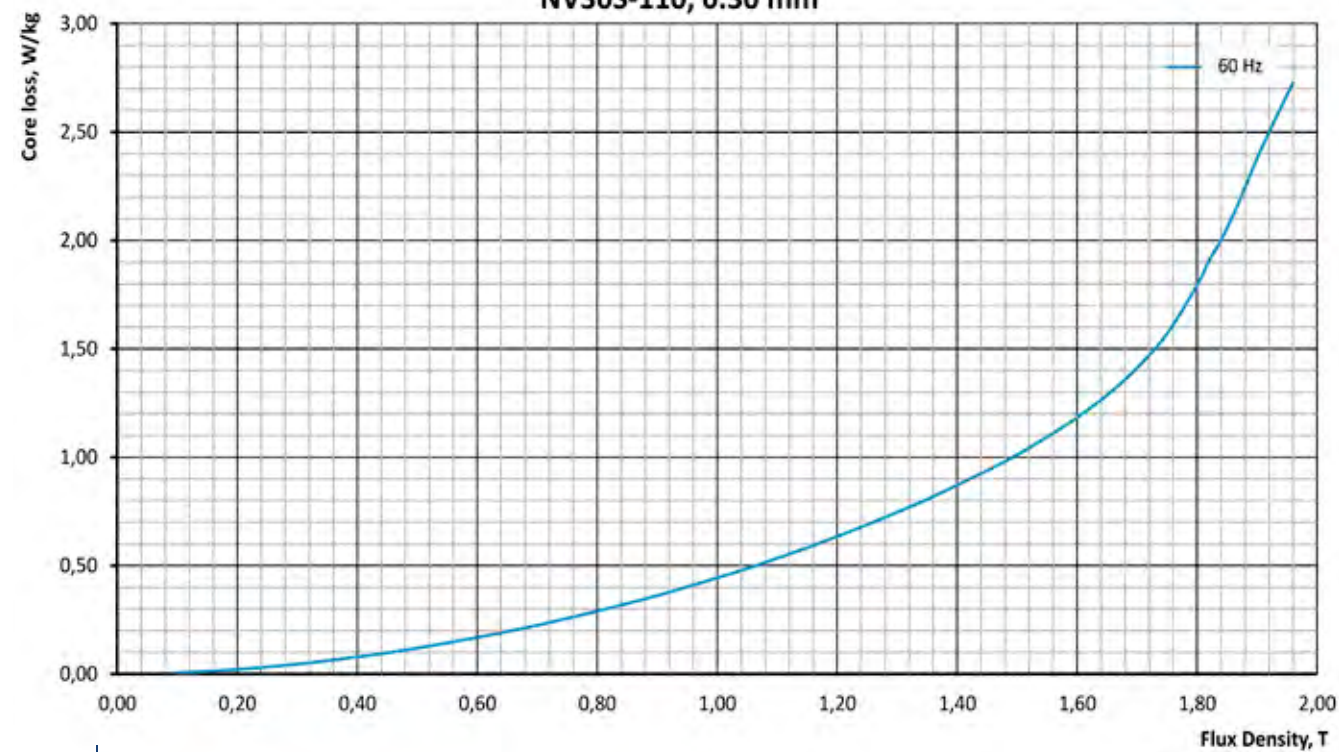
**Specific core loss
NV30S-110, 0.30 mm**



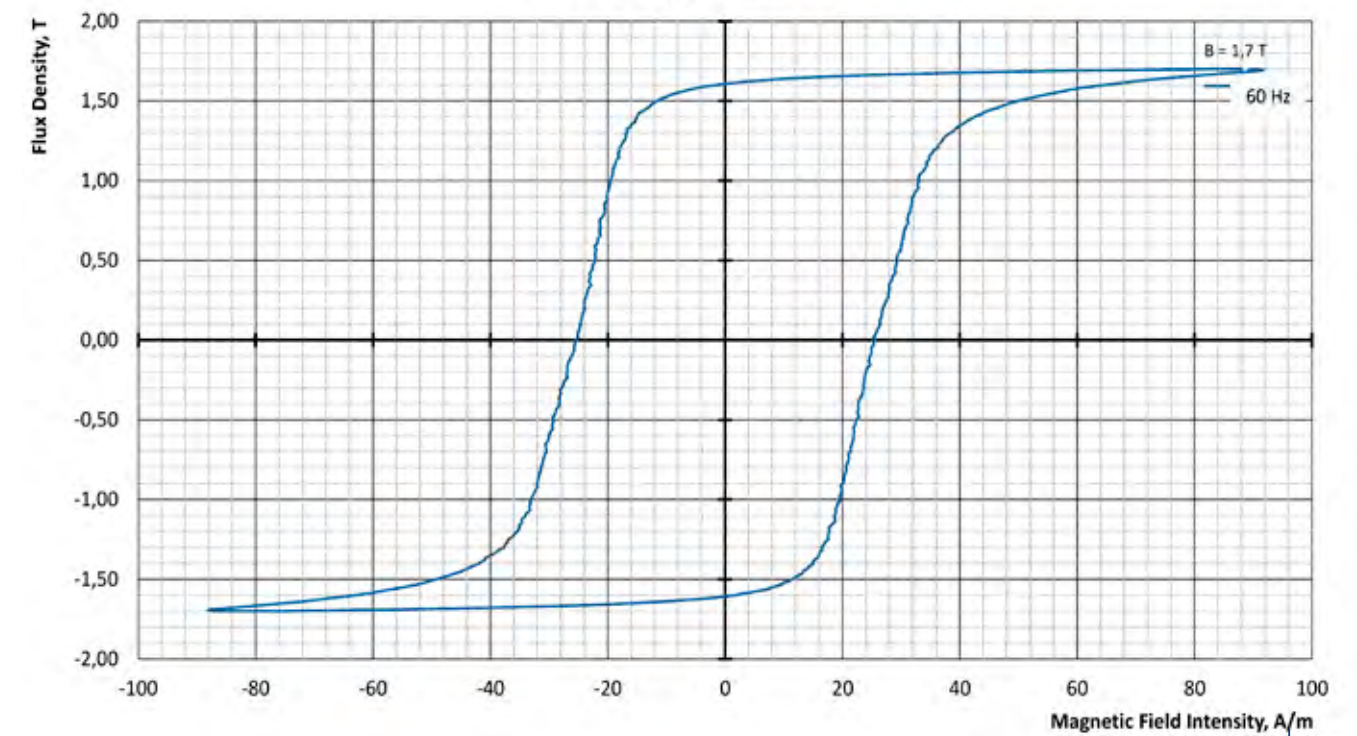
**Hysteresis loop
NV30S-110, 0.30 mm**

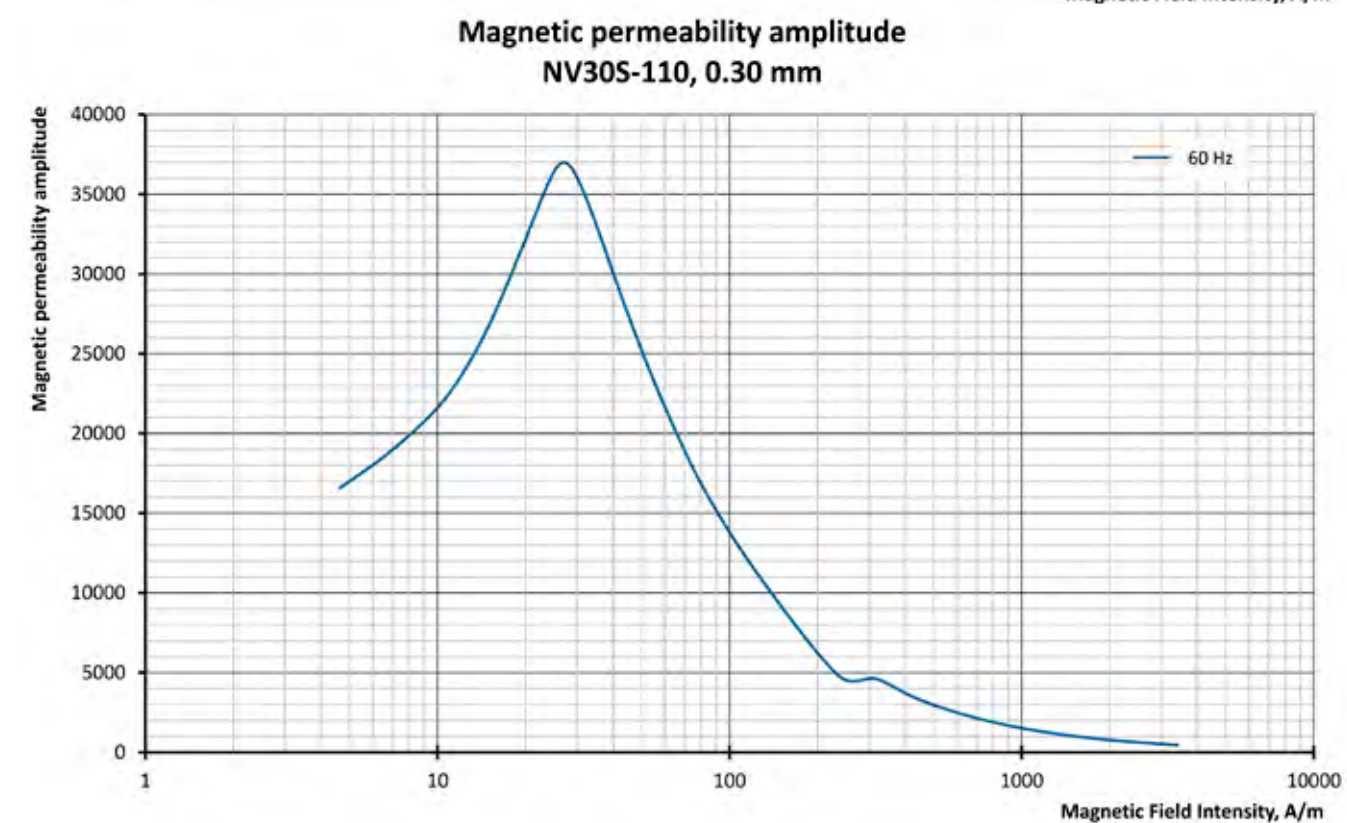
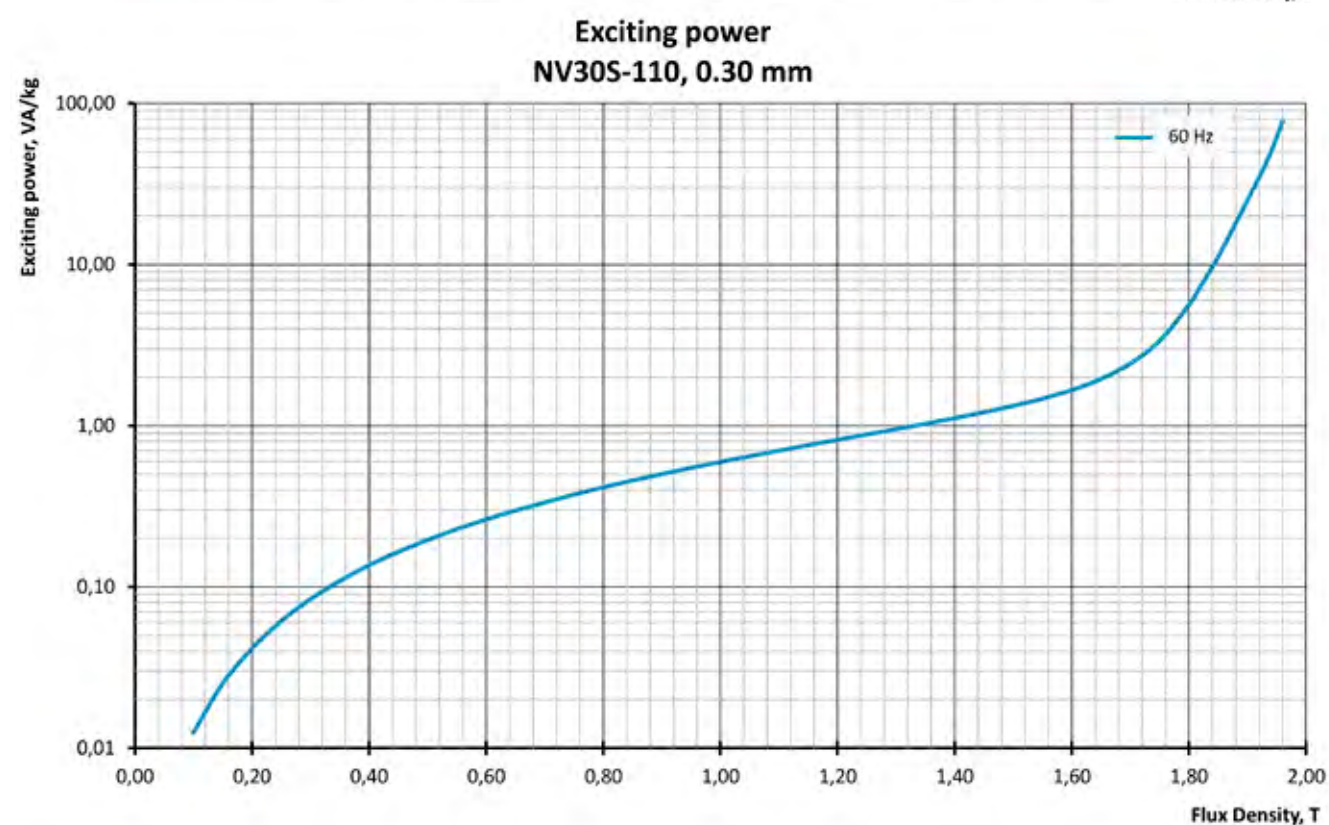
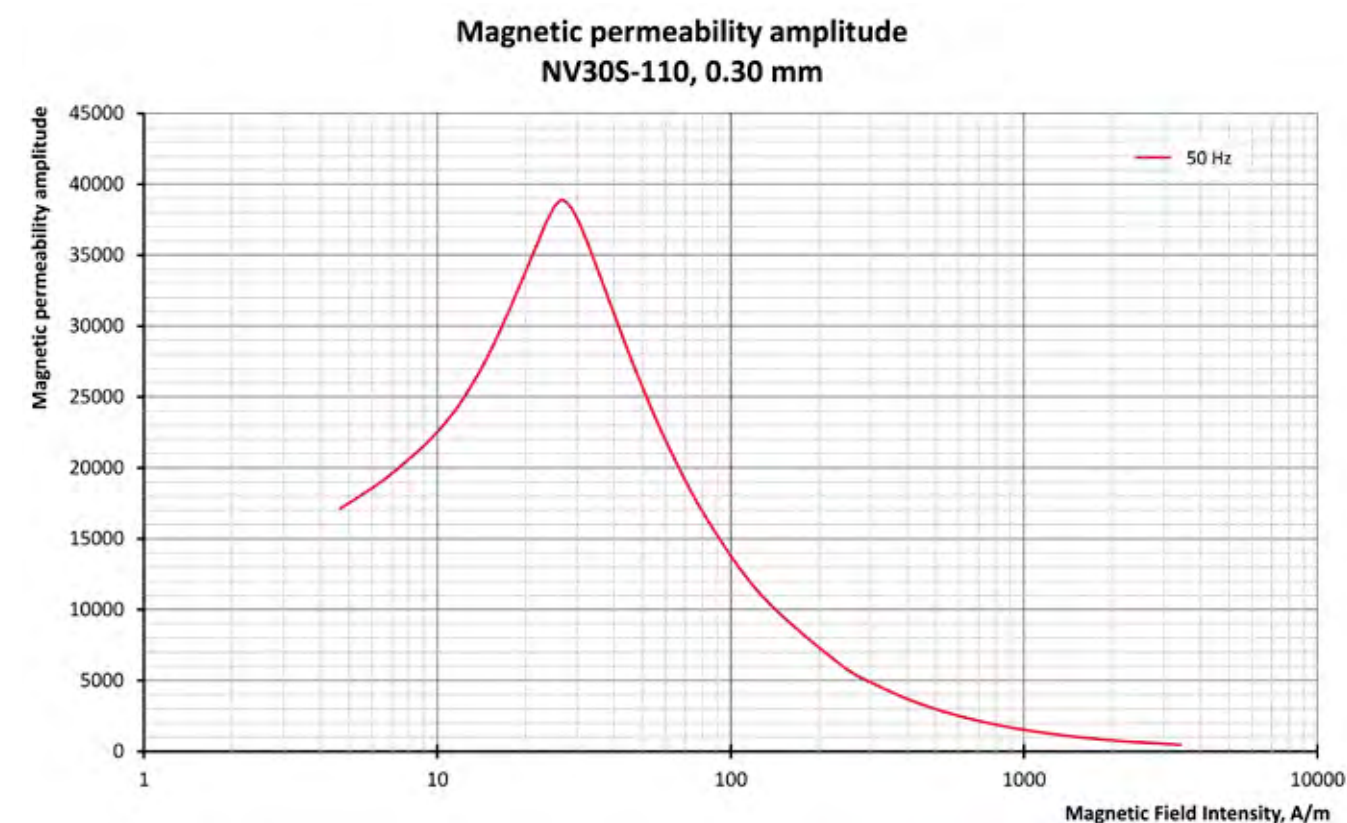
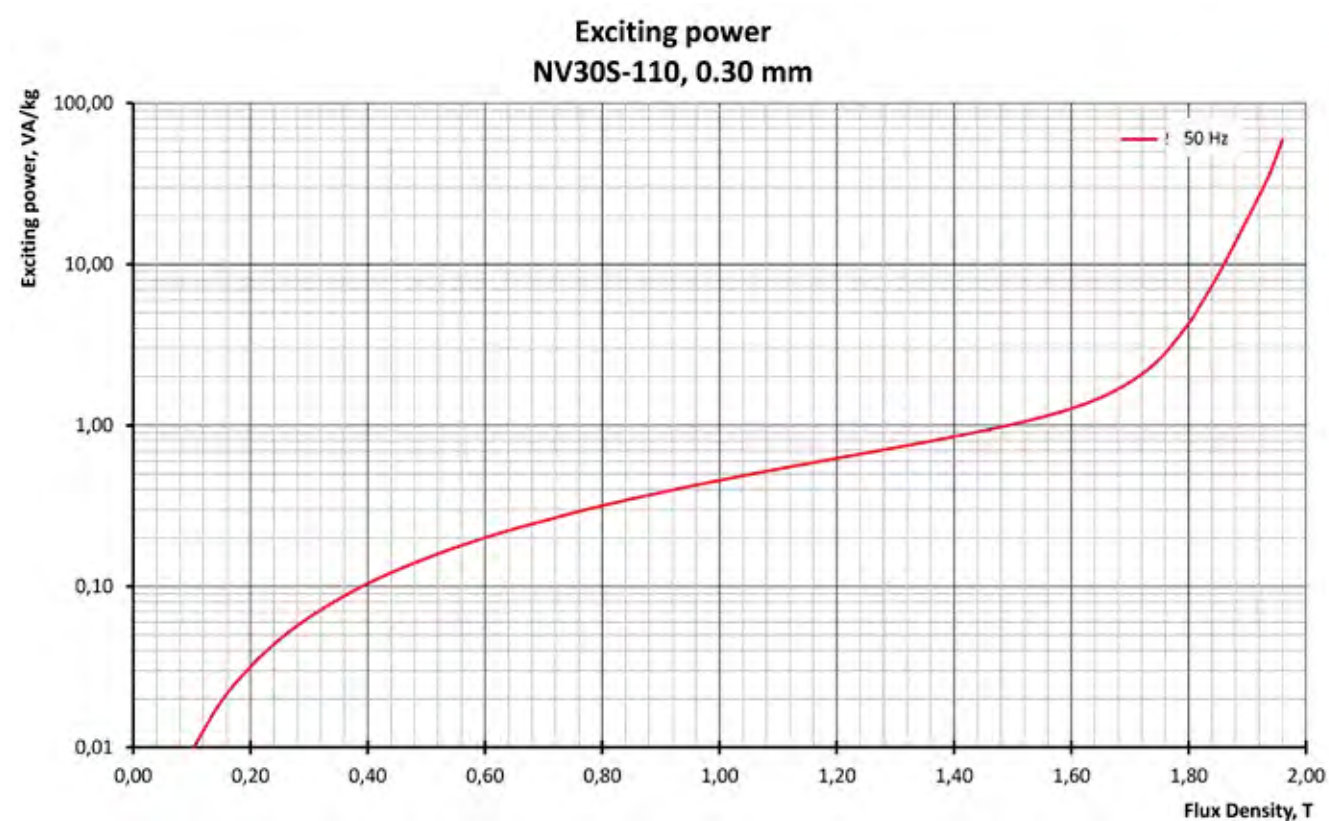


