INTRODUCTION

The predominant feature of ferroxcube lies in its high resistivity that allows cores to be made of solid material without the eddy current losses becoming prohibitively high, even if the cores are used in the megacycle range.
Compared with powder-iron, the permeability of ferroxcube is high, whereas the losses remain comparatively low.

Ferroxcube cores are available in convenient shapes such as potcores, square cores , E- and I-cores, X-cores, toroids, U-cores, aerial rods, yoke rings, screw cores, rods and tubes.
Potcores, E-I cores and X cores enable well-defined air gaps to be used without introducing appreciable stray fields. In this way the permeability of the material may be reduced to an effective value at which core and copper losses are matched. The dependence of the permeability on temperature and time is furthermore reduced to values that guarantee correct operation of the equipment.

This section contains comprehensive data on manganese zinc ferrites (ferroxcube 3) and nickel zinc ferrites (ferroxcube 4) and their various grades. The latter material in general shows higher specific resistance values, lower values of permeability and saturation flux density, higher coercivities and higher Curie points.

APPLICATION

grade	application
3B	potcores, cores for small coils
3B3	frames for i.f. transformers, potcores, rods, screw cores
3B5	potcores
3B7	potcores and square cores
3C2	yoke rings, L-cores, erasing heads
3C6	E- and U-cores
3C8	U- and I-cores, E-cores
3D3	potcores, square cores, screw cores
3E1	E- and I-cores, toroids, potcores
3E2	H-cores and toroids
3E3	toroids
3E4	potcores and square cores
3H1	potcores, square cores, small toroids, cross cores, erasing heads

grade	application
4A4	frames for i.f. transformers
4A10	aerial rods
4B1	aerial rods, frames for i.f. transformers
4C1	rods and tubes
4C6	potcores, square cores, toroids, frames for i.f. transformers, rods and tubes
4D1, 4D2, 4E1	frames for i.f. transformers, screw cores, tubes and rods
4H1 4L1 4L2 4MX	These are special-purpose NiZn ferrites developed for one type of application, namely resonant cavities for particle accelerators. In this field, usually a technical discussion is necessary before the correct material can be determined.

SYMBOLS

(in accordance with IEC401)

l_e	effective length of the magnetic path in mm
A_e	cross-section of a homogeneous part of a core in mm^2
μ_i	relative initial permeability, defined by: $\mu_i = \frac{1}{\mu_0} \lim_{H \to 0} \frac{B}{H}$
μ_Δ	relative incremental permeability, defined by: $\mu_\Delta = \frac{1}{\mu_0} \frac{\Delta B}{\Delta H}$
μ_a	relative amplitude permeability, defined by: $\mu_a = \frac{1}{\mu_0} \frac{B}{H}$
μ_e	relative effective permeability, defined by: $\mu_e = \frac{1}{\mu_0} \frac{\Sigma \frac{l_e}{A_e}}{\Sigma \frac{l_e}{\mu_i A_e}}$
V_e	effective volume of a core in mm^3 = volume of an ideal toroid in the same material grade and with the same magnetic properties as the core. V_e is calculated from: $V_e = \frac{\left(\Sigma \frac{l_e}{A_e}\right)^3}{\left(\Sigma \frac{l_e}{A_e^2}\right)^2} \; mm^3$
$\alpha_F = \frac{1}{\mu_i 2} \cdot \frac{d\mu}{dT}$	temperature factor = value for a certain ferroxcube material over a certain temperature range. In order to calculate the temperature coefficient per deg C of a coil the temperature factor has to be multiplied by the effective permeability.

So t.c. $= \frac{\Delta\mu}{\mu_i} \times \frac{\mu_e}{\mu_i} = \frac{\Delta\mu}{\mu_i^2} \times \mu_e$ per deg C

$D_F = \frac{\mu_1 - \mu_2}{\mu_1^2 \log \frac{t_2}{t_1}}$	disaccommodation factor, which gives the permeability variation, measured between 10 and 100 minutes after demagnetisation.
Curie point	critical temperature in $^{\circ}$C above which the ferromagnetic body is paramagnetic.
$\frac{\tan \delta}{\mu_i}$	constant for eddy current and residual losses together at a certain frequency, determined at $\hat{B} \leq 0,1$ mT through the coil. The resulting R/L value for eddy current and residual losses is: $\frac{R}{L} = \frac{\tan \delta}{\mu_i} \times \mu_e \times 2\pi f$ Ω/H (f in Hz)
$q_{2\text{-}24\text{-}100}$	constant for hysteresis losses standardised for an effective volume of 24 000 mm^3, $\mu_e = 100$ and measured between two currents, corresponding with two B_{max} values. At 800 Hz for a given volume V_e and for an effective permeability μ_e, we obtain: $q_{2\text{-}V\text{-}\mu} = q_{2\text{-}24\text{-}100} \times \left(\frac{\mu_e}{100}\right)^{3/2} \times \sqrt{\frac{24\,000}{V_e}}$ Ω/H$^{3/2}$ mA $\frac{R_h}{L} = q_{2\text{-}V\text{-}\mu} \times \sqrt{L} \times i \times \frac{f}{800}$ Ω/H (L in henry, f in Hz and i in mA) The hysteresis losses can also be expressed in η_B $\frac{R_h}{L} = \eta_B \times \hat{B} \times \mu_e \times 2\pi f$ (L in henry, η_B in tesla^{-1}, $\hat{B}$ in tesla, f in hertz)
η_B	$\eta_B = 0,615 \times 10^{-3} \times q_{2\text{-}24\text{-}100}$ T^{-1} or $q_{2\text{-}24\text{-}100} = 1,63 \times 10^{3}\ \eta_B$ Ω/H$^{3/2}$ mA
ρ	specific resistance in Ω m measured with d.c. current
ϵ	dielectric constant
θ	temperature in $^{\circ}$C
P	power loss in kW/m^3

Note

$0,1$ mT $= 10^{-4}$ T $= 10^{-4}$ Vs/m^2 $= 10^{-4}$ Wb/m^2 (= 1 Gs)

1 A/m $= \frac{4\pi}{10^3}$ Oe $\left(\approx \frac{1}{80}\right.$ Oe$\left.\right)$

$\mu_0 = 4\pi . 10^{-7}$ H/m (= 1 Gs/Oe)

TECHNICAL DATA

←

	(approximate values)
Specific heat at 25 °C	
MnZn ferrites	1100 J/kg degC
NiZn ferrites	750 J/kg degC
Thermal conductivity at 25 to 85 °C	3, 5 to 4, 3 W/m degC
Coefficient of linear expansion	10^{-5}/deg C
Modulus of elasticity	15×10^4 N/mm^2
Tensile strength	18 N/mm^2
Crushing strength	73 N/mm^2

Note - The tables on the following pages are in accordance with IEC 401.

	unit	3B	3B3	3B5	3B7	3C2	3C6	3C8
Initial permeability μ_i		900 ± 20%	900 ± 20%	1400 ± 25%	2300 ± 20%	900 ± 25%	1200 ± 25%	1200 ± 25%
at $B \leq 0,1$ mT								
at $B = 0,7-1$ mT, $\theta = 10-70\ ^{\circ}C$								
at $B = 0,7-1$ mT, $\theta = 25-70\ ^{\circ}C$								
Induction B, ballistically measured at								
H = 250 A/m, $\theta = 100\ ^{\circ}C$	mT						≥ 290	≥ 330
H = 800 A/m, $\theta = 25\ ^{\circ}C$		~ 345			~ 430	~ 350		
$\theta = 70\ ^{\circ}C$					~ 345			
$\theta = 100\ ^{\circ}C$		~ 230				~ 245		
Eddy current and residual loss factor								
$\frac{\tan\delta}{\mu_i}$ at $B \leq 0,1$ mT, $\theta = 25\ ^{\circ}C$,								
f = 4 kHz	$\times 10^{-6}$		≤ 7	≤ 2,5	≤ 1			
f = 50 kHz								
f = 100 kHz			≤ 15	≤ 10	≤ 5			
f = 250 kHz			≤ 27					
f = 450 kHz		≤ 50	≤ 50					
f = 500 kHz								
f = 1000 kHz								
Power loss P at 16 kHz, B = 200 mT,								
$\theta = 25\ ^{\circ}C$	kW/m^3 $(= mW/cm^3)$						≤ 170	≤ 110
$\theta = 50\ ^{\circ}C$							≤ 160	
$\theta = 100\ ^{\circ}C$							≤ 140	≤ 100
Hysteresis material constant,								
η_B at $\hat{B} = 0,3-1,2$ mT, f = 4 kHz,								
$\theta = 25\ ^{\circ}C$	$\times 10^{-3}\ T^{-1}$							
$\hat{B} = 1,5-3,0$ mT, f = 4 kHz,								
$\theta = 25\ ^{\circ}C$	$\times 10^{-3}\ T^{-1}$		≤ 7,4	≤ 1,5	≤ 1,1			
or								
$q_{2-24-100}$, at $\hat{B} = 0,3-1,2$ mT, f = 4 kHz,								
$\theta = 25\ ^{\circ}C$	$\Omega/H^{3/2}\ mA$							
$\hat{B} = 1,5-3,0$ mT, f = 4 kHz,								
$\theta = 25\ ^{\circ}C$	$\Omega/H^{3/2}\ mA$		≤ 12	≤ 25	≤ 1,8			