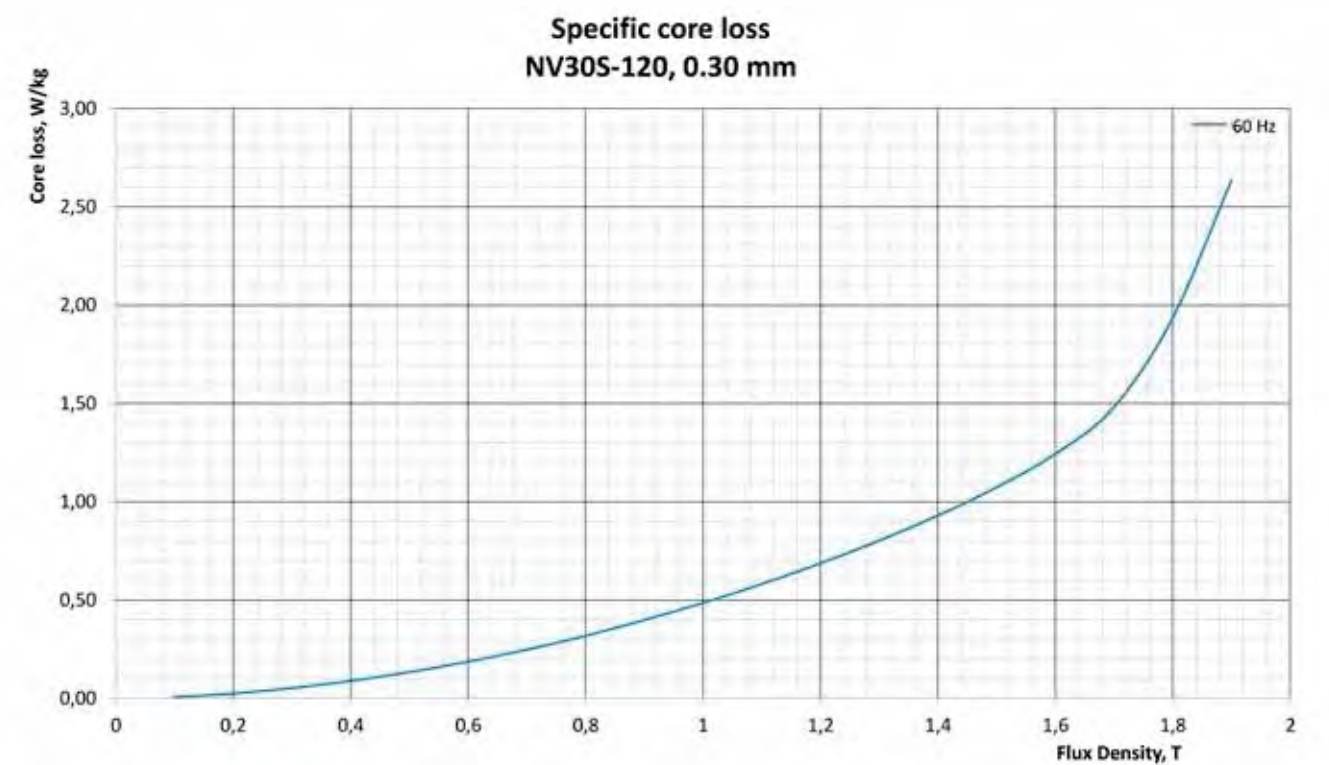
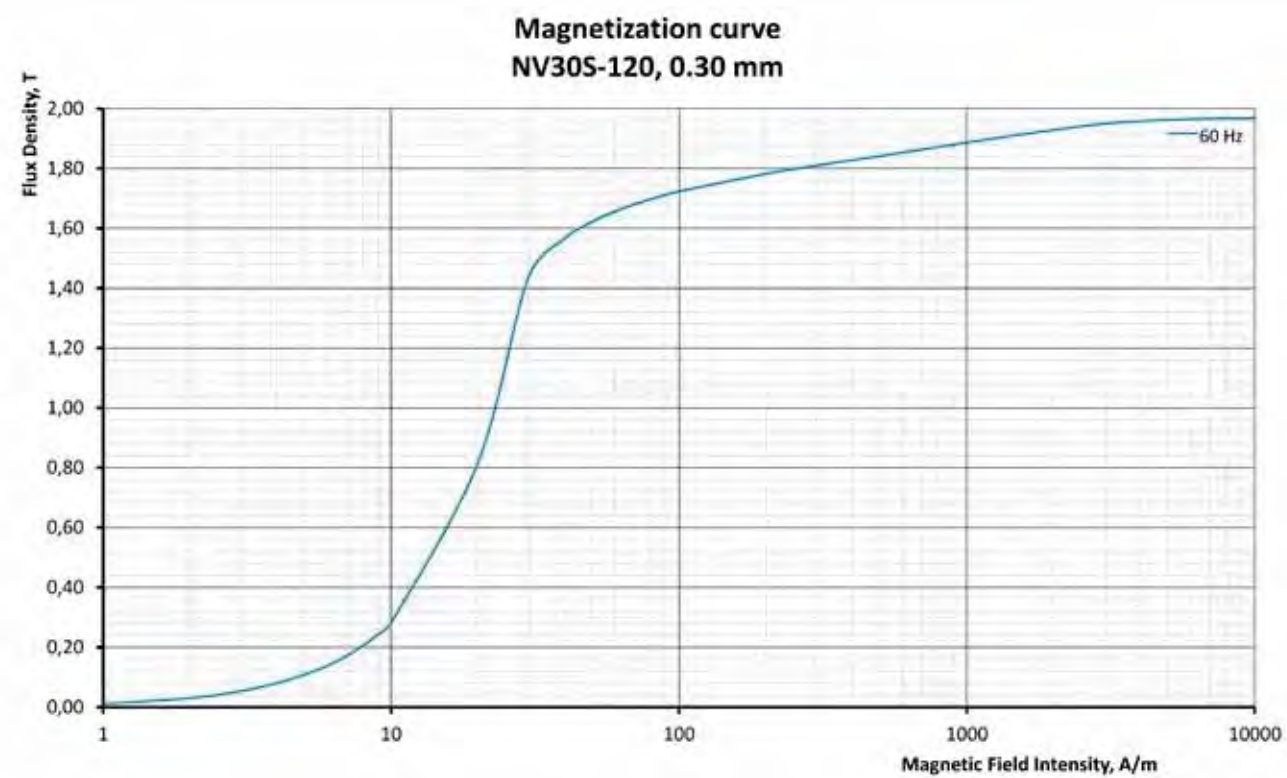
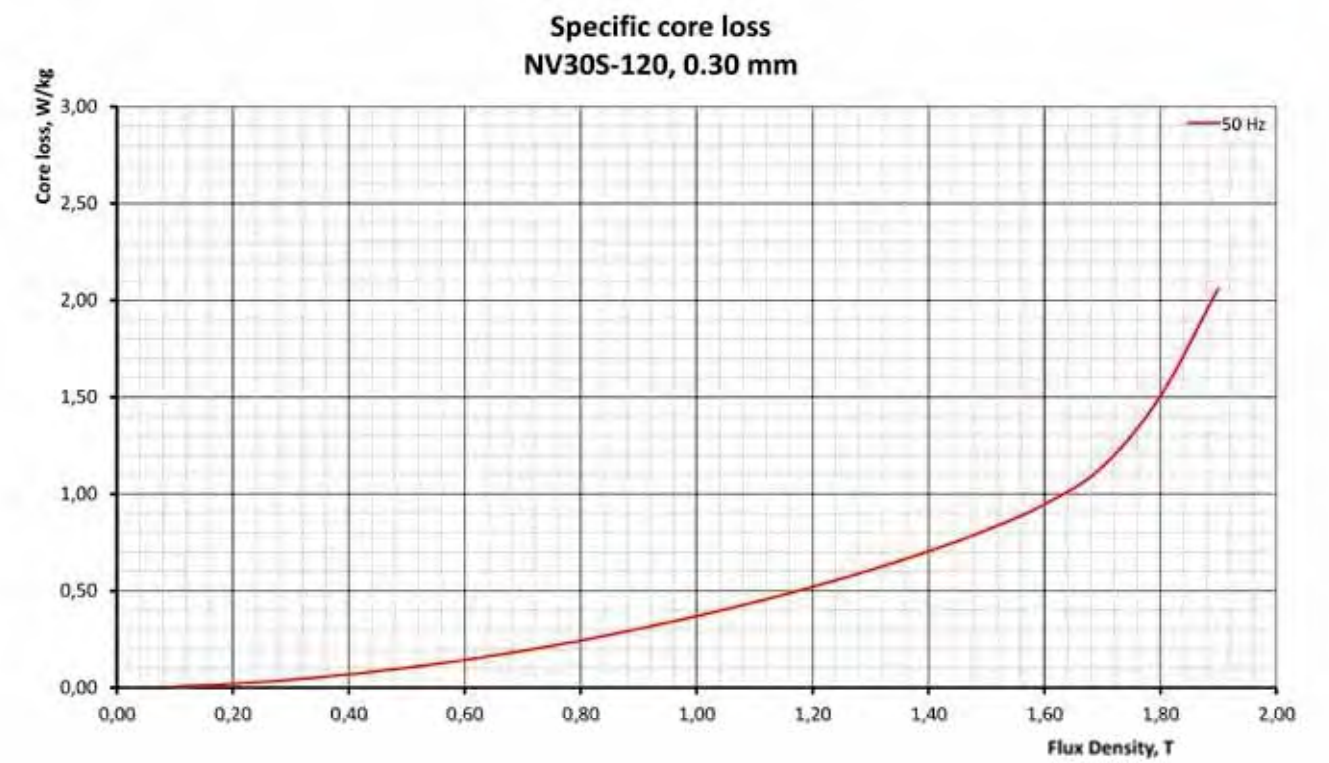
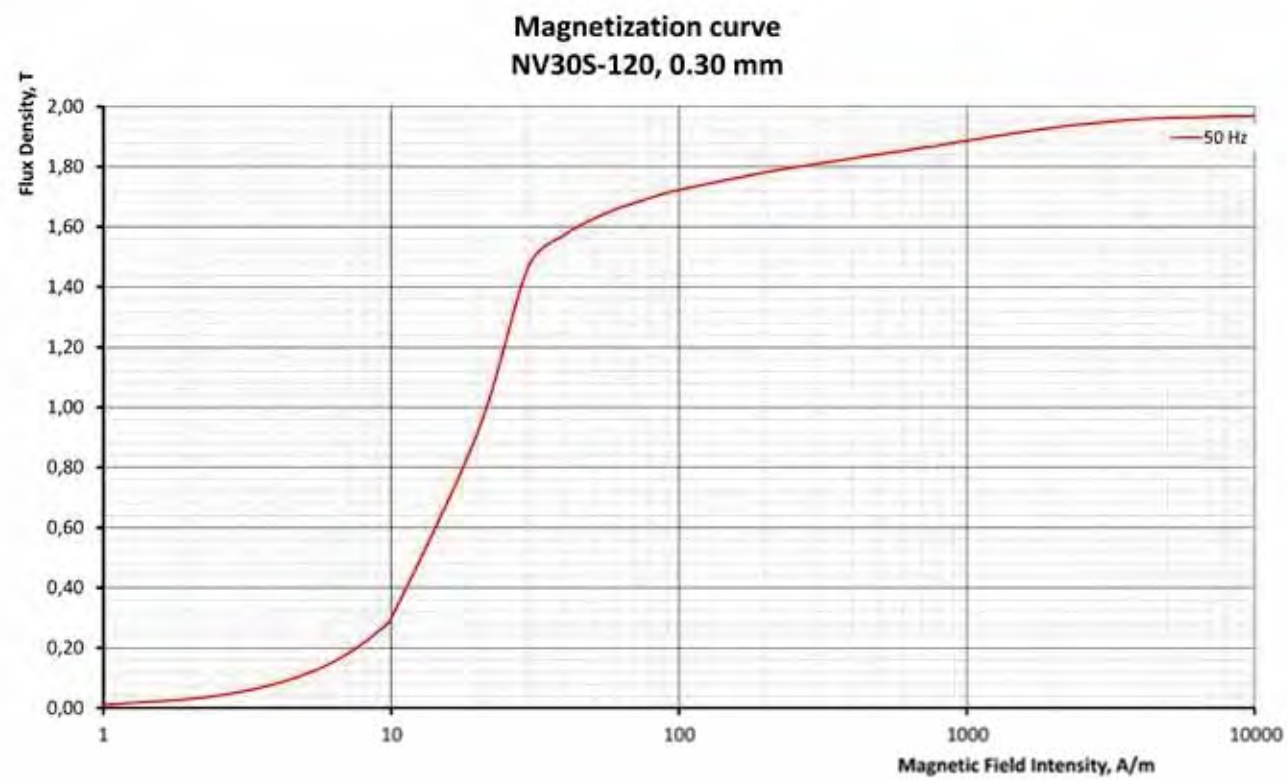
**Specific core loss
NV30S-110, 0.30 mm**

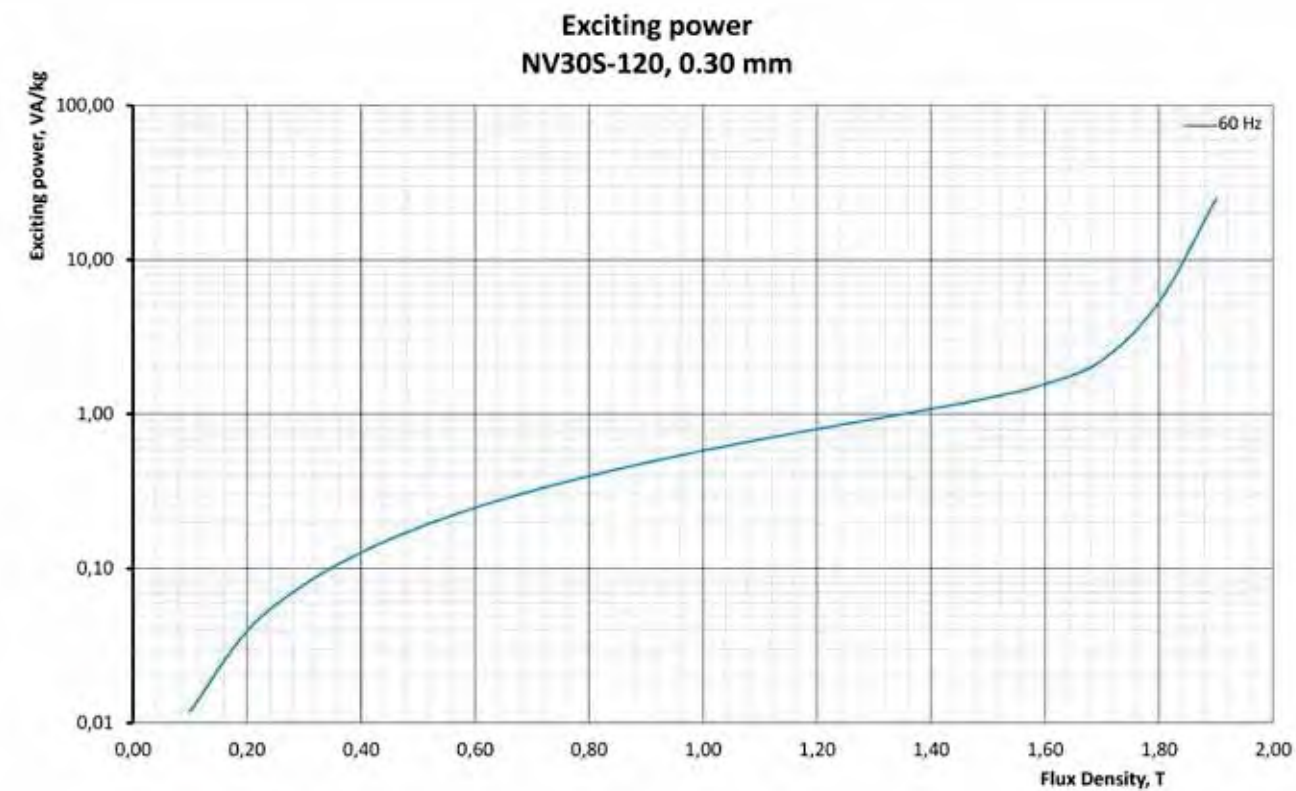
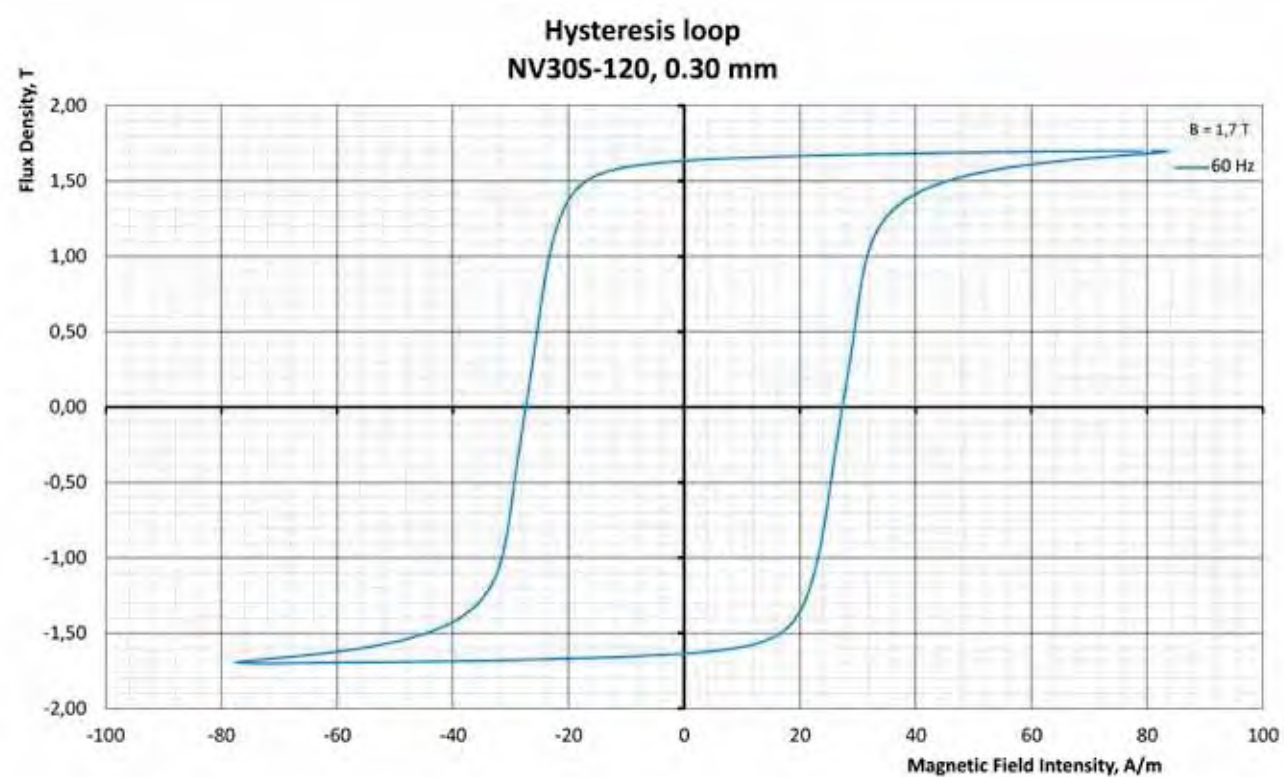
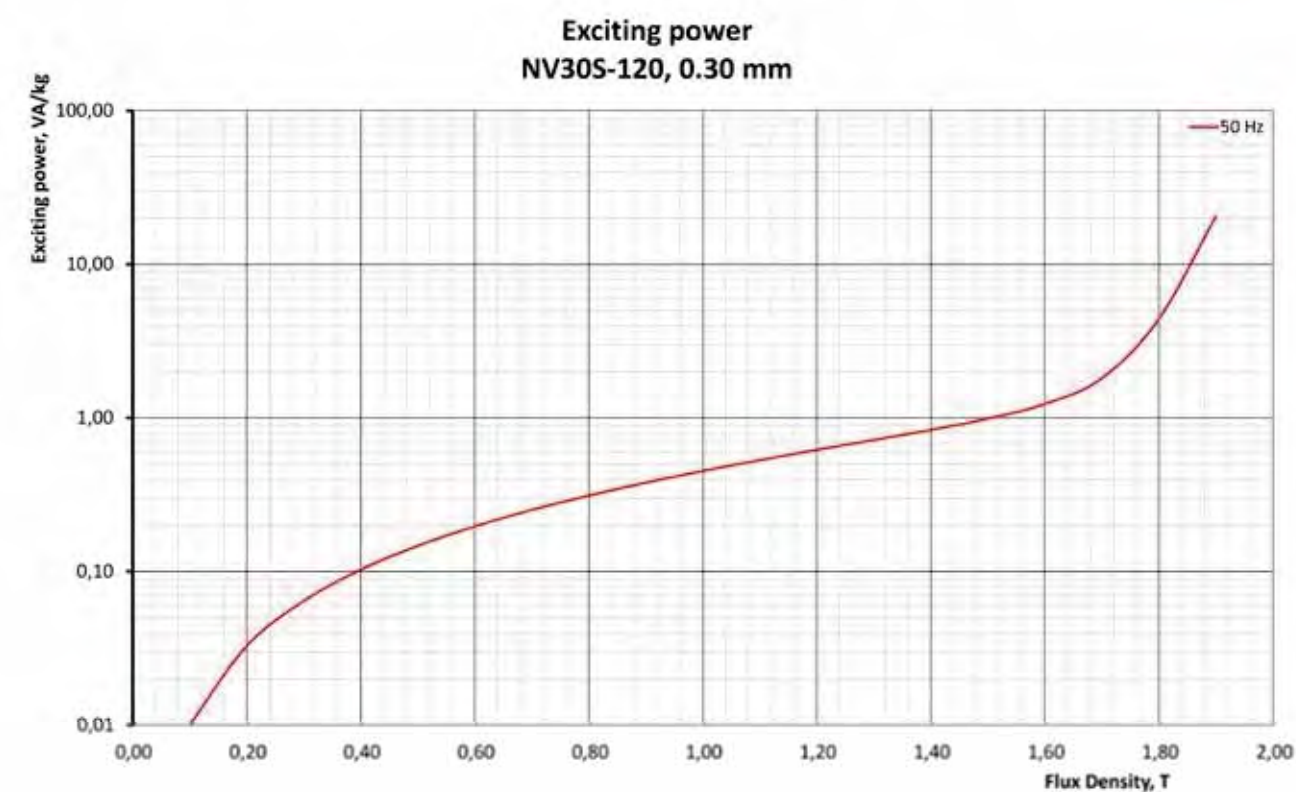
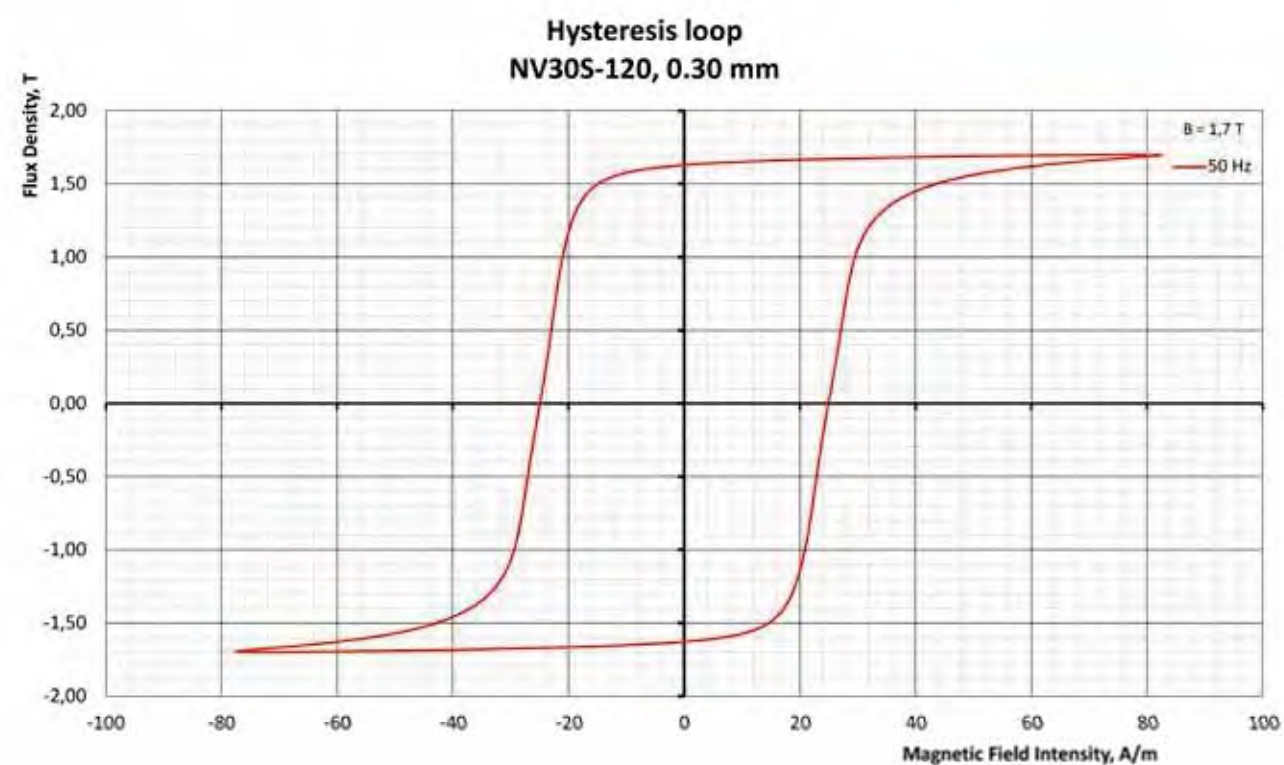