	unit	3B	3B3	3B5	3B7	3C2	3C6	3C8
Resistivity ρ measured with d.c. current	Ω m	≥ 0, 2	≥ 1	≥ 0, 2	≥1	≥0, 1	≥ 1	≥ 1
Disaccommodation factor D_F, between 10 and 100 min after demagnetisation, θ = 25 ± 1 ^oC	x 10^{-6}	≤ 10	≤ 11	≤ 7, 5	≤4, 3			
Temperature factor of permeability α_F at θ = +5 to +25 ^oC +25 to +55 ^oC +25 to +70 ^oC	x 10^{-6}/degC	0 to +3	0 to +2	0 to+2, 3	-0,6 to+0,6	0 to +4, 5		
Curie point	^oC	≥150	≥150	≥150	≥170	≥150	≥190	≥200
Specific weight	kg/m^3	4700-4900	4700-4900	4700-4900	4700-4900	4700-4900	4700-4900	4700-4900

Note: The temperature factor α_F of 3B7 grade is measured 10 min after demagnetisation, of the other material grades 24 hours after demagnetisation.

	unit	3D3	3E1	3E2	3E3	3E4	3H1
Initial permeability μ_i							
at $B \leq 0,1$ mT		750 ± 20%	3800 ± 20%			4700 ± 20%	2300 ± 20%
at $B = 0,7-1$ mT, $\theta = 10-70$ °C					≥ 10 000		
at $B = 0,7-1$ mT, $\theta = 25-70$ °C				≥ 5000			
Induction B, ballistically measured at							
$H = 250$ A/m, $\theta = 100$ °C	mT						
$H = 800$ A/m, $\theta = 25$ °C	mT	~ 350	~ 350	~ 420	~ 380		~ 360
$= 70$ °C	mT		~ 270	~ 340	~ 280		~ 280
Eddy current and residual loss factor $\frac{\tan \delta}{\mu_i}$ at $B \leq 0,1$ mT, $\theta = 25$ °C							
$f = 4$ kHz	x 10^{-6}		≤ 2,5	≤ 2,5	≤ 2,5	≤ 2,5	≤ 1
$f = 50$ kHz	x 10^{-6}				≤ 20		
$f = 100$ kHz	x 10^{-6}	≤ 8	≤ 20	≤ 15	≤ 50	≤ 20	≤ 5
$f = 500$ kHz	x 10^{-6}	≤ 14	≤ 200			≤ 200	
$f = 1000$ kHz	x 10^{-6}	≤ 30					
Power loss P at 16 kHz, $B = 200$ mT,							
$\theta = 25$ °C	kW/m^3 (= mW/cm^3)						
$\theta = 50$ °C	kW/m^3 (= mW/cm^3)						
$\theta = 100$ °C	kW/m^3 (= mW/cm^3)						
Hysteresis material constant,							
η_B at $\hat{B} = 0,3-1,2$ mT, $f = 4$ kHz, $\theta = 25$ °C	x 10^{-3} T^{-1}	≤ 1,8					
$\hat{B} = 1,5-3,0$ mT, $f = 4$ kHz, $\theta = 25$ °C	x 10^{-3} T^{-1}		≤ 1,1	≤ 1,1	≤ 1,1	≤ 0,85	≤ 1,1
or							
$q_{2-24-100}$, at $\hat{B} = 0,3-1,2$ mT, $f = 4$ kHz, $\theta = 25$ °C	$\Omega/H^{3/2}$ mA	≤ 3					
$\hat{B} = 1,5-3,0$ mT, $f = 4$ kHz, $\theta = 25$ °C	$\Omega/H^{3/2}$ mA		≤ 1,8	≤ 1,8	≤ 1,8	≤ 1,4	≤ 1,8