**Hysteresis loop
NV30S-110, 0.30 mm**

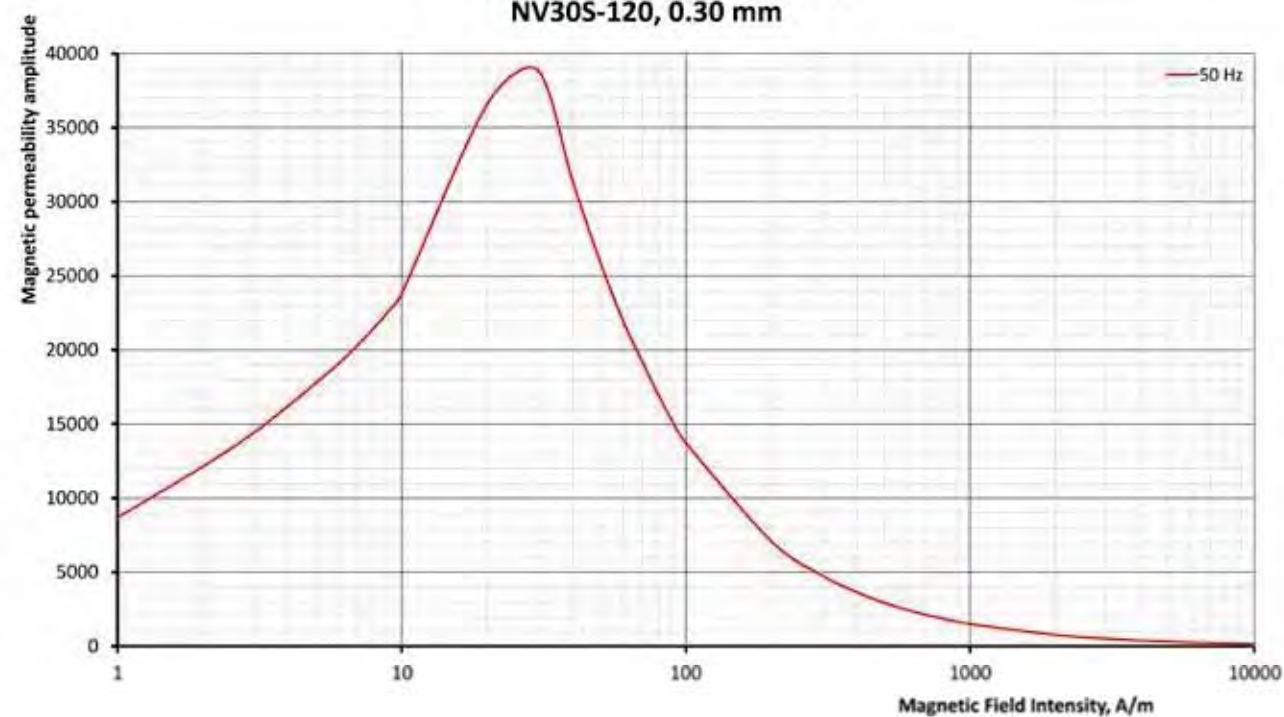




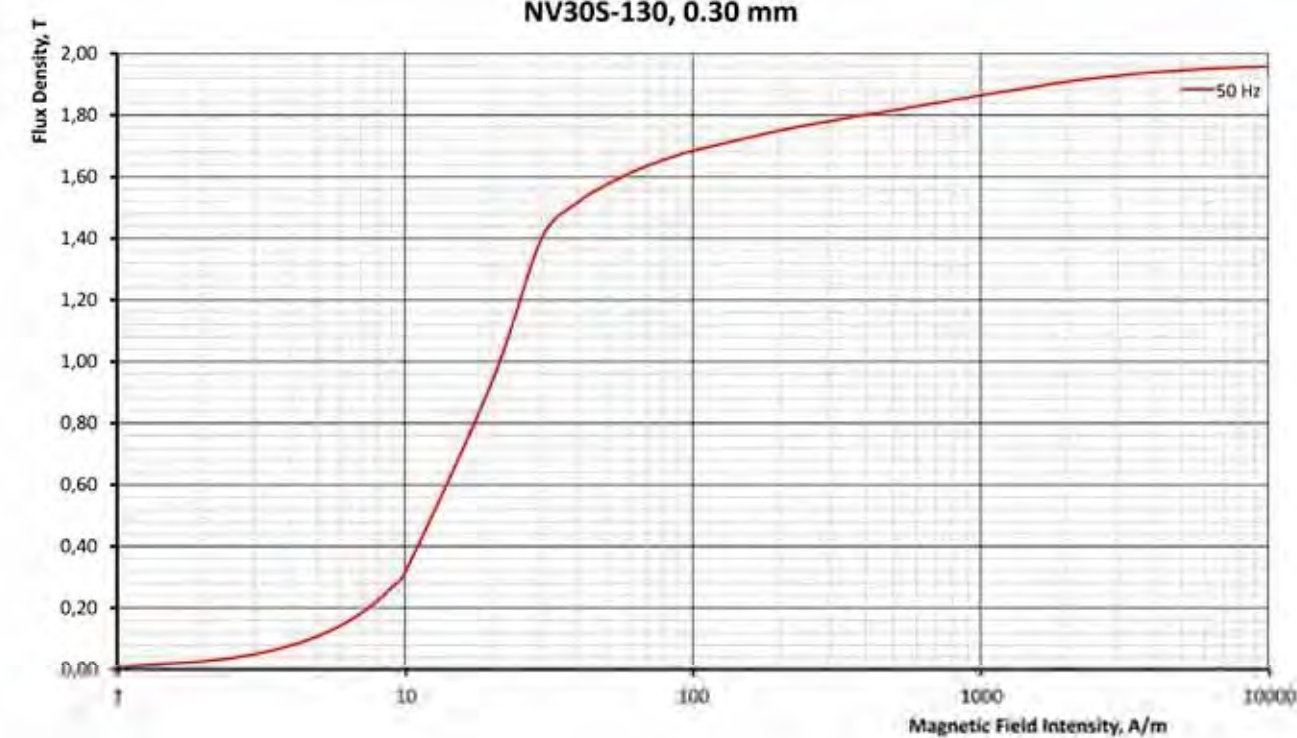




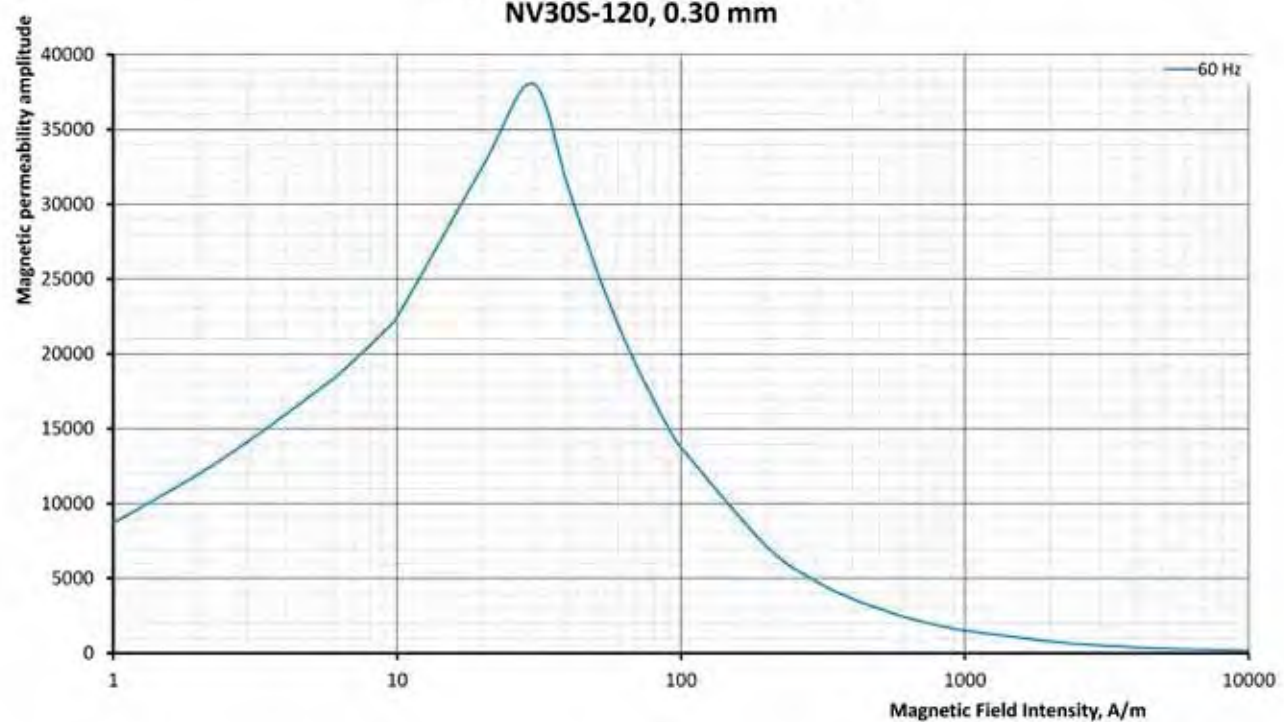
**Magnetic permeability amplitude
NV30S-120, 0.30 mm**



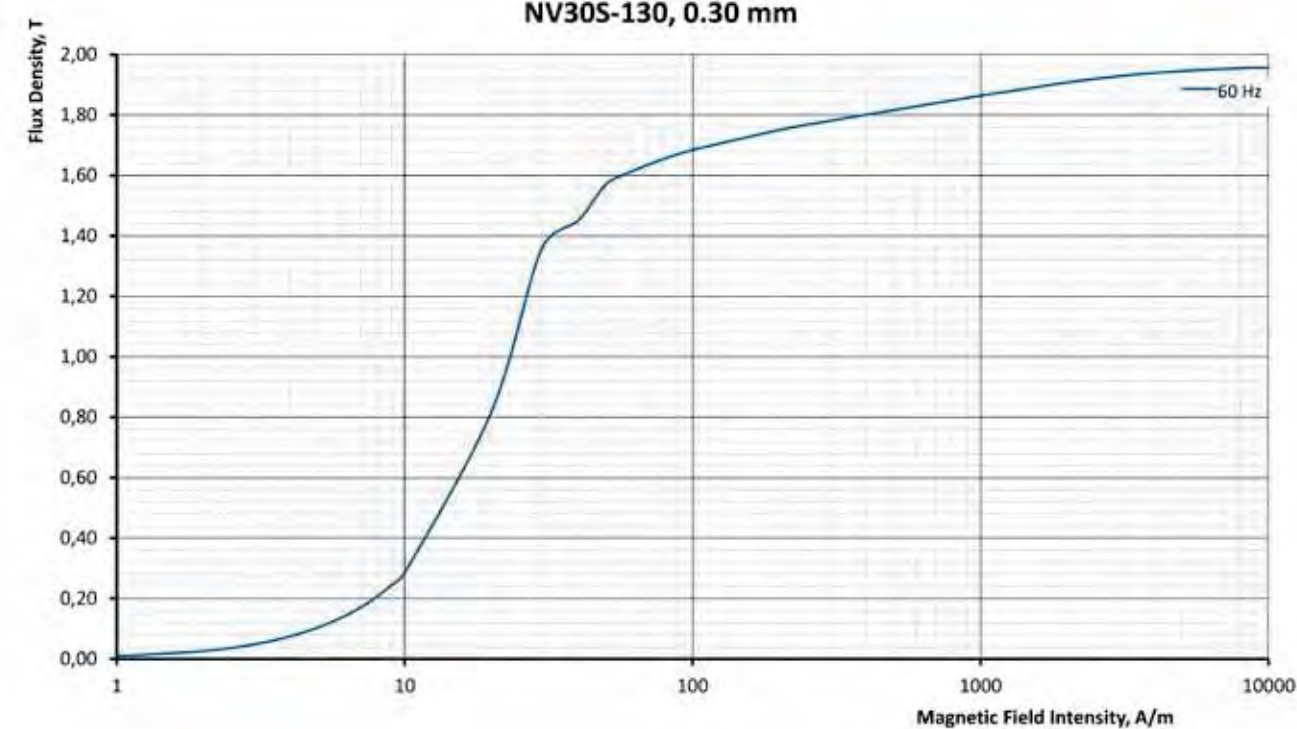
**Magnetization curve
NV30S-130, 0.30 mm**



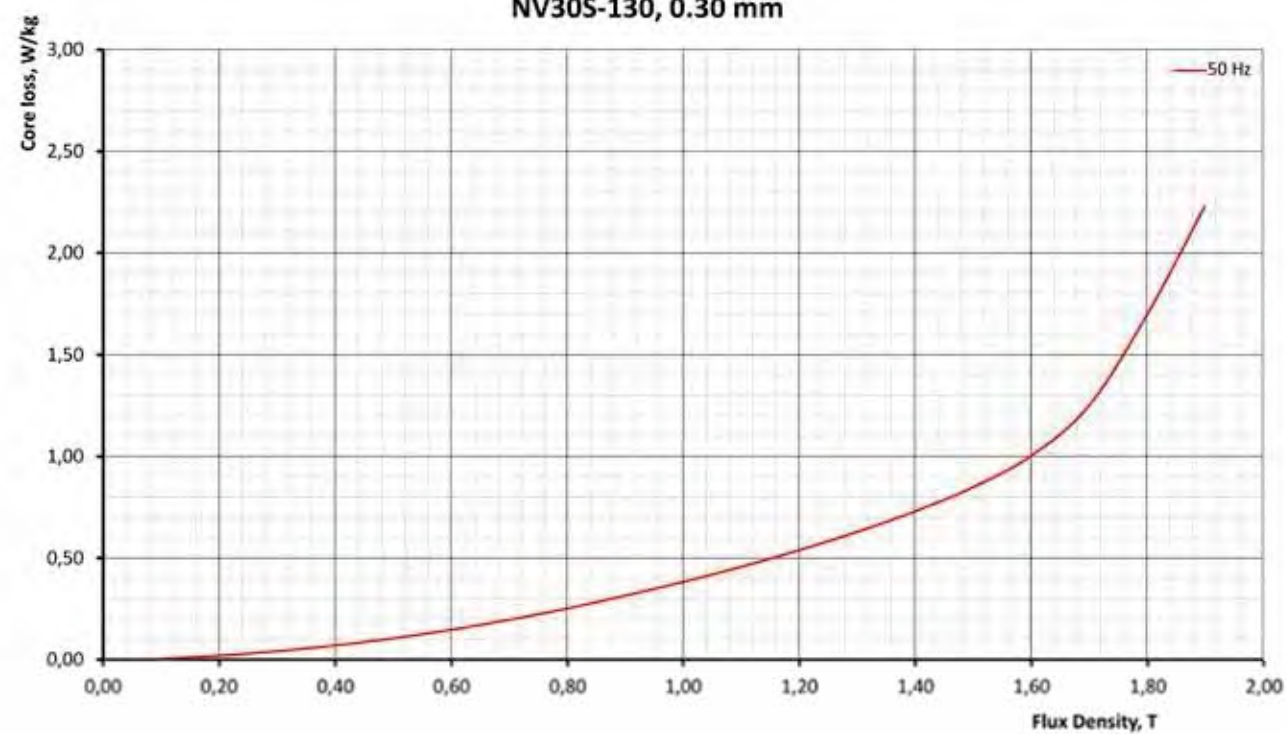
**Magnetic permeability amplitude
NV30S-120, 0.30 mm**



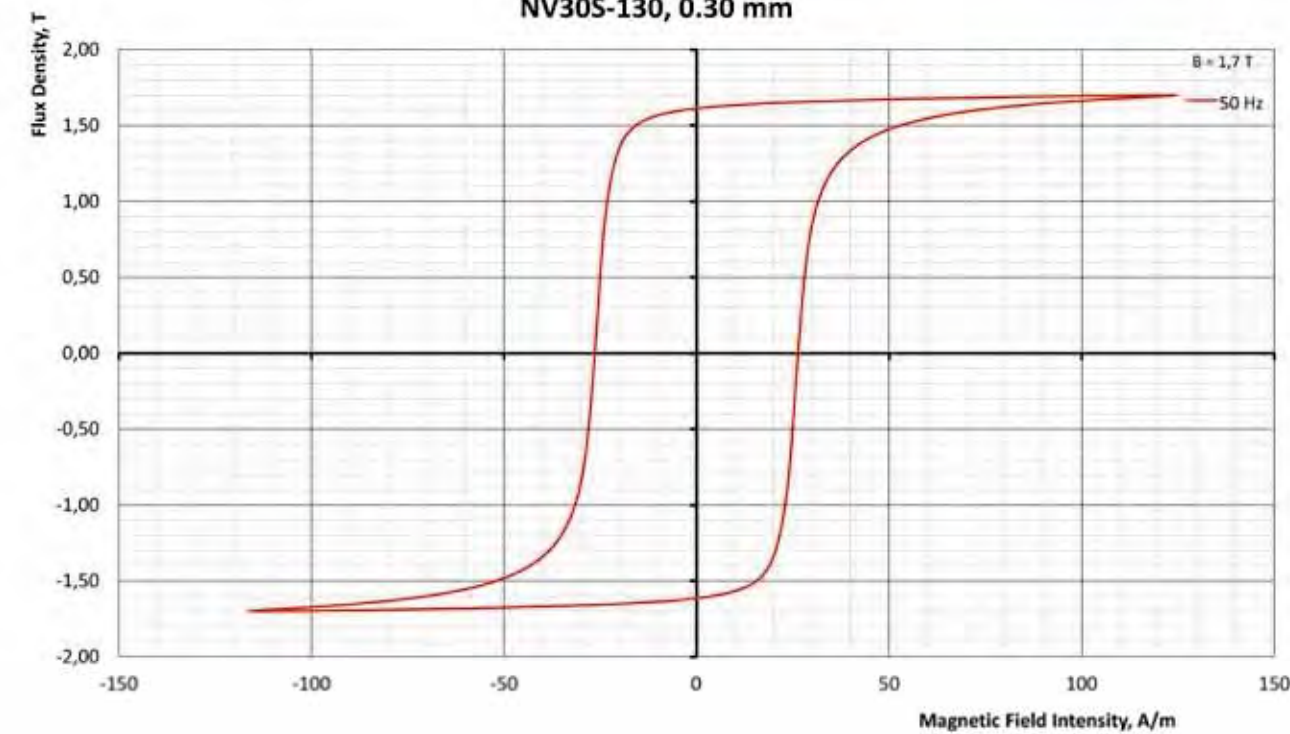
**Magnetization curve
NV30S-130, 0.30 mm**



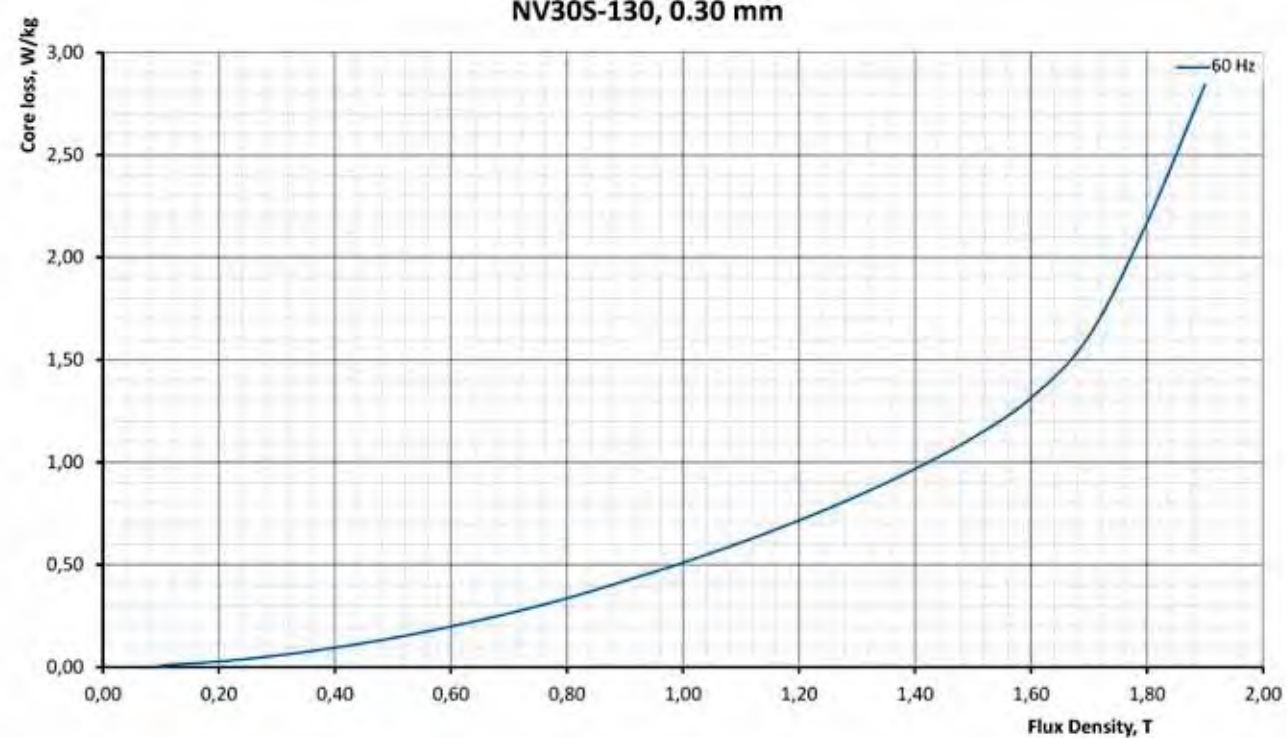
Specific core loss
NV30S-130, 0.30 mm



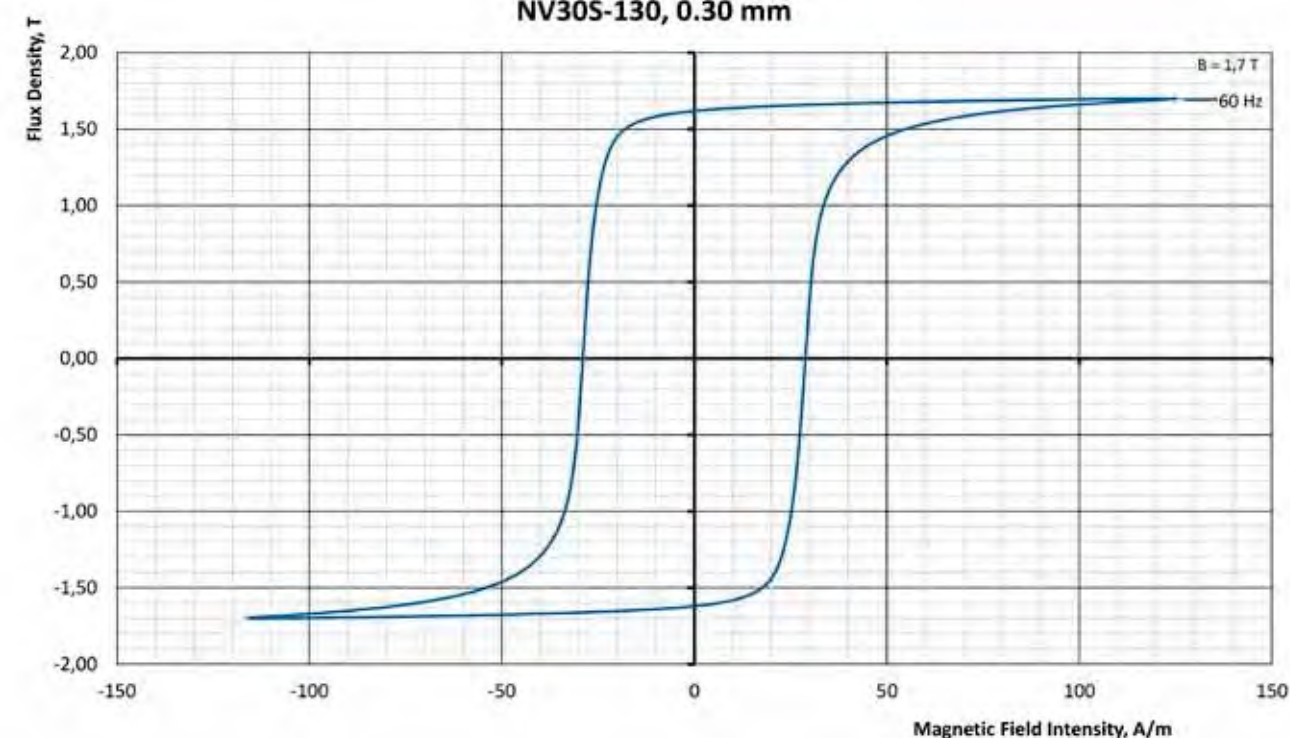
Hysteresis loop
NV30S-130, 0.30 mm

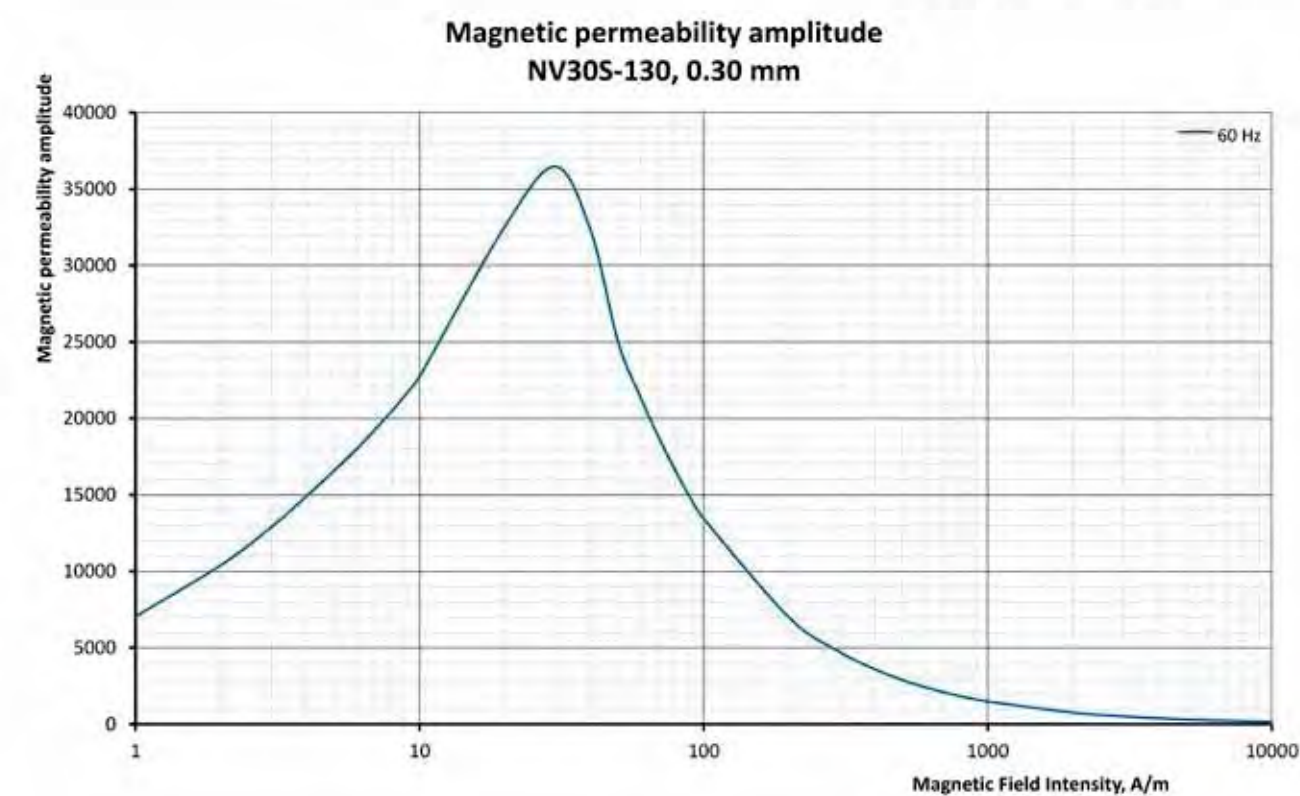
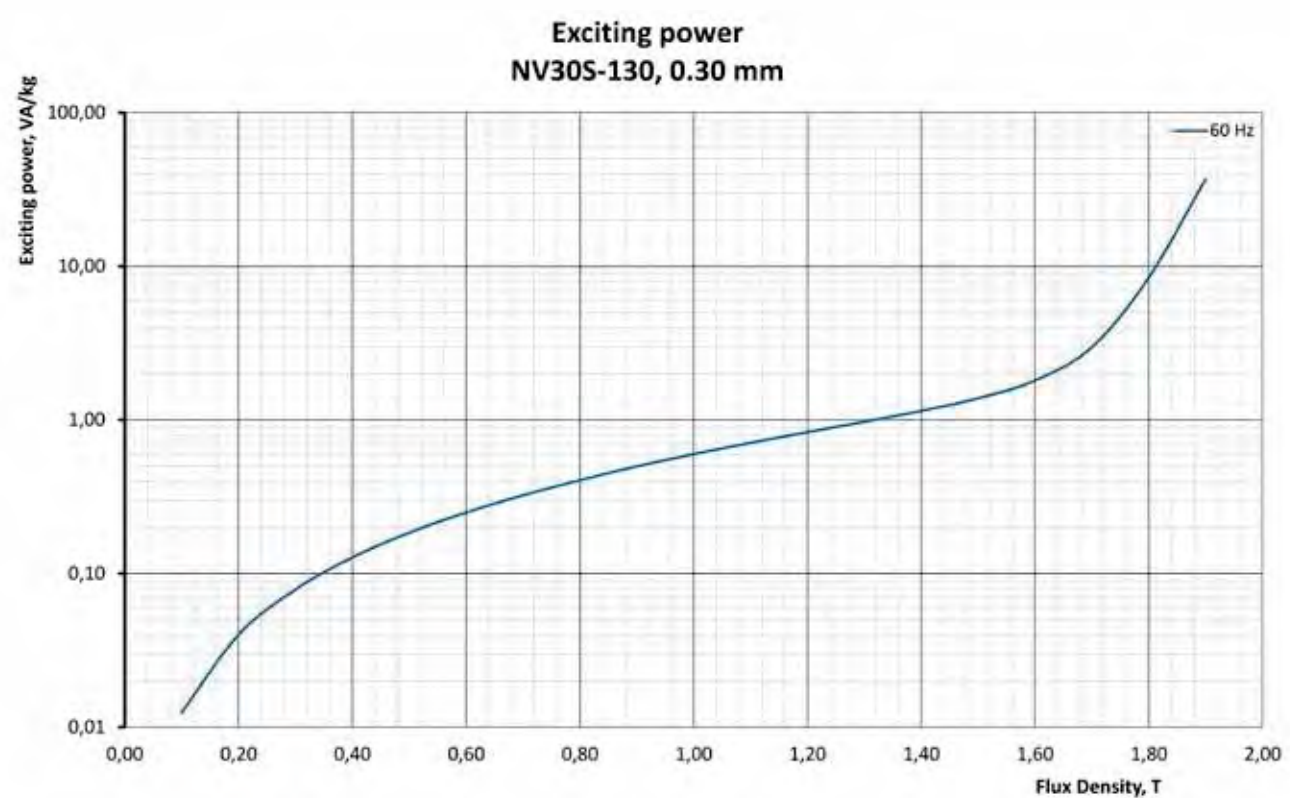
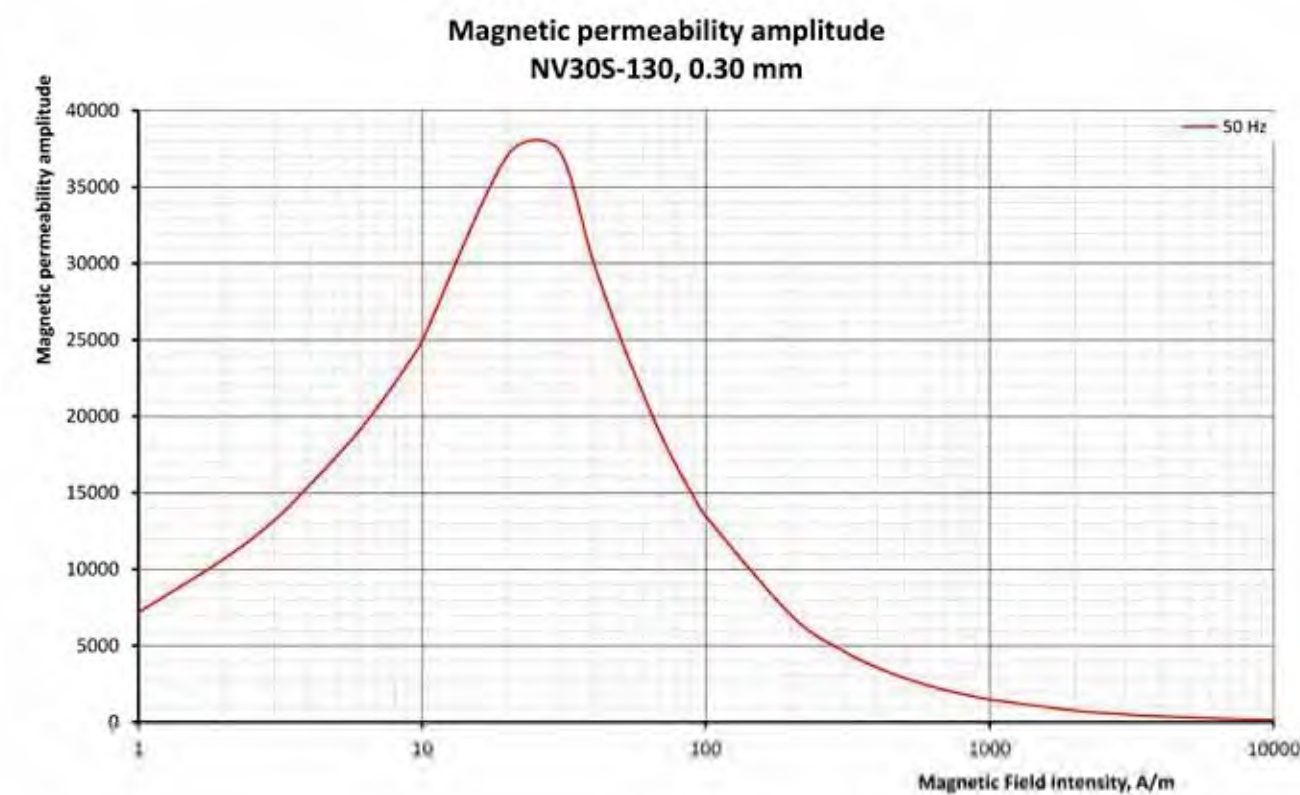
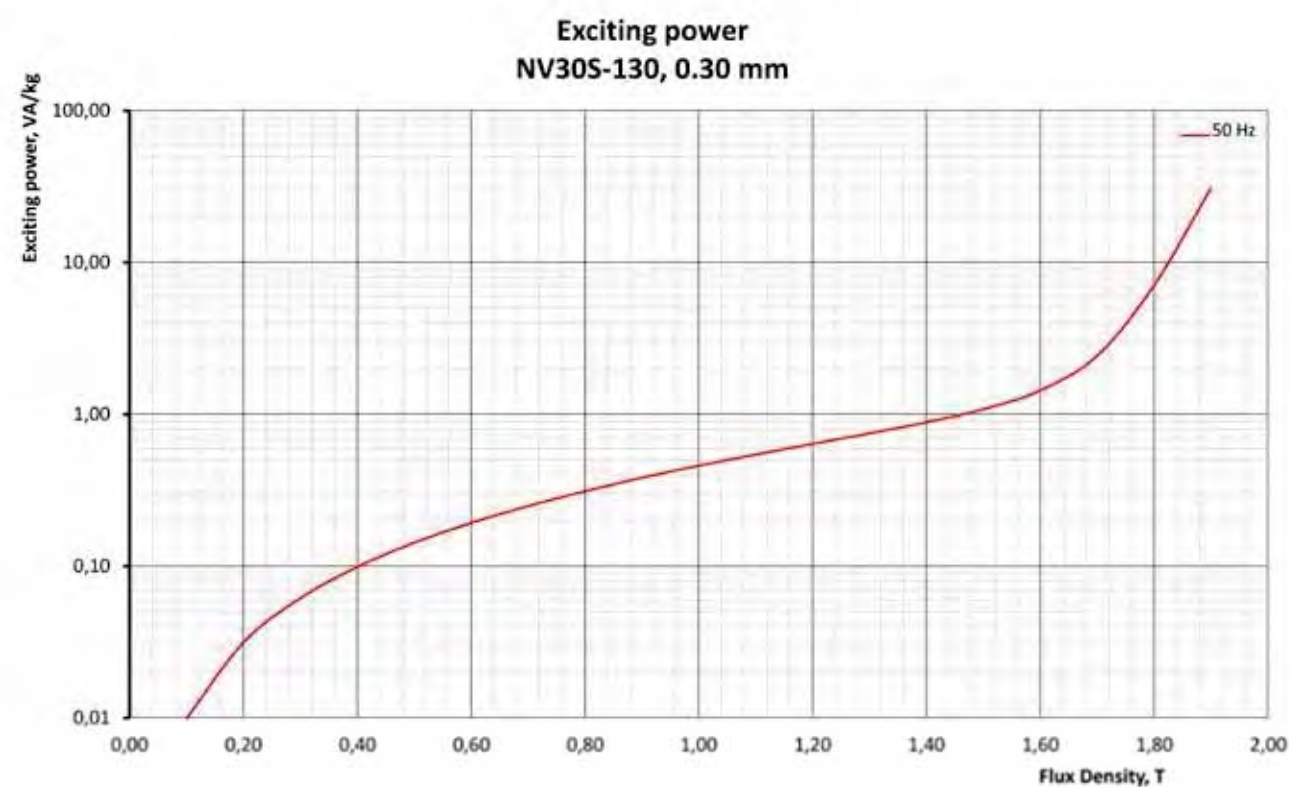


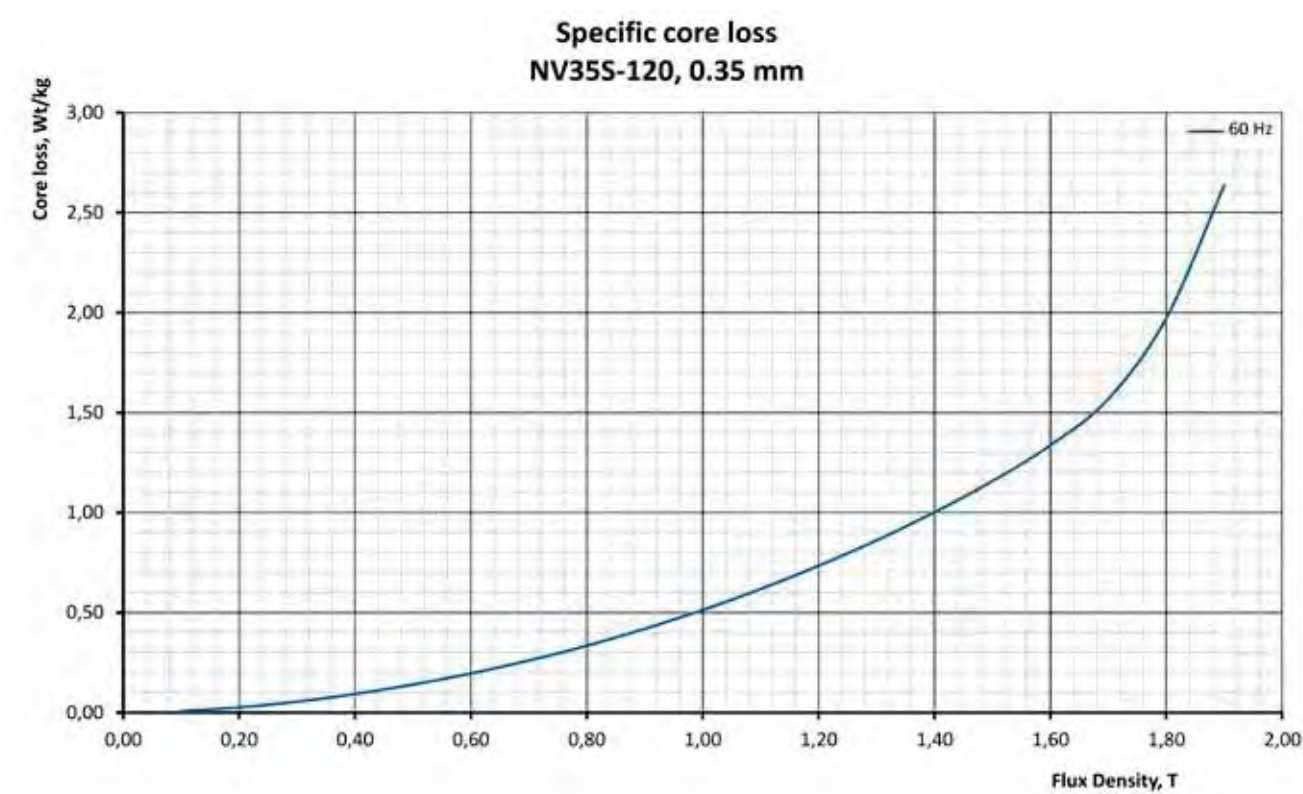
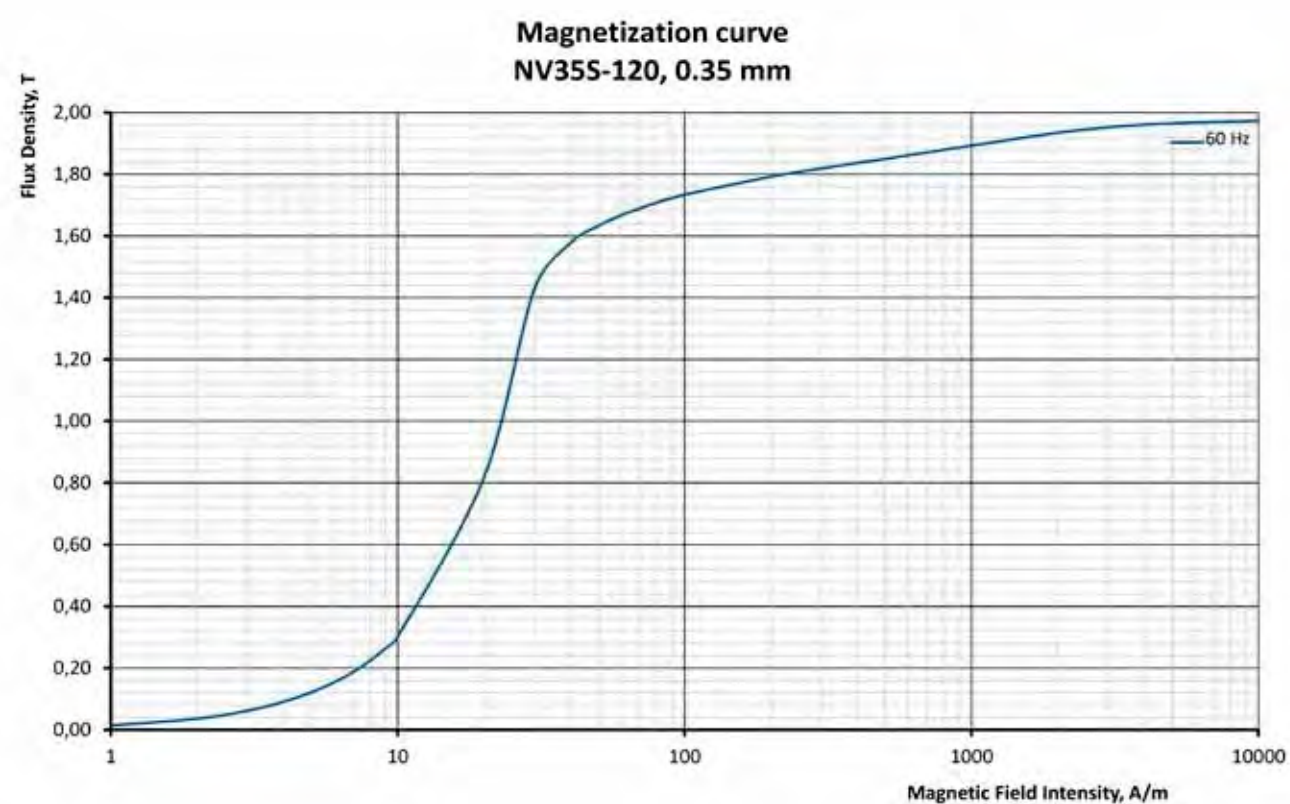
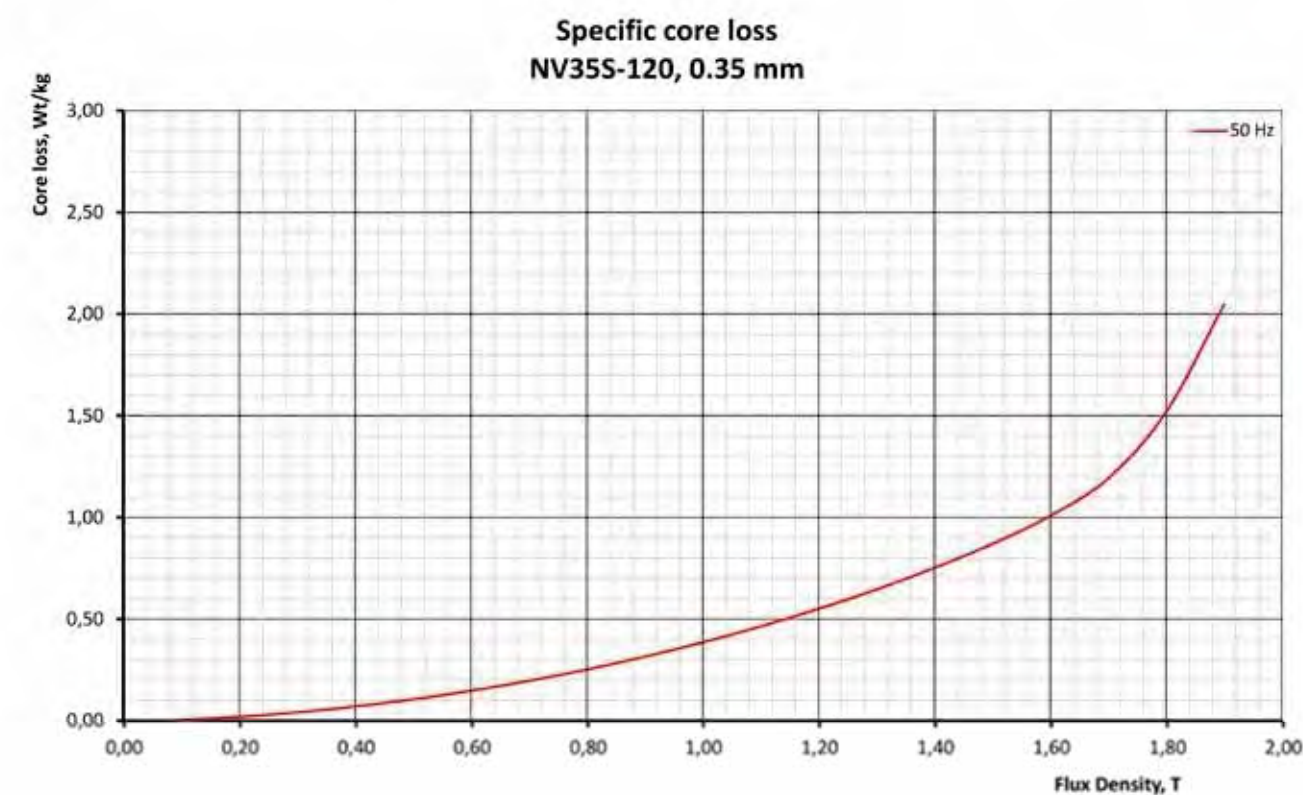
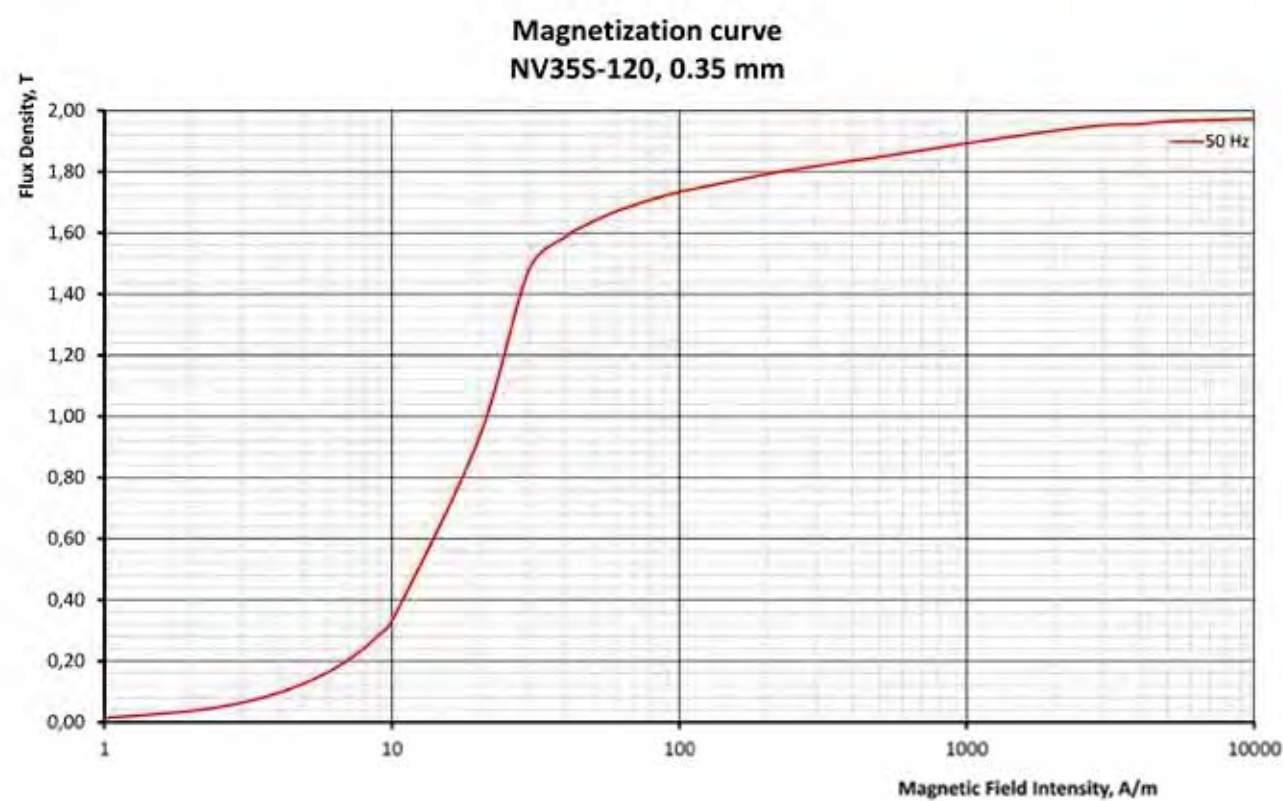
Specific core loss
NV30S-130, 0.30 mm