	unit	3D3	3E1	3E2	3E3	3E4	3H1
Resistivity ρ measured with d.c. current	Ωm	≥ 1, 5	≥ 0, 3	≥ 0, 1	≥ 0, 05	≥ 0, 3	≥ 1
Disaccommodation factor D_F, between 10 and 100 min after demagnetisation, $\theta = 25 \pm 1\ ^{o}C$	x 10^{-6}	≤ 12		≤ 1, 9	≤ 1, 9	≤ 4, 3	≤ 4, 3
Temperature factor of permeability							
α_F at θ = +5 to +25 °C	x 10^{-6}/degC		1 ± 1			1 ± 1	1 ± 0, 5
+25 to +55 °C	x 10^{-6}/degC		1 ± 1			1 ± 1	1 ± 0, 5
+25 to +70 °C	x 10^{-6}/degC	0 to +2	1 ± 1			1 ± 1	1 ± 0, 5
Curie point	°C	≥ 150	≥ 125	≥ 130	≥ 125	≥ 125	≥ 130
Specific weight	kg/m³	4500-4900	4700-4900	4700-4900	4800-4950	4700-4900	4700-4900

Note: The temperature factor α_F of 3B7 grade is measured 10 min after demagnetisation, of the other material grades 24 hours after demagnetisation.

	unit	4A4	4B1	4C1	4C6	4D1	4D2	4E1
Initial permeability μ_i at $B \le 0,1$ mT		500 ± 20%	250 ± 20%	125 ± 20%	120 ± 20%	50 ± 20%	60 ± 10%	15 ± 20%
Induction B, ballistically measured at	mT							
H = 800 A/m, θ = 25 °C		~ 270						
= 70 °C		~ 210						
H = 1600 A/m, θ = 25 °C			~ 325					
= 100 °C			~ 260					
H = 2000 A/m, θ = 25 °C								
ϑ = 70 °C								
H = 2400 A/m, θ = 25 °C				~ 275	~ 380			
θ = 70 °C					~ 350			
θ = 100 °C				~ 245				
H = 3200 A/m, θ = 25 °C						~ 240		
θ = 100 °C						~ 220		
H = 4800 A/m, θ = 25 °C								~ 175
θ = 100 °C								~ 165
Eddy current and residual loss factor $\frac{\tan\delta}{\mu_i}$ at $B \le 0,1$ mT, θ = 25 °C,	x 10^{-6}							
f = 500 kHz		≤ 30						
f = 700 kHz			≤ 70					
f = 1 MHz			≤ 90					
f = 1,5 MHz		≤ 40	≤ 140					
f = 2 MHz		≤ 70		≤ 120	≤ 40			
f = 3 MHz				≤ 160		≤ 180		
f = 5 MHz				≤ 300		≤ 210		
f = 10 MHz					≤ 100	≤ 300	≤ 100	≤ 300
f = 25 MHz							≤ 200	
f = 40 MHz							≤ 600	≤ 360
Hysteresis material constant, η_B at $\hat{B}$ = 0, 3-1,2 mT, f = 100 kHz, θ = 25 °C	x $10^{-3}T^{-1}$	≤ 1, 8			≤ 6, 1			
or $q_{2-24-100}$ at $\hat{B}$ = 0, 3-1, 2 mT, f = 100 kHz θ = 25 °C	$\Omega/H^{3/2}mA$	≤ 3			≤ 10			

	unit	4A4	4B1	4C1	4C6	4D1	4D2	4E1
Resistivity ρ measured with d.c. current	Ωm	≥ 10^3	≥ 10^3	≥ 10^3	≥ 10^3	≥ 10^3	≥ 10^3	≥ 10^3
Dielectric constant ϵ at 1 MHz, θ = 25 °C		15–20			10–15			
Disaccommodation factor D_F, between 10 and 100 min after demagnetisation, θ = 25 ± 1 °C	x 10^{-6}	≤ 5			≤ 10			
Temperature factor of permeability								
α_F at θ = +5 to +25 °C	x 10^{-6}/degC				1 ± 3			
+25 to +55 °C			0 to +8	0 to +12	3 ± 3	0 to +15		0 to +15
+25 to +70 °C		10 ± 5					0 to +15	
Curie point	°C	≥ 135	≥ 250	≥ 350	≥ 350	≥ 400		≥ 500
Specific weight	kg/m³	4700-5100	4400-4800	4200-4600	4000-5000	4000-4400		3500-4000

Note: The temperature factor α_F of all ferroxcube 4 grade materials is measured 24 hours after demagnetisation.

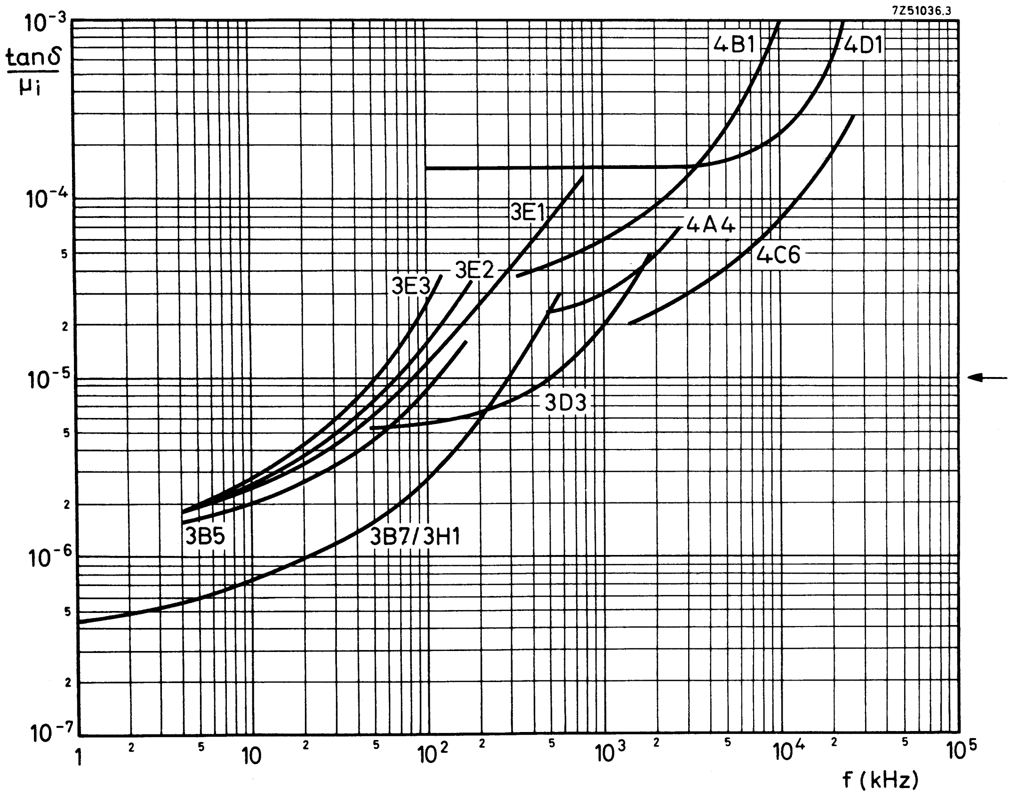
NiZn ferrites for resonant cavities

	4H1	4L1	4L2	4MX
Q80/Q~	0.9	0.7	0.7	0.8
μ_{rem}/μ_i	0.6-0.7	0.7-0.8	0.8-0.9	0.8-0.9
μ in remanent state (μ_{rem}) approx.	170	150	190	130
μQ in remanent state at 1.5 MHz, 50 Gs	21400	17800	21400	21800
at 1.5 MHz, 100 Gs	16000	14000	17000	20500
at 1.5 MHz, 150 Gs	12800	11200	14000	18800
at 1.5 MHz, 200 Gs	8600	9200	9700	14000
at 2.5 MHz, 50 Gs	15000	13000	17000	
at 2.5 MHz, 100 Gs	6000	7200	14500	
at 2.5 MHz, 150 Gs		5000	11000	
at 2.5 MHz, 200 Gs			8200	
at 5 MHz, 50 Gs	5000	10600	12000	19200
at 5 MHz, 100 Gs		4600	9700	16000
at 5 MHz, 150 Gs			6700	12500
at 5 MHz, 200 Gs			4500	5600
at 10 MHz, 50 Gs		4200		11200
at 10 MHz, 100 Gs				8200
at 10 MHz, 150 Gs				5600

Q80/Q~ indicates the properties under pulse conditions.
Q80 is the quality factor 80 milliseconds after application of a continuous bias of approx. 50 oerstedts.
Q~ is the quality factor in the static state.
μ_{rem}/μ_i indicates the squareness of the hysteresis loop.

CHARACTERISTIC CURVES

EDDY CURRENT LOSSES AND RESIDUAL LOSSES AS A FUNCTION OF THE FREQUENCY AT LOW INDUCTION LEVEL