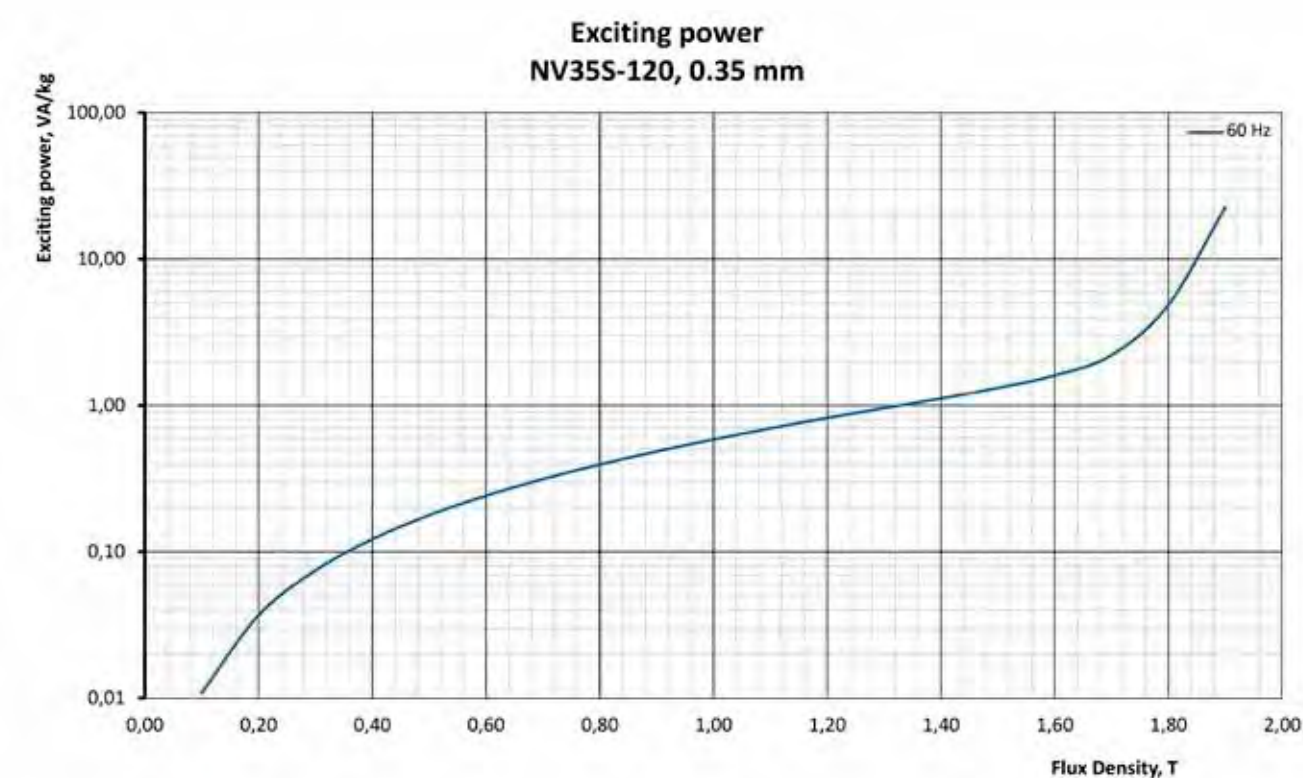
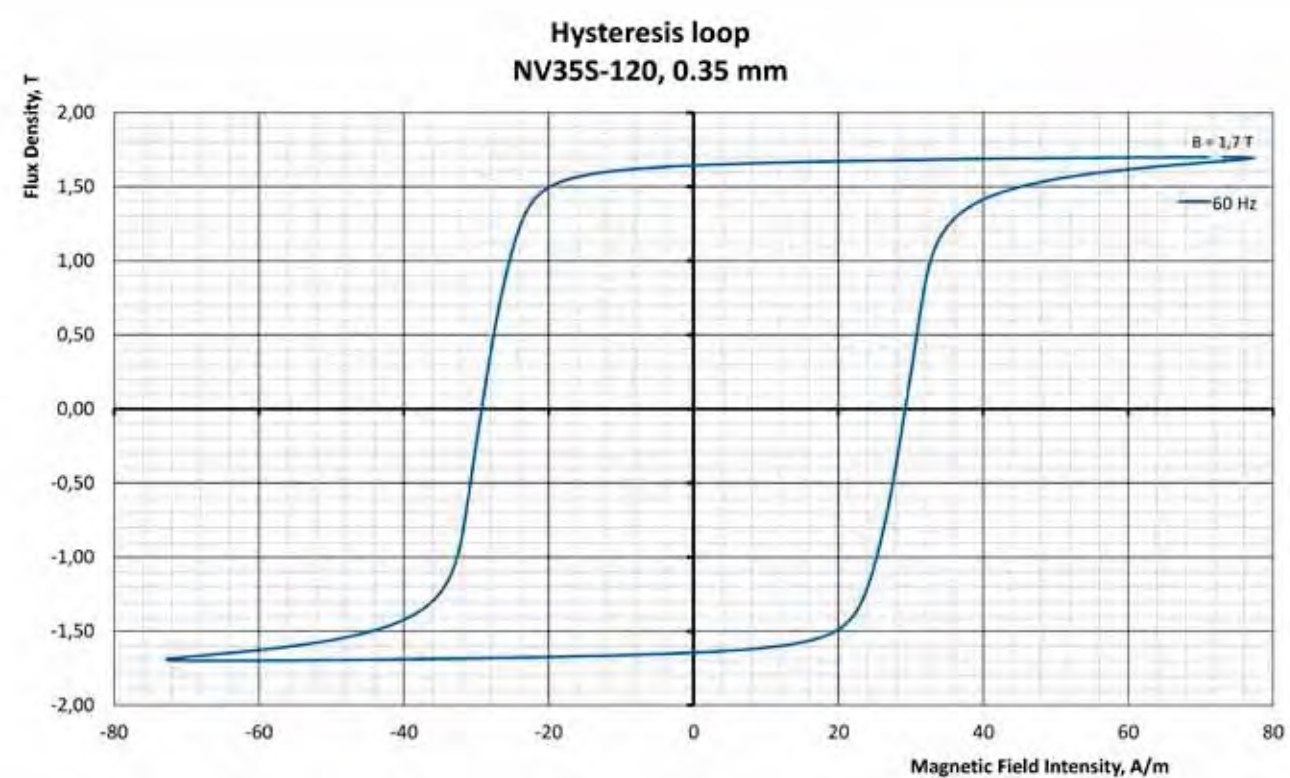
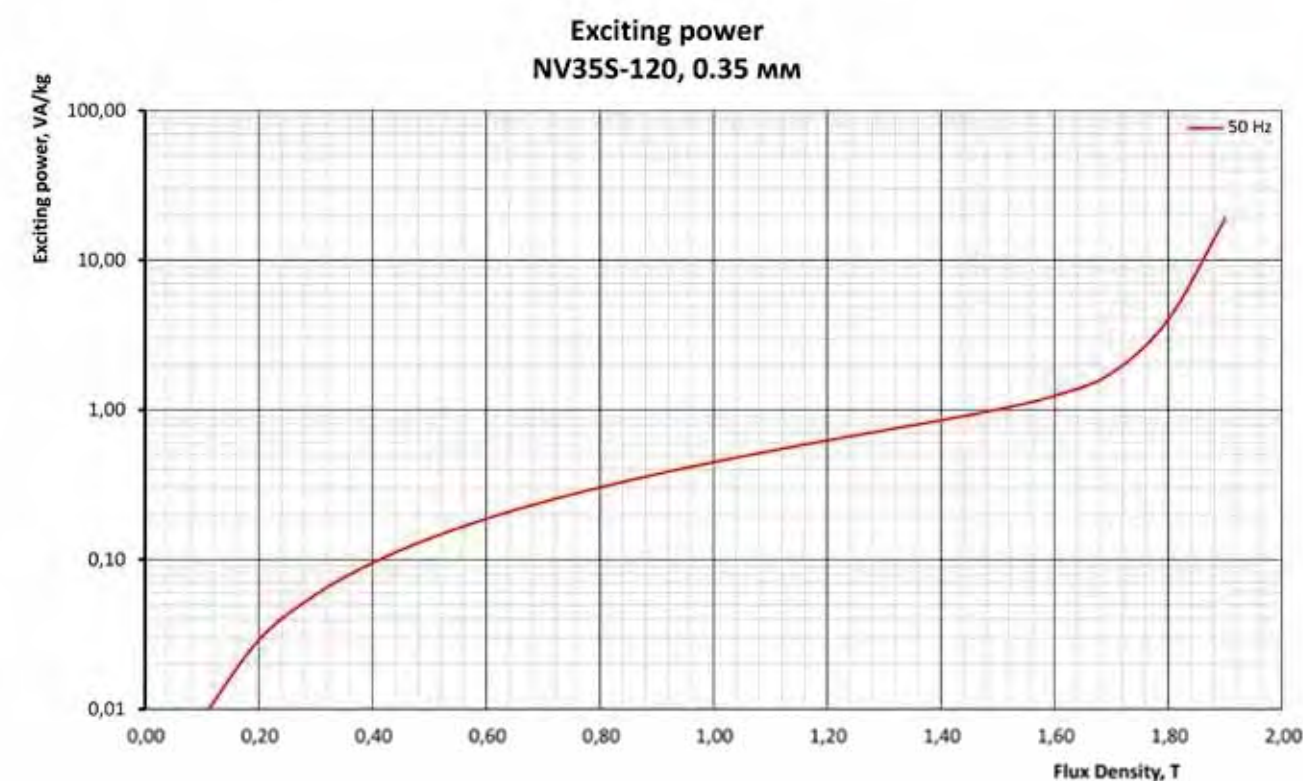
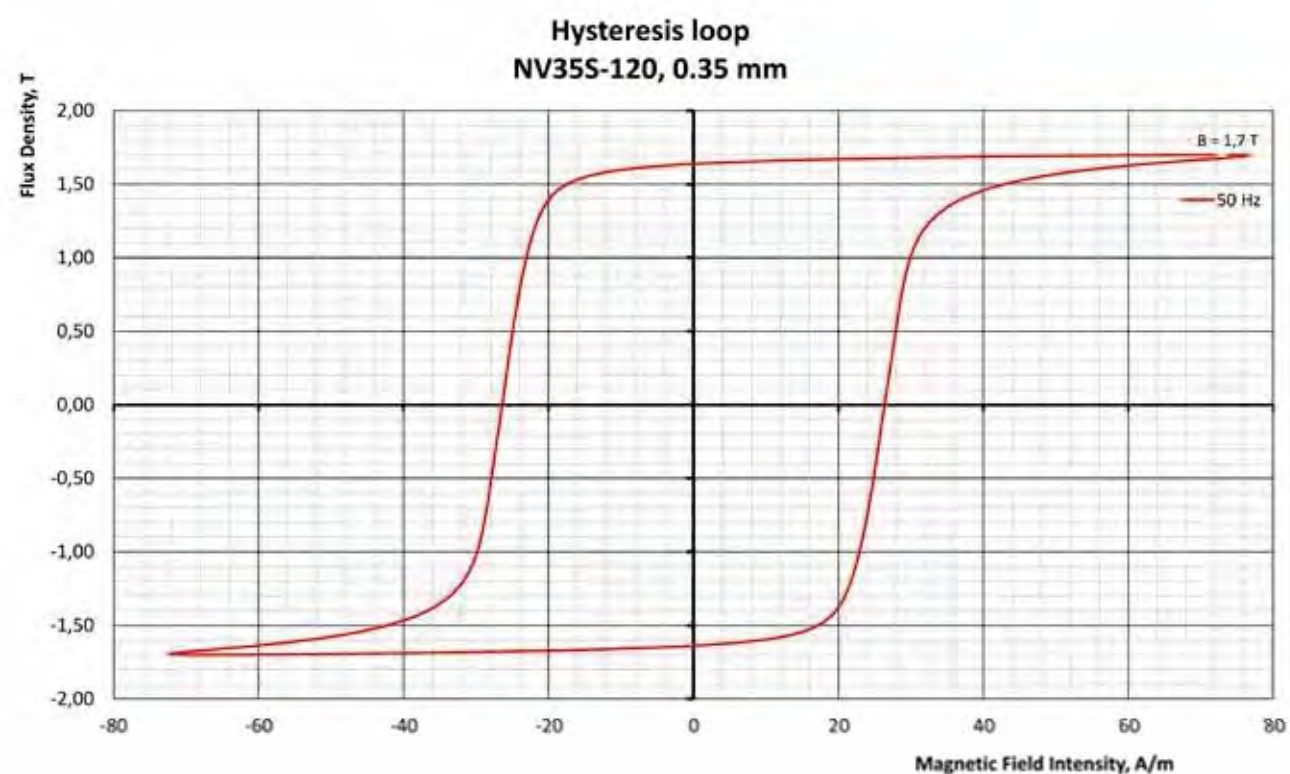