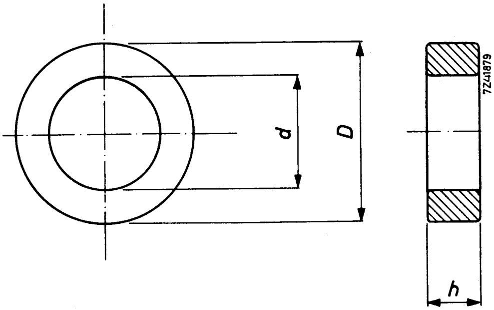


INTRODUCTION

Toroids, having no air gap, posses a small magnetic stray field and a high permeability.
In spite of the closed magnetic circuit the losses are low due to the favourable properties of ferroxcube.

Toroids are mainly used in small broadband transformers, pulse transformers and chokes. If, however, the direct current through the transformer is relatively large, transformer cores with an air gap are to be preferred.
Toroids are not recommended for tuned circuits.

TOROIDS



Ferroxcube toroids are used in small broadband transformers, pulse transformers, etc.
Toroids are available in various sizes and ferroxcube grades. They are barrel-finished and coated with an insulating lacquer.

DIMENSIONAL QUANTITIES, TOLERANCES AND WEIGHTS (Table I)

D (mm)	d (mm)	h (mm)	l_e (mm)	$\Sigma\frac{l_e}{A_e}$ (mm^{-1})	V_e (mm^3)	weight (g)
2 ±0.1	1.3 ±0.1	0.7 ±0.1	5,11	20,8	1,25	0.006
3.93 ±0.13	2.23 ±0.09	1.27 ±0.09	-	8,74	-	-
4 ±0.1	2.2 ±0.1	1.1 ±0.1	9,46	9,56	9,37	0.045
4.83 ±0.25	2.28 ±0.25	1.27 ±0.25	-	6,63	-	-
5.84 ±0.13	3.05 ±0.2	1.52 ±0.13	-	6,34	-	-
6 ±0.15	4 ±0.15	2 ±0.1	15,5	7,75	31,0	0.15
9 ±0.2	6 ±0.2	3 ±0.1	23,3	5,17	105	0.50
9.53 ±0.25	4.75 ±0.25	3.18 ±0.25	-	2,84	-	-
14 ±0.3	9 ±0.25	5 ±0.15	35,5	2,85	445	2.14
23 ±0.5	14 ±0.35	7 ±0.2	57,0	1,81	1790	8.6
29 ±0.5	19 ±0.4	7.5 ±0.2	75,0	2,01	2580	13
36 ±0.7	23 ±0.5	10 ±0.2	92,0	1,42	5600	29
36 ±0.7	23 ±0.5	15 ±0.2	92,0	0,942	8500	44

Notes

1. All dimensions apply to non-lacquered toroids.
2. All μ-values in the following are determined with the $\Sigma\frac{l_e}{A_e}$ values of Table I at 25 °C.
   The relevant A_L values can be calculated with the formula $A_L = \frac{4\pi\mu}{\Sigma\frac{l_e}{A_e}}$
3. The smaller a toroid, the more its properties deviate from the material properties. Therefore a straight-forward translation of the material figures is not always possible.