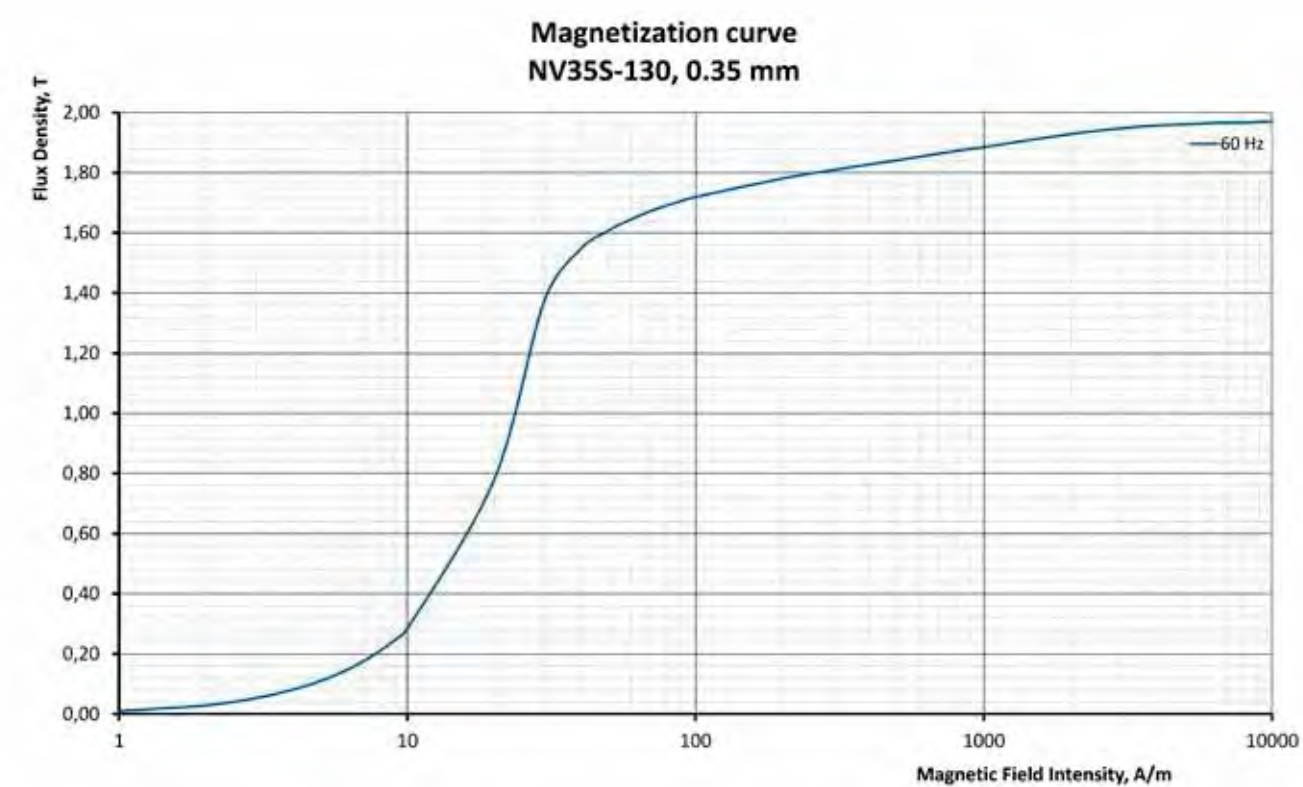
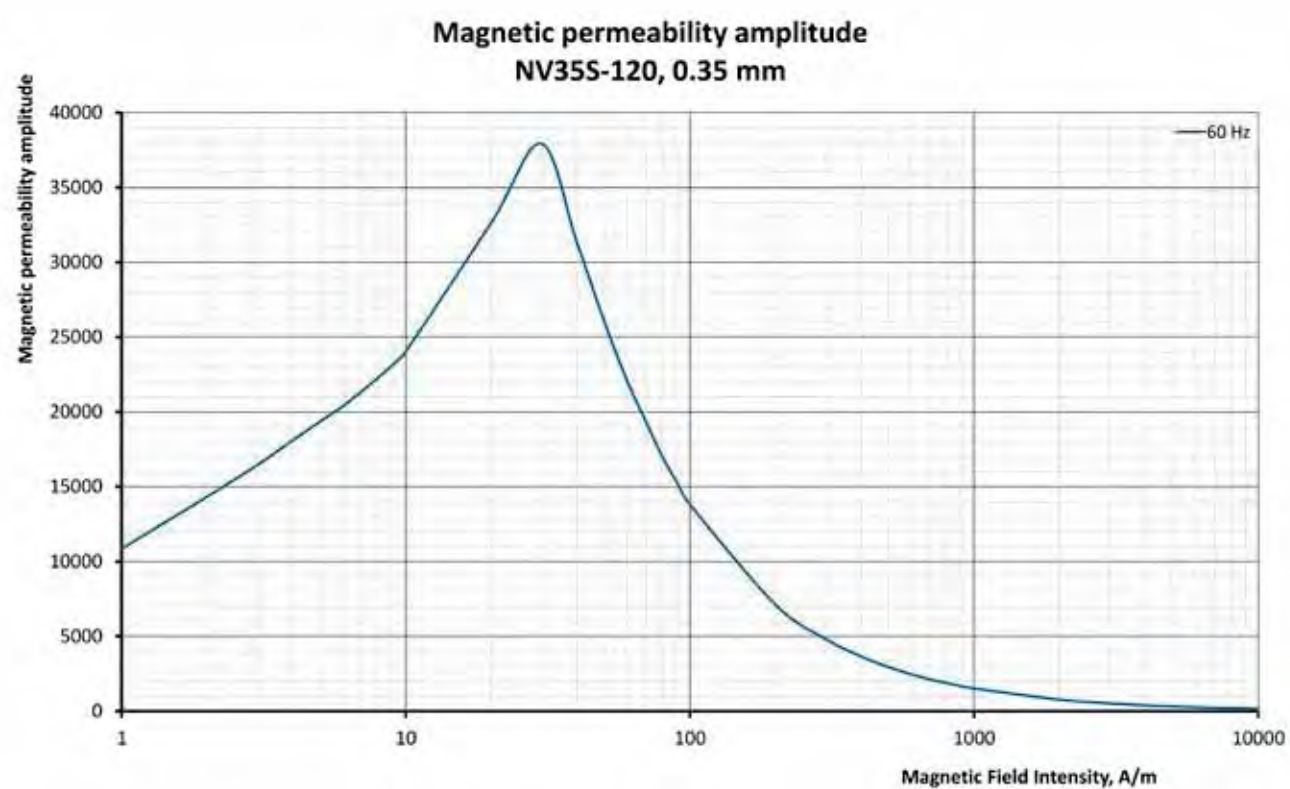
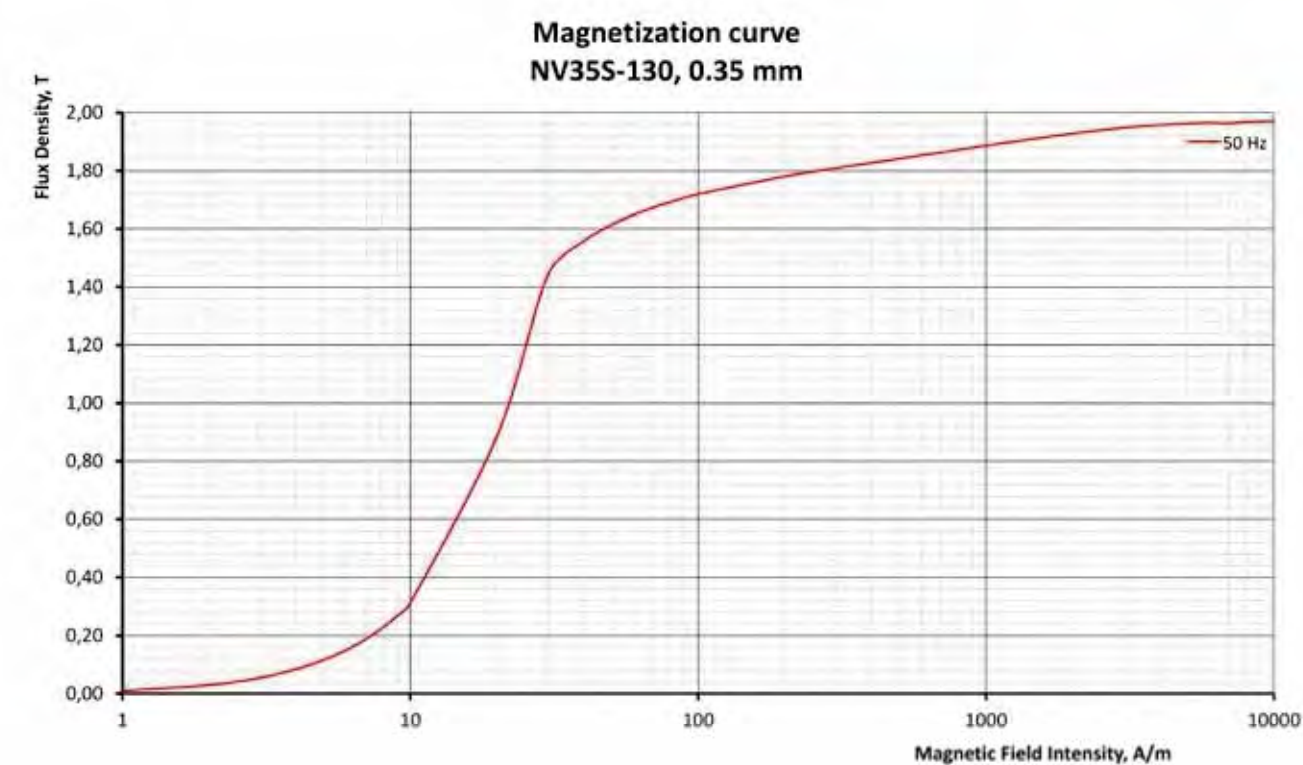
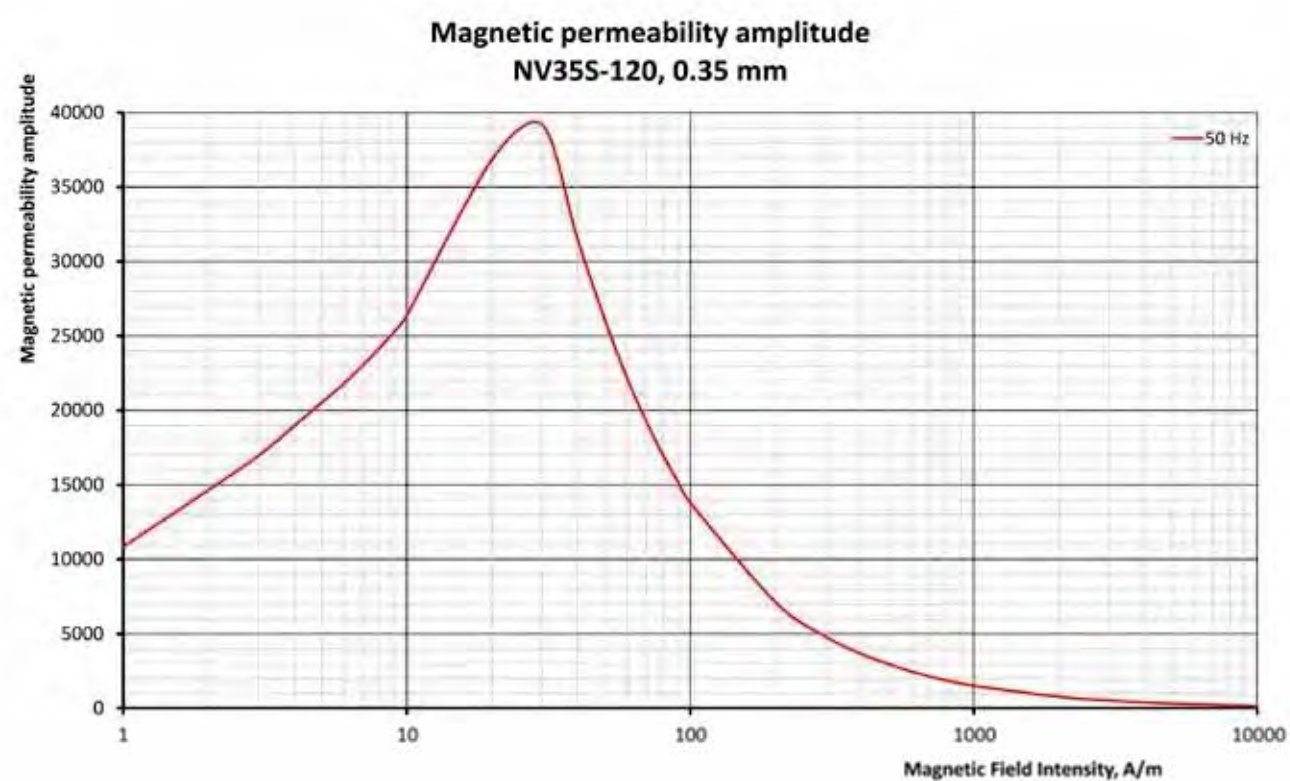
Hysteresis loop
NV30S-130, 0.30 mm



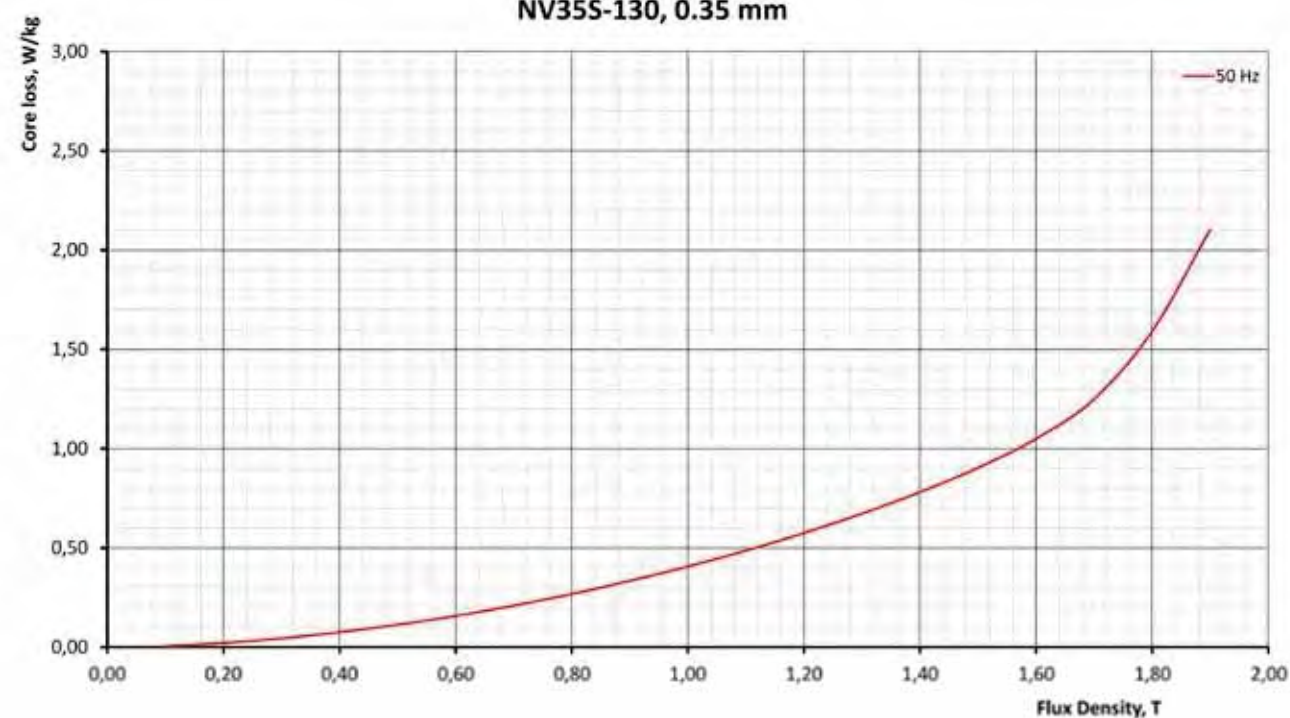




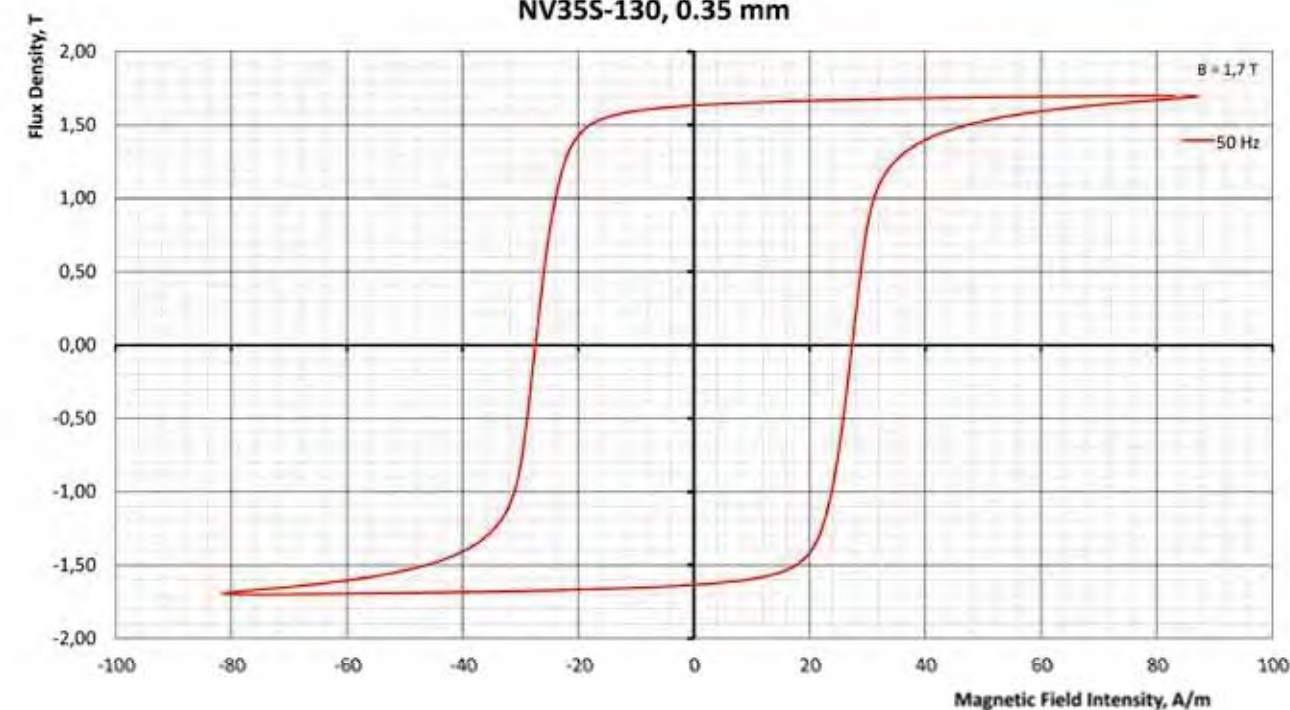




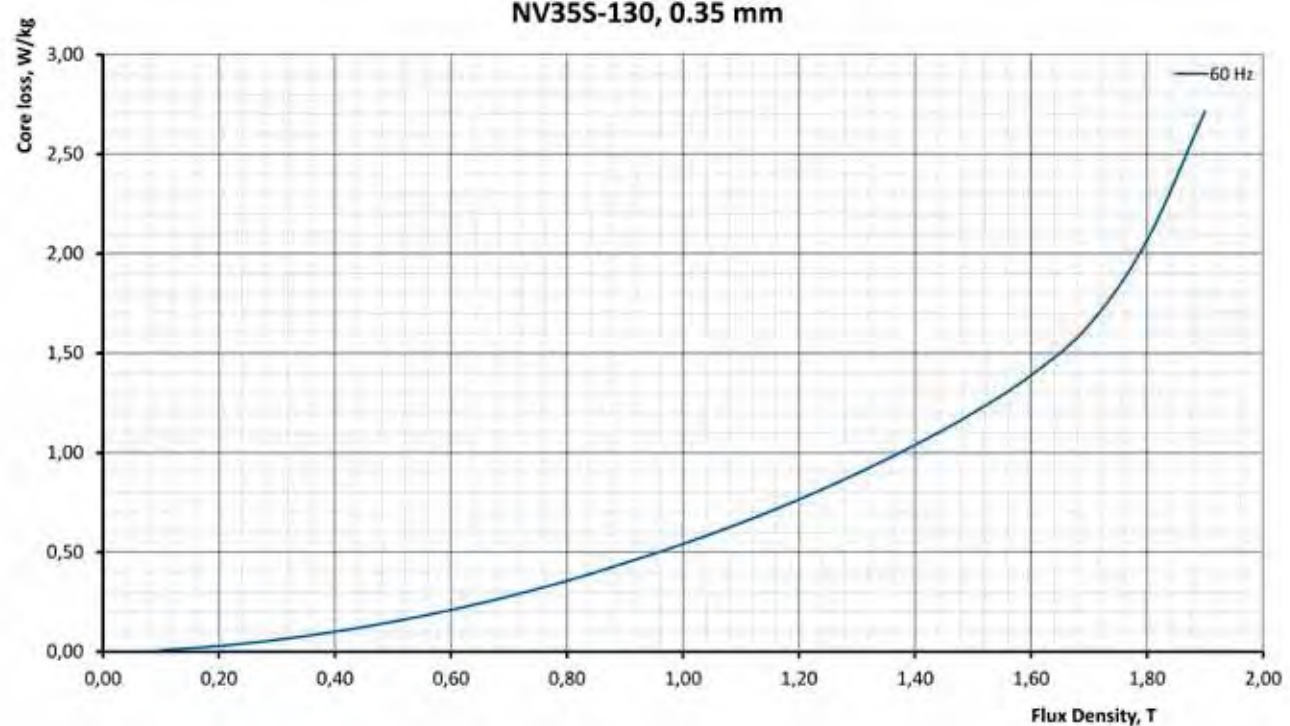
Specific core loss
NV35S-130, 0.35 mm



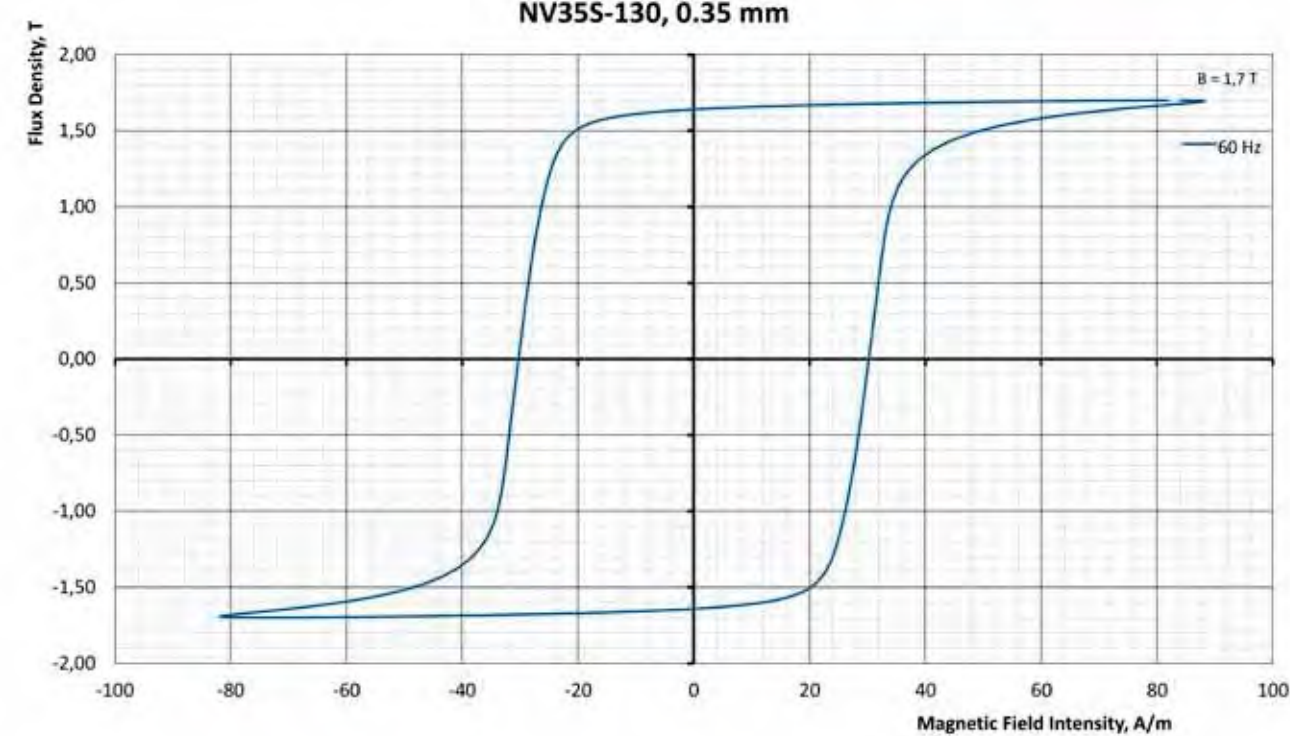
Hysteresis loop
NV35S-130, 0.35 mm

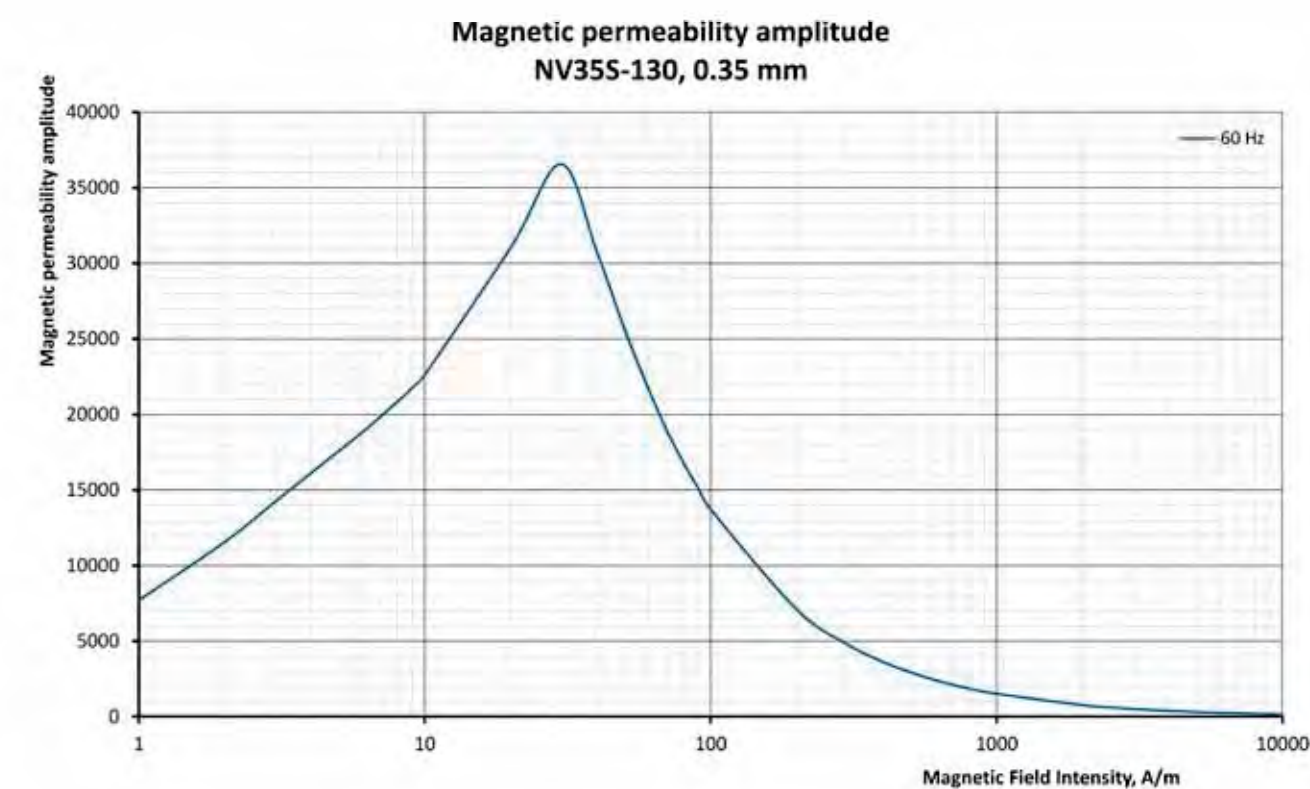
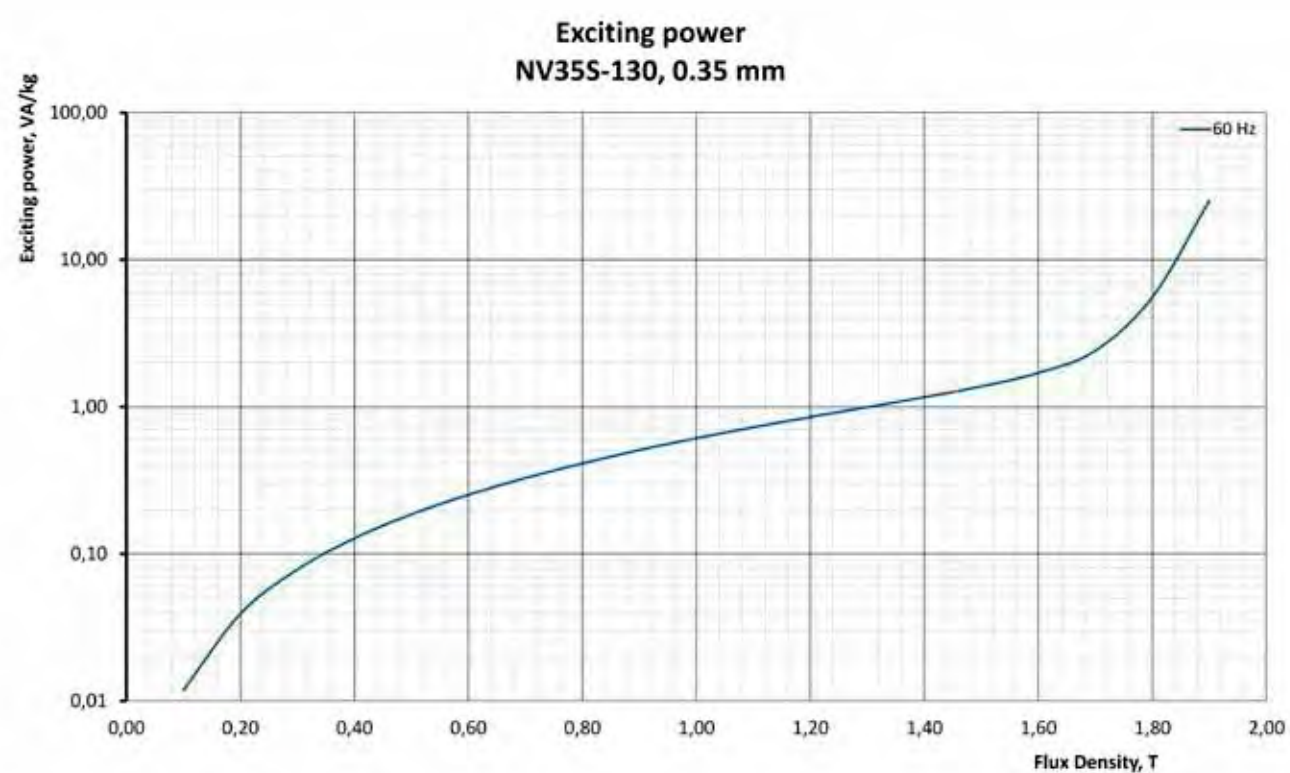
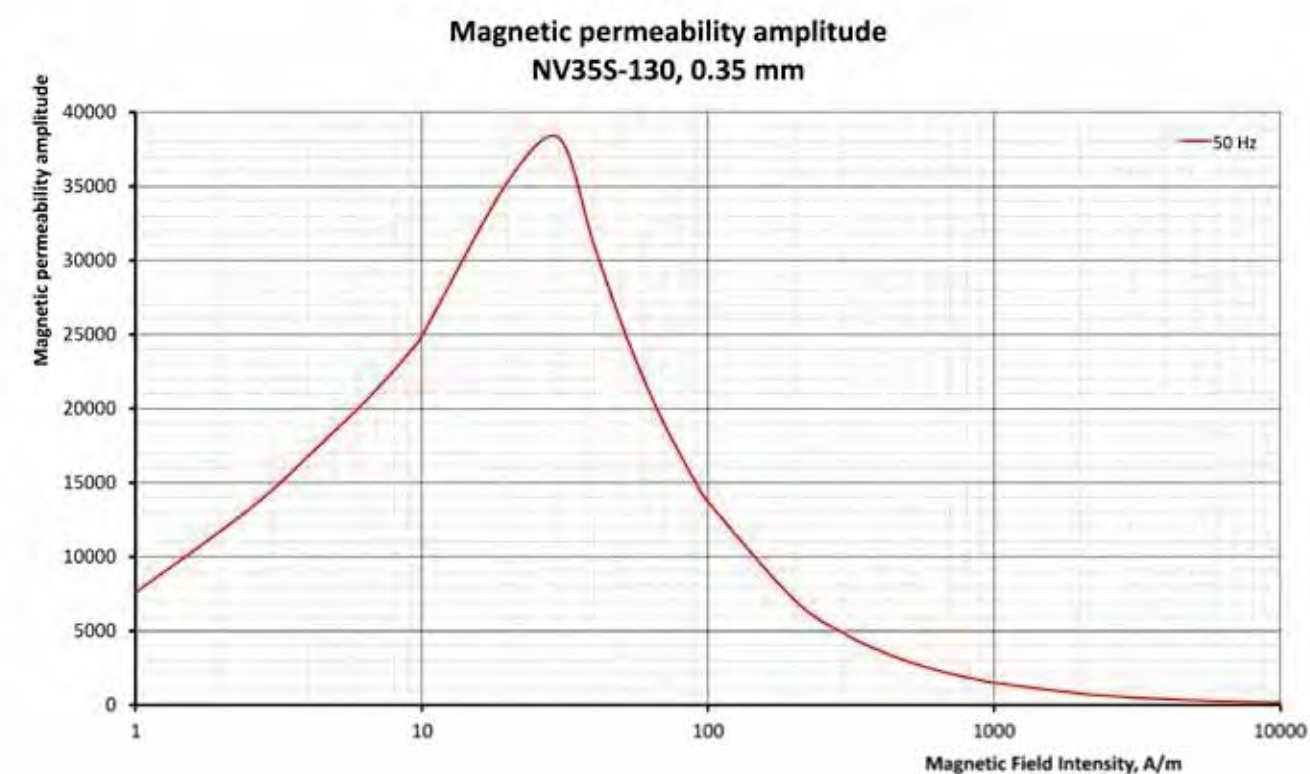
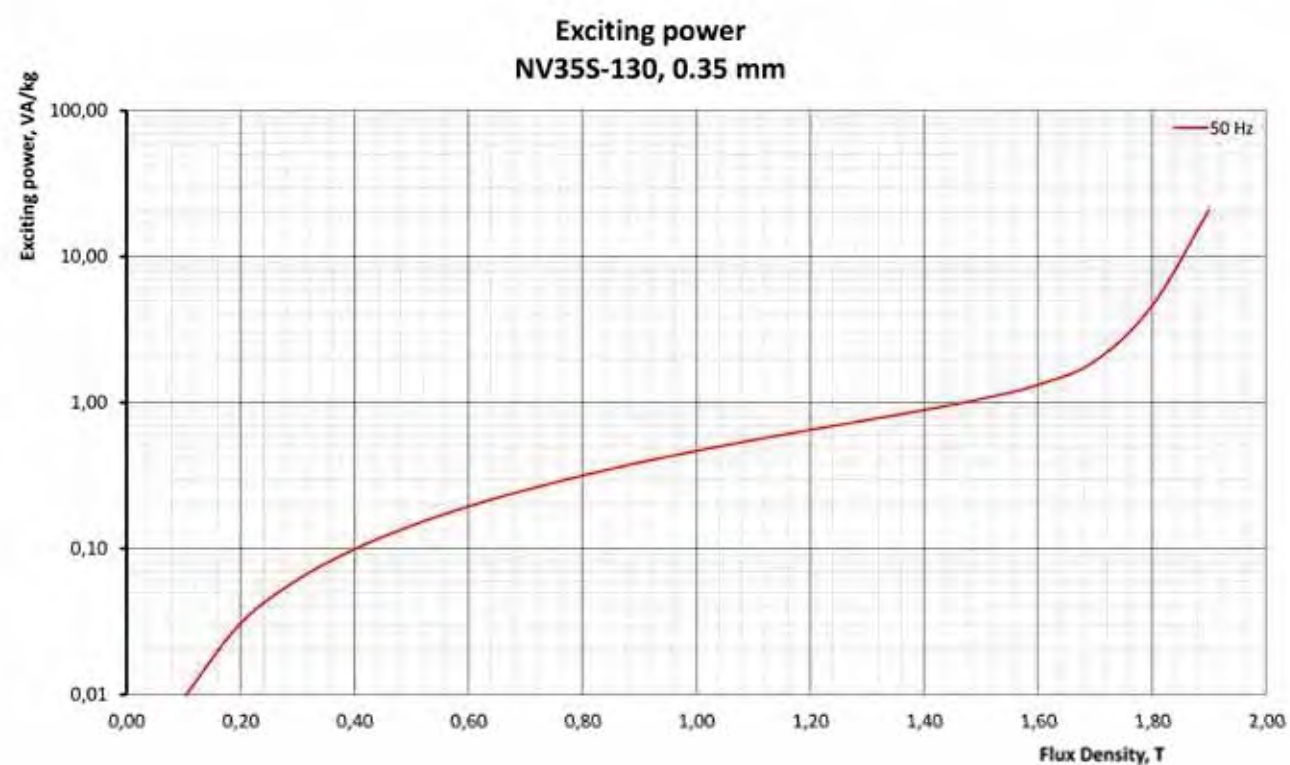


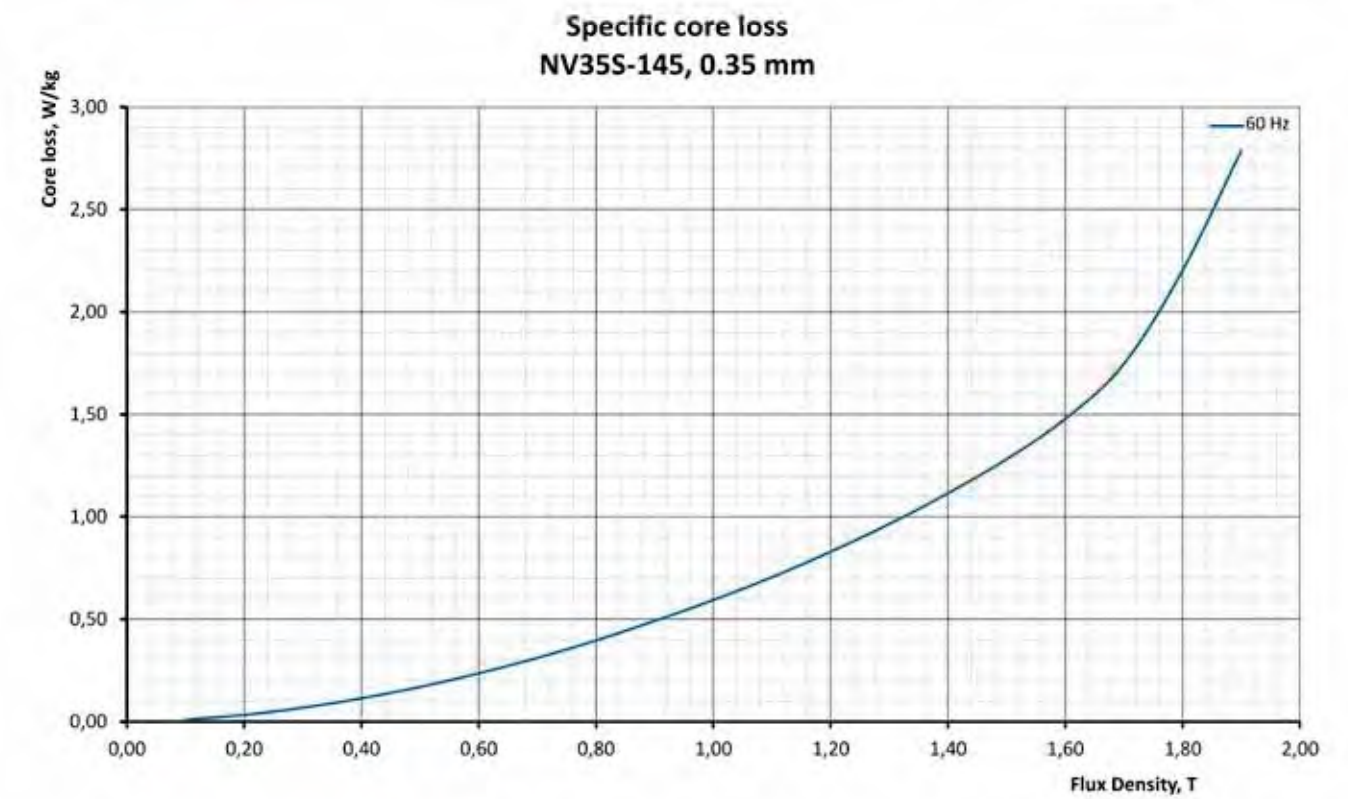
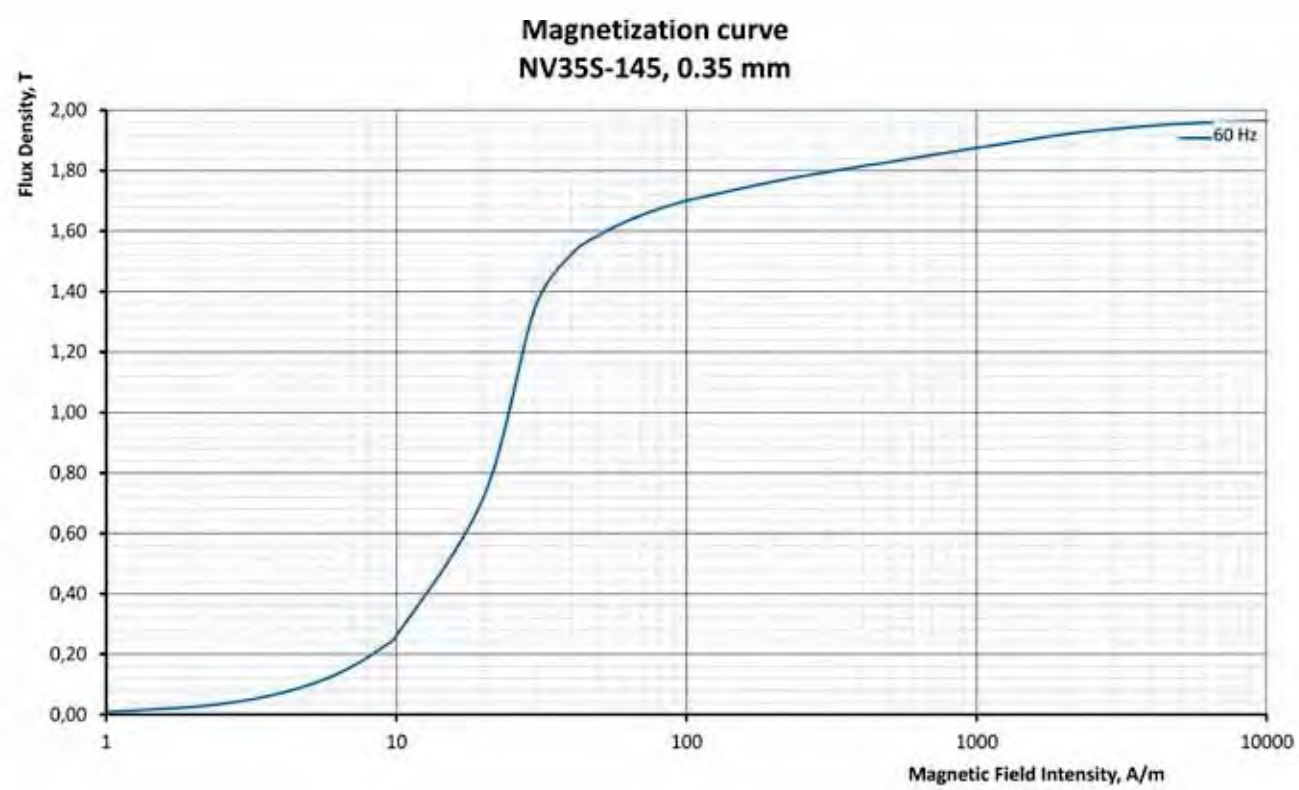
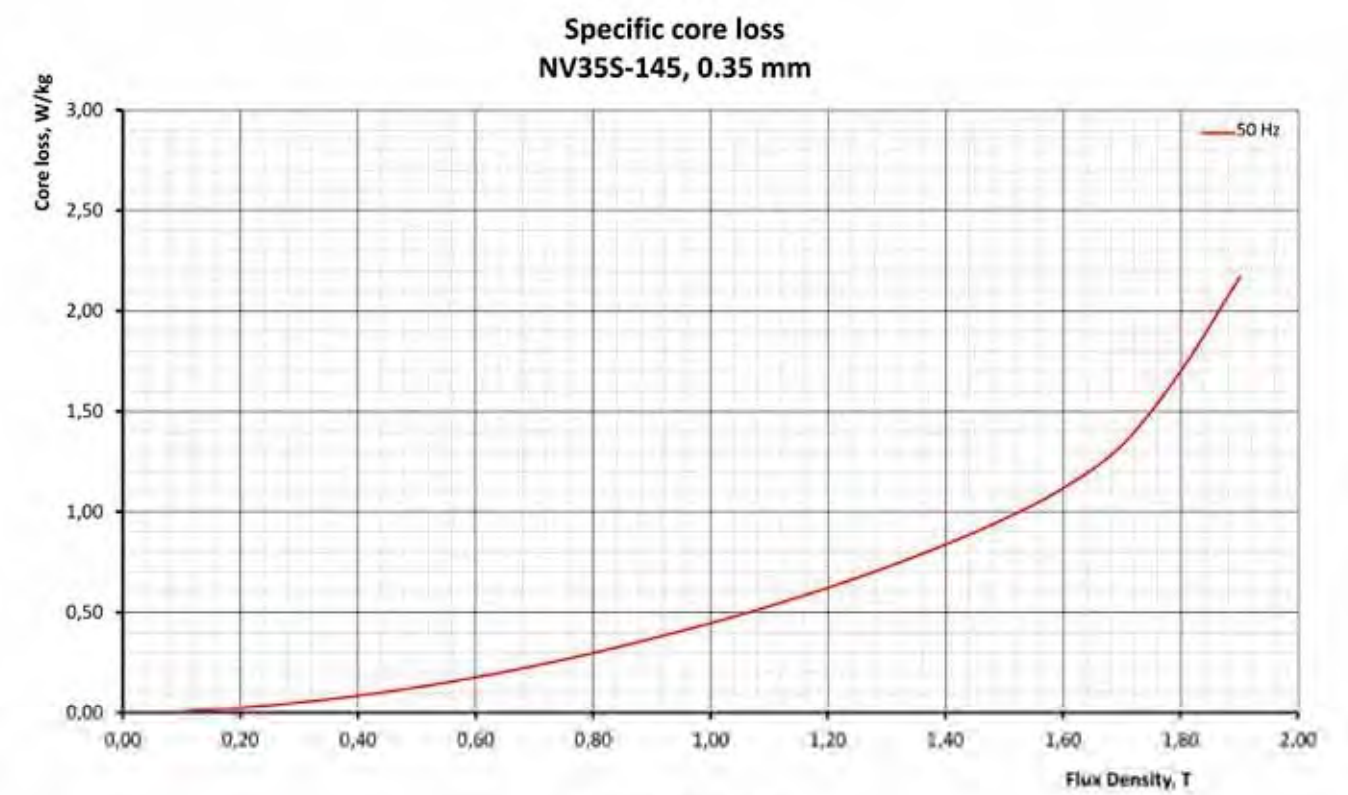
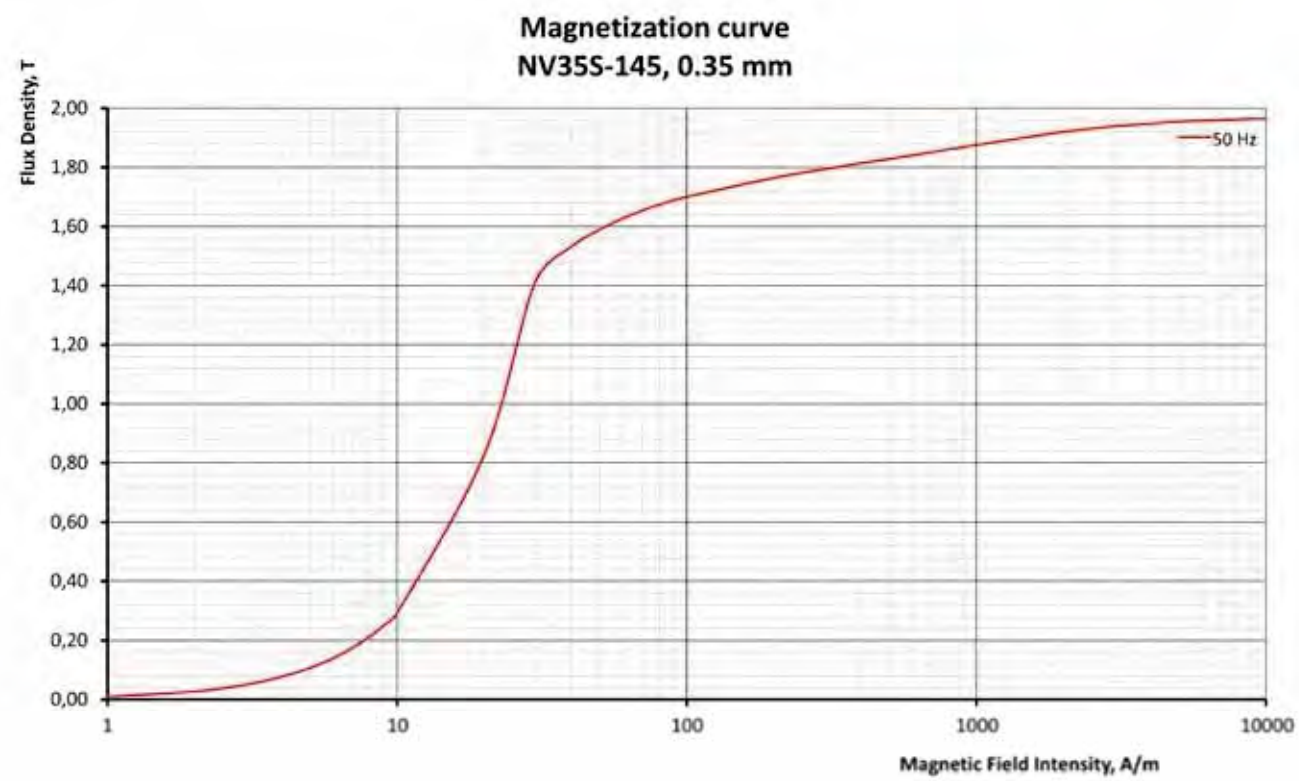
Specific core loss
NV35S-130, 0.35 mm