GRADES AND SIZES

Toroids of ferroxcube 3E1

μ_{tor} = 2700 ±20% at 23 ± 1 °C
Lacquered green

dimensions (mm)	catalog number
29 x 19 x 7.5	4322 020 36550
36 x 23 x 10	4322 020 36560
36 x 23 x 15	4322 020 36570

Toroids of ferroxcube 3E2

$\mu_{tor} > 5000$ at +23 to +70 °C
Lacquered blue

dimensions (mm)	catalog number
4 x 2.2 x 1.1	4322 020 36650
6 x 4 x 2	4322 020 36660
9 x 6 x 3	4322 020 36670
14 x 9 x 5	4322 020 36680
23 x 14 x 7	4322 020 36690

Toroids of ferroxcube 3E3

$\mu_{tor} > 10\,000$ at +10 to +70 °C
Lacquered brown
* Not lacquered

dimensions (mm)	catalog number
*2 x 1.3 x 0.7	4322 020 90950
4 x 2.2 x 1.1	4322 020 36700
6 x 4 x 2	4322 020 36710
9 x 6 x 3	4322 020 36720

Toroids of ferroxcube 3H1

Sorted into μ groups.
Lacquered orange
$D_F \leq 4.3 \times 10^{-6}$ at 23 ± 1 °C

dimensions (mm)	catalog number
4 x 2.2 x 1.1	4322 020 36590
6 x 4 x 2	4322 020 36600
9 x 6 x 3	4322 020 36610
14 x 9 x 5	4322 020 36620
23 x 14 x 7	4322 020 36630

For the convenience of the user the toroids of ferroxcube 3H1 are delivered sorted into groups of approximately equal μ-value. The μ-value is indicated by the colour of the circumference of the toroids, see Table II. Groups are not separately available.

Table II (for toroids of the 3H1 series)

group	colour of circumference	μ_{tor} at 23 ± 1 °C	4322 020				
			36590	36600	36610	36620	36630
			α-factor				
2	red	2140-2360	58.3	52.3	42.8	31.8	25.3
3	orange	2300-2540	56.0	50.3	41.2	30.6	24.4
4	yellow	2480-2740	54.0	48.6	39.8	29.5	23.5
5	green	2680-2960	51.8	46.6	38.2	28.3	22.6
6	blue	2900-3210	49.9	44.8	36.7	27.3	21.7
7	violet	3150-3480	48.0	43.2	35.4	26.2	20.9
8	grey	3420-3780	46.2	41.4	34.0	25.2	20.1
9	white	3720-4110	44.2	39.7	32.5	24.1	19.2

Number of turns for L mH : $N = \alpha\sqrt{L}$

The α factors are mean values, except those of the last group.

Between +23 and +70 °C the min μ_{tor} of the product is higher than the min μ_{tor} of the group.

Toroids of ferroxcube 4C6

$\mu_{tor} > 100$ at +5 to +55 °C
Lacquered violet

dimensions (mm)	catalog number
6 x 4 x 2	4322 020 91000
9 x 6 x 3	4322 020 91010
14 x 9 x 5	4322 020 91020
23 x 14 x 7	4322 020 91070
36 x 23 x 15	4322 020 91090

Toroids of ferroxcube 3B7

Between 0 and +60 °C the deviation in A_L is max. +10/−6% with regard to A_L at the reference temperature +23 °C.
Not lacquered.

dimensions (mm)	A_L ± 20% at 23 ± 1 °C	catalog number
3.93 x 2.23 x 1.27	360	4322 020 90820
4.83 x 2.28 x 1.27	475	4322 020 90830
5.84 x 3.05 x 1.52	495	4322 020 90840
9.53 x 4.75 x 3.18	1100	4322 020 90850