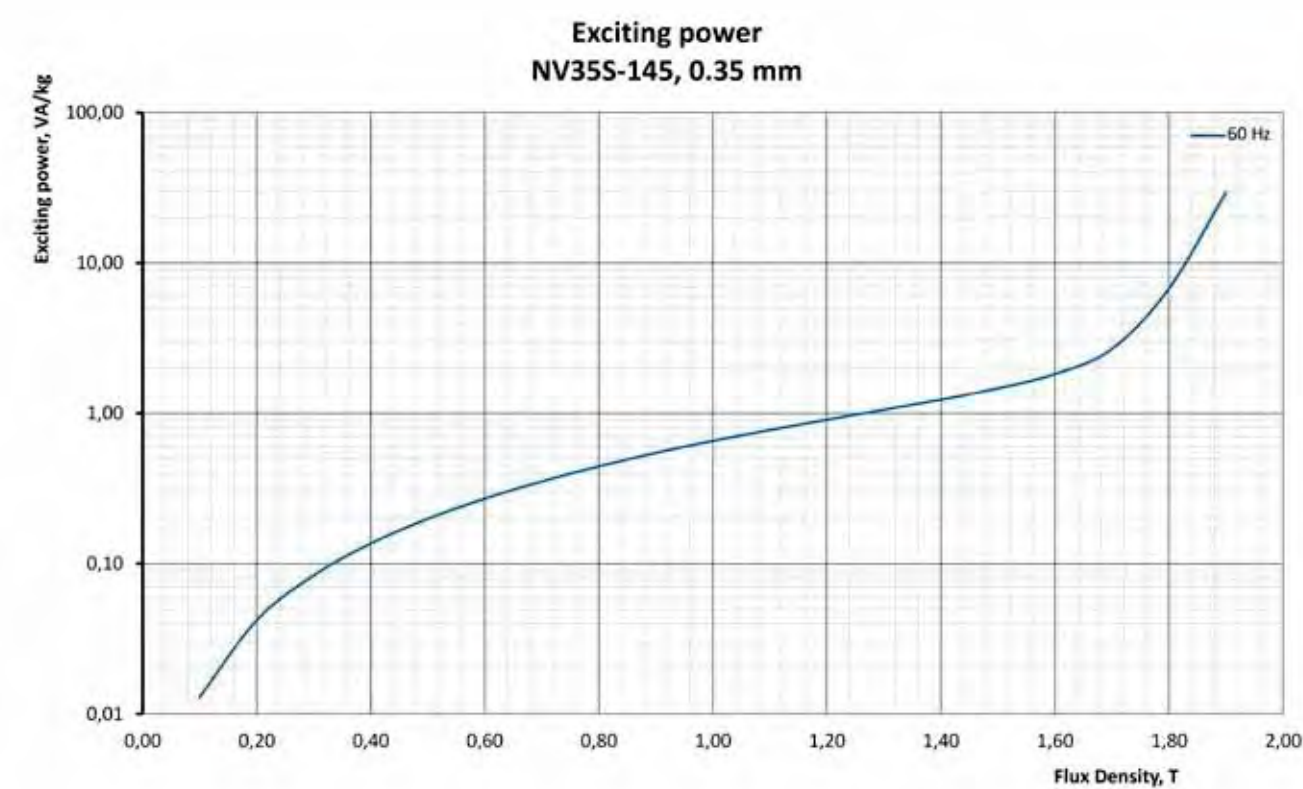
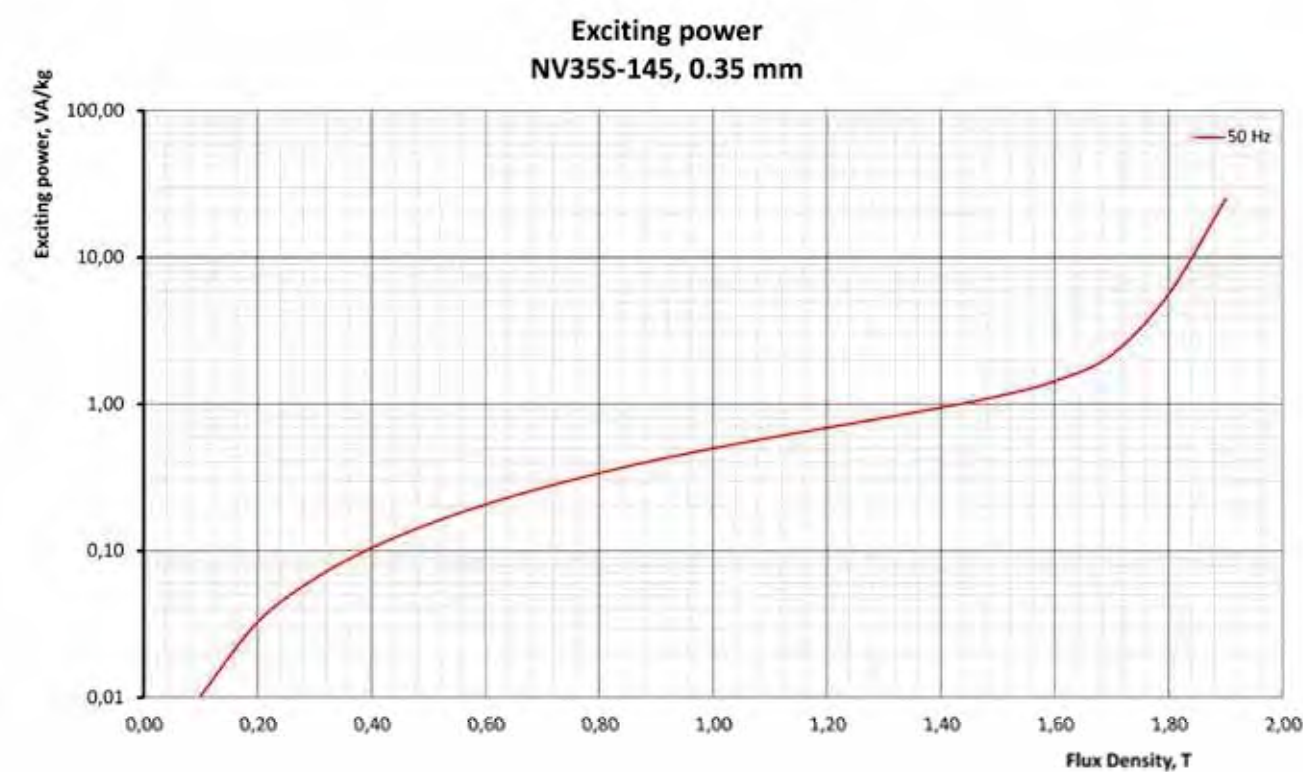
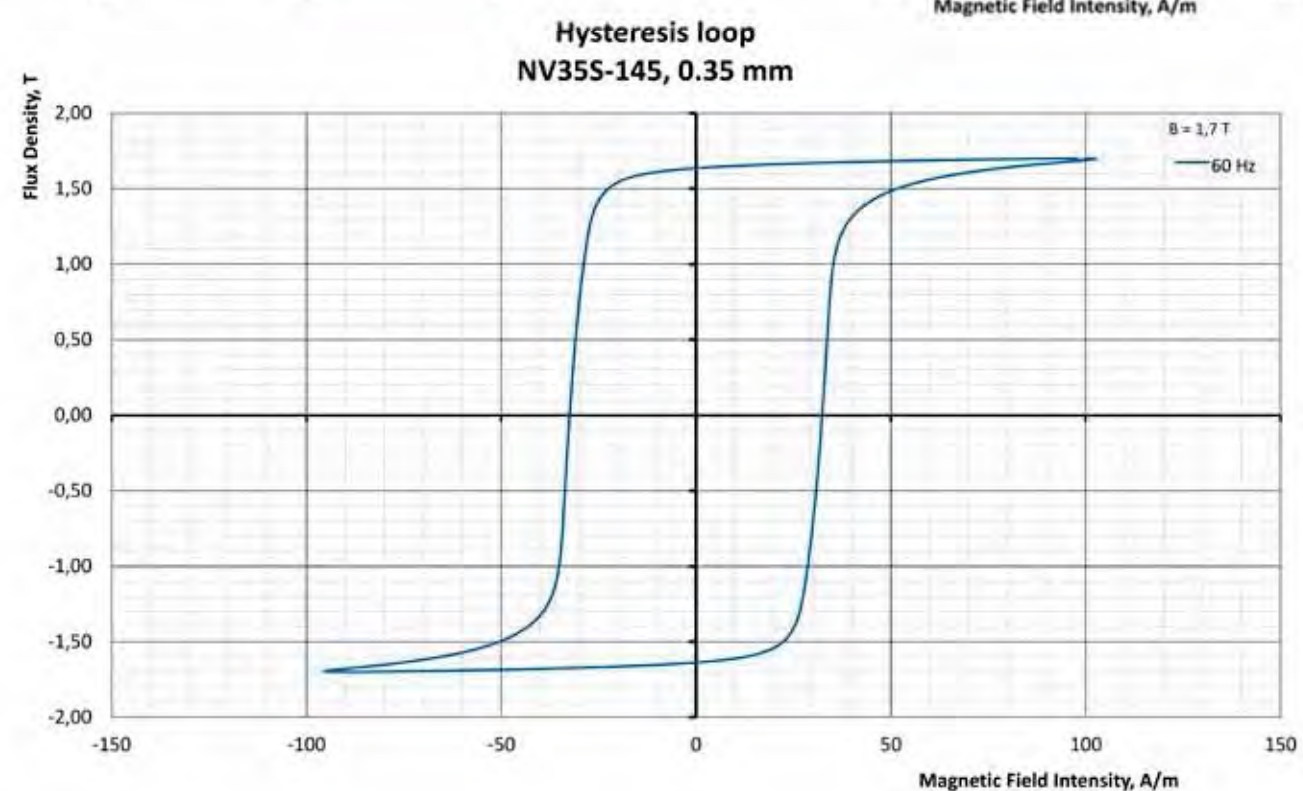
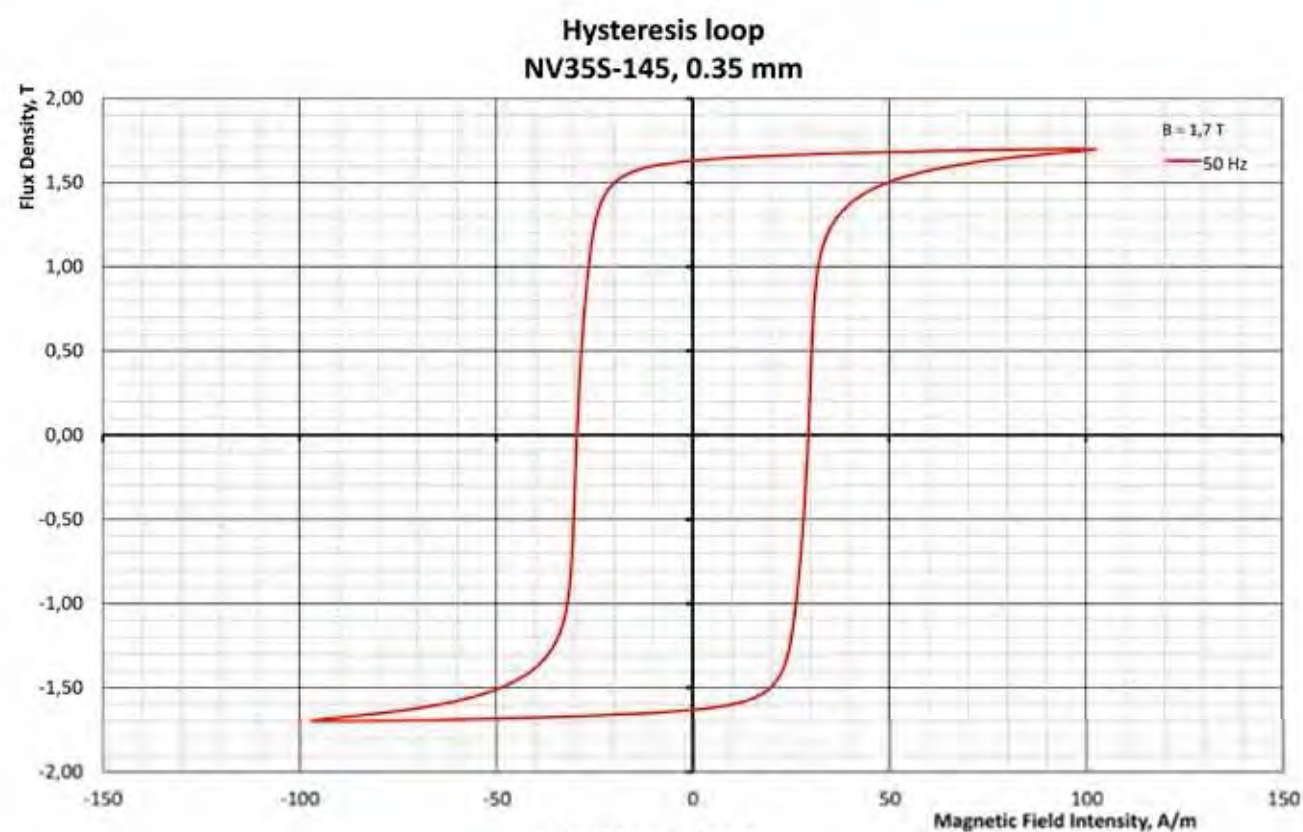


Hysteresis loop
NV35S-130, 0.35 mm

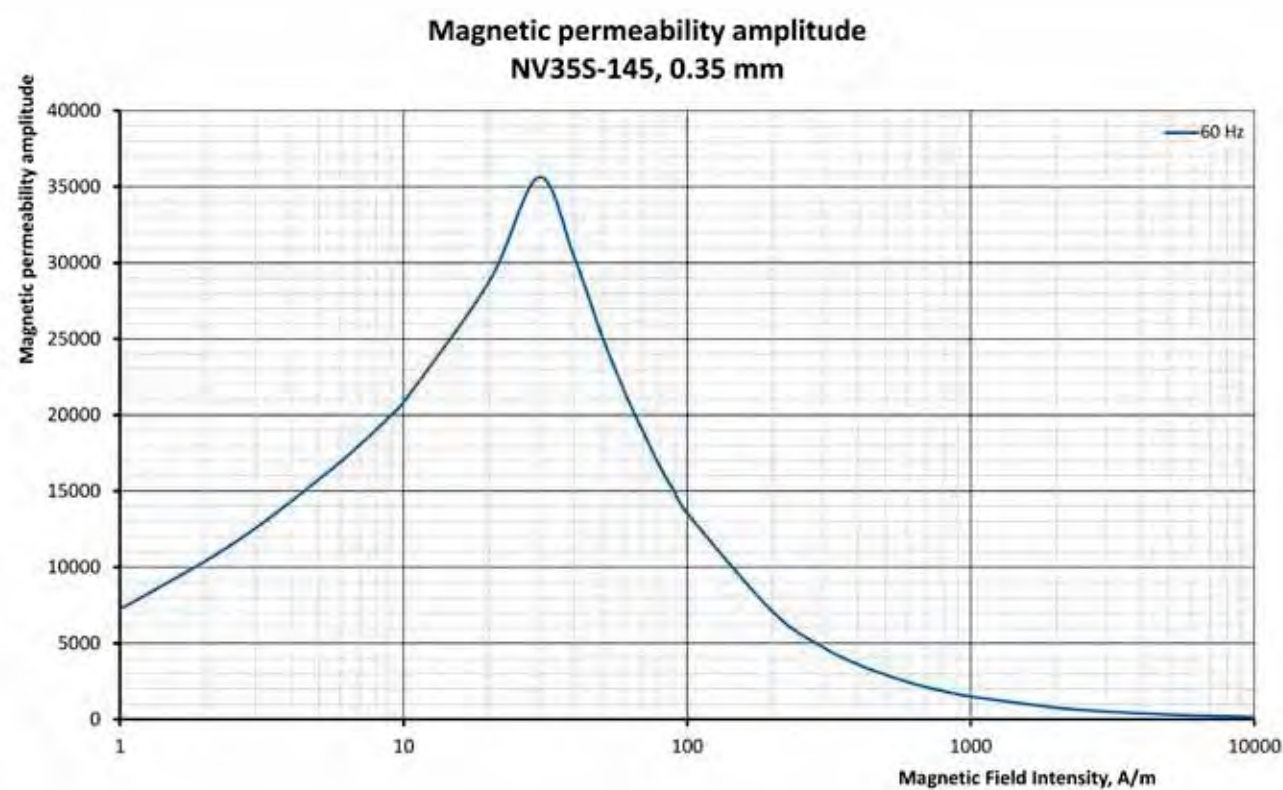
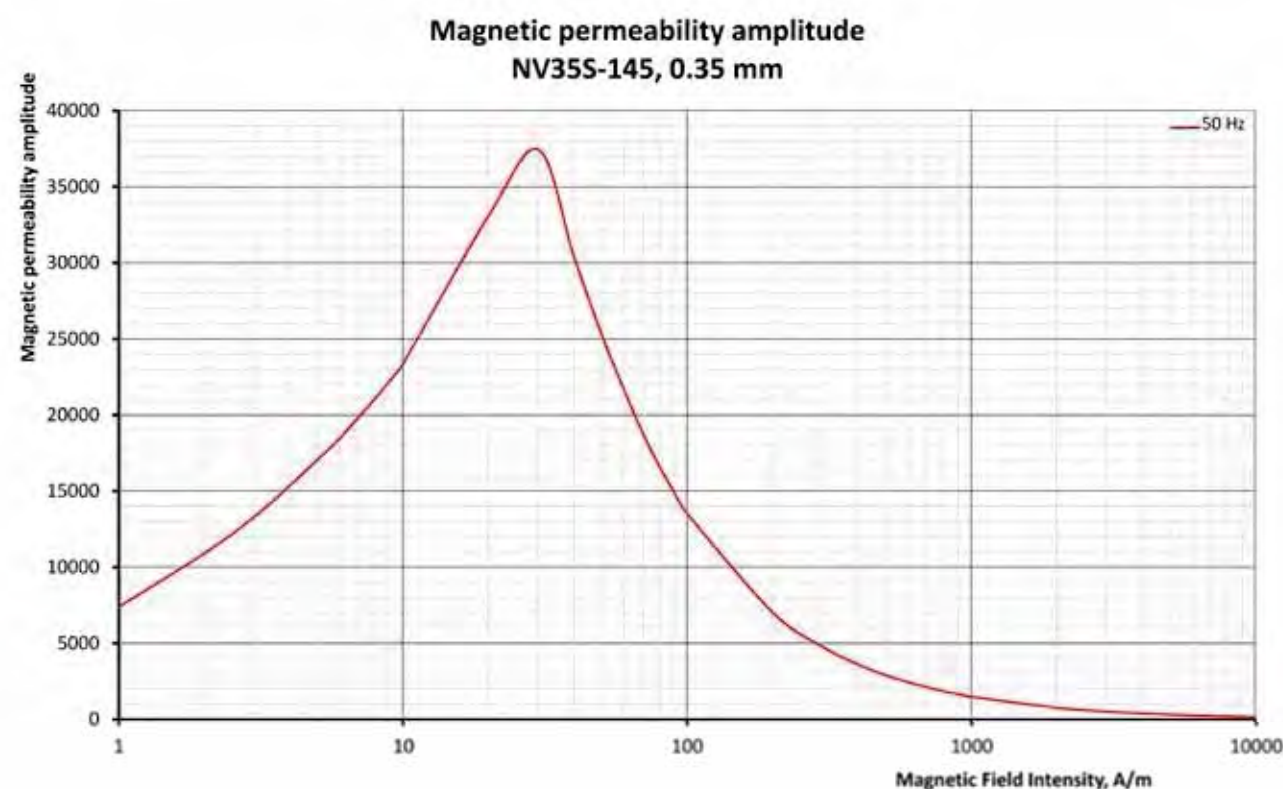








PHYSICAL AND MECHANICAL PROPERTIES



Parameter		Value	Thickness, mm			
			0,23	0,27	0,30	0,35
σ_r , N/mm ²	Along	Average	335	339	332	335
		Min-max	320-360	315-350	315-360	310-360
	Across	Average	357	358	352	354
		Min-max	345-370	349-369	344-361	347-365
σ_b , N/mm ²	Along	Average	362	359	354	356
		Min-max	340-375	341-372	336-376	338-375
	Across	Average	405	409	400	408
		Min-max	395-415	399-421	386-426	390-425
δ_4 , %	Along	Average	8	9	10	11
		Min-max	6-12	7-13	7-16	
	Across	Average	27	28	28	29
		Min-max	34-30	24-31	24-37	25-37
HV ₅		Average	175	174	178	177
		Min-max	165-190	164-182	165-195	168-200
Stacking factor, %		Min	0,945	0,950	0,955	0,960
Specific electrical resistivity, Ohm·mm ² /m		Average	0,475			
		Min-max	0,45-0,50			

ELECTRIC INSULATION COATING

GO electrical steel is supplied in coils, narrow strips or sheets with electric insulation coating of two types:

- CC (Coating Conventional) – a primer based on magnesium and silicon oxides coated with phosphate layer (equivalent of C2+C5 coating under ASTM A976M);
- CM (Coating Magnetoactive) – a primer based on magnesium and silicon oxides coated with phosphate and silicon oxide layer (equivalent of S2 coating, as well as C2+C5 under ASTM A976M).

TECHNICAL SPECIFICATION OF ELECTRIC INSULATION COATINGS ON GO ELECTRICAL STEEL UNDER STO 05757665-008

Type of coating as per STO 05757665-008	Base	Color	Coating thickness, μm	Resistance coefficient, $\text{Ohm} \times \text{cm}^2$	Heat resistance
CC	Phosphates	Grey	$\leq 5,0$	≥ 20	$(840 \pm 10) ^\circ\text{C}$, 3 h. in neutral atmosphere
CM	Silicates Phosphates. chromates	Grey or grey-brown	$\leq 5,0$	≥ 20	$(840 \pm 10) ^\circ\text{C}$, 3 h. in neutral atmosphere



CONVERSION TABLE

Value name	Unit of measurement	Conversion factor	Conversion unit
Magnetic induction, B	T	10^4	G
	G	10^{-4}	T
	line/sq.in.	$1,55 \times 10^{-5}$	T
	T	$6,45 \times 10^4$	line/sq.in.
Magnetic field intensity	Oersted	79,58	A/m
	A/m	0,01257	Oersted
Specific core loss, P	W/kg	0,4536	W/lb
	W/lb	2,205	W/kg
Tensile strength	MPa. (N/mm^2)	145	lb/sq.in.
	lb/sq.in.	$6,9 \times 10^{-3}$	MPa. (N/mm^2)
Temperature, T	$^\circ\text{C}$	$\times 1,8 + 32$	$^\circ\text{F}$
	$^\circ\text{F}$	$\times 0,556 + 17,8$	$^\circ\text{C}$
Weight	lb	0,4536	kg
	kg	2,205	lb
Thickness, width, length	m	39,4	in.
	in.	0,0254	m
	m	3,281	ft
	ft	0,3048	m

LABORATORY AND TEST EQUIPMENT

Laboratory and measurement centres of NLMK Group's companies are equipped with modern equipment of leading foreign companies that allow to carry out all necessary tests and measurements and to assure compliance of the products with the international standard requirements.



Magnetometering units
Brockhaus Messtechnik



Franklin tester
Brockhaus Messtechnik



Optical
microscopes



Magnetometering units
Brockhaus Messtechnik



Thickness gages
Fischerscop

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FOR NOTES

