MICROMETALS™

POWDER CORE SOLUTIONS

2019 Iron Powder 200C Materials

High Temperature

General Material Properties

-60	55	±10	Silicon-Iron	168	6.1	1.3	2.0	Brown/Black	✓
-61	38	±10	Silicon-Iron	-418	6.1	2.0	2.0	Brown/Gray	✓
-63	35	±10	Silicon-Iron	-313	5.9	5.8	3.0	Brown/Beige	✓
-65	42	±10	Silicon-Iron	-80	6.1	2.0	2.0	Brown/Yellow	✓
-66	66	±10	Silicon-Iron	-220	6.2	1.5	2.5	Brown/Brown	✓
-70	100	±10	Nickel-Iron	216	7.4	0.66	9.9	Beige/Black	✓
-M125	125	±10	Molyper-malloy	150	7.7	0.48	12	Lt.Blue/Lt.Blue	✓

*Relative cost as compared to Micrometals -26 or -40 materials for a 25mm toroid.

Material Magnetic Characteristics

-60	14,400	35	71	39	43	76	52	68	630
-61	14,400	65	85	32	80	113	69	72	569
-63	14,100	69	86	30	74	60	31	20	88
-65	16,000	55	82	35	54	77	33	48	567
-66	16,200	36	71	47	48	48	17	31	392
-70	8,600	20	47	47	6	10	13	69	947
-M125	8,800	24	44	55	5	6	13	86	1193

Material Information

-60 Material: The 60 Series of materials are cost effective magnetic powder alloy materials that are not subject to thermal aging for operating temperatures up to 200°C. The -60 Material has 55 permeability and can be considered as a substitute for -18 Material.

-61 Material, -63 Materials: Both materials have initial permeability of 35. The -63 Material has excellent high frequency properties and be and can operate past 10MHz. -63 Material can be considered for high temperature alternate to -8 Material. Both materials are not subject to thermal aging concerns.

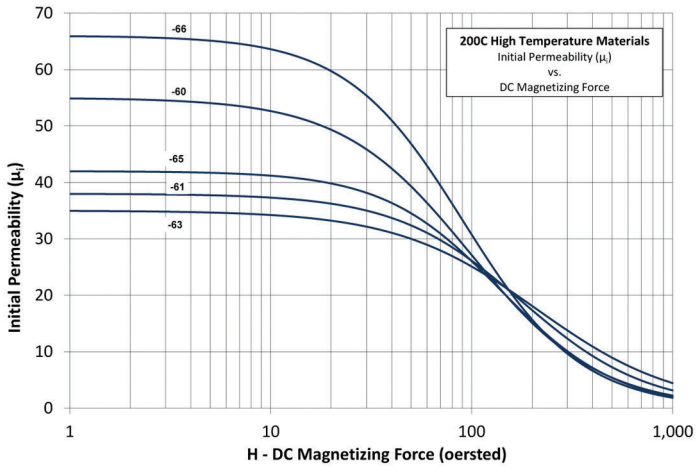
-65 Material: This material has a permeability of 42 and is most popular in Microcube geometries. The -65 has higher core losses at high frequencies compared to -66 Material but better DC saturation. No thermal aging concerns.

-66 Material: This material offers low core losses and is well suited from 100kHz to 500kHz. No thermal aging concerns.

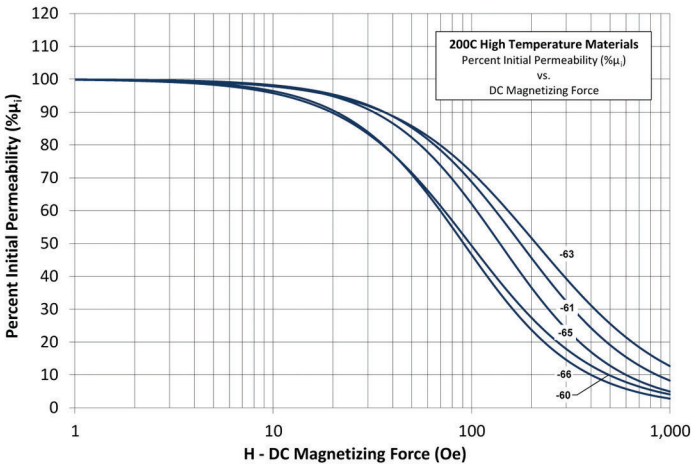
-70 Material: This is a magnetic powder alloy including nickel. The -70 Material has higher permeability than the 60 Series with excellent losses up to 400kHz. This is a relatively expensive material, most competitively priced in smaller sizes. No thermal aging concerns.

-M125 Material: This is a molypermally powder material and will have the highest permeability and lowest losses below 200kHz. Similar to the -70 Material is cost, the -M125 Material will be most competitively priced in smaller sizes.

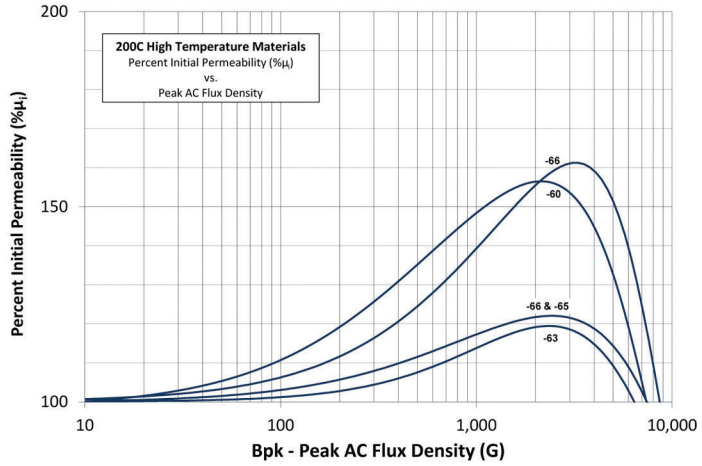
Initial Permeability (μi) vs. DC Magnetizing Force



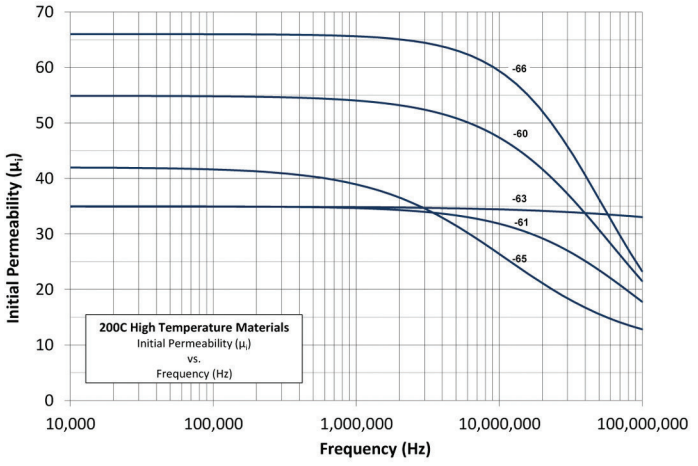
Percent Initial Permeability (%μi) vs. DC Magnetizing Force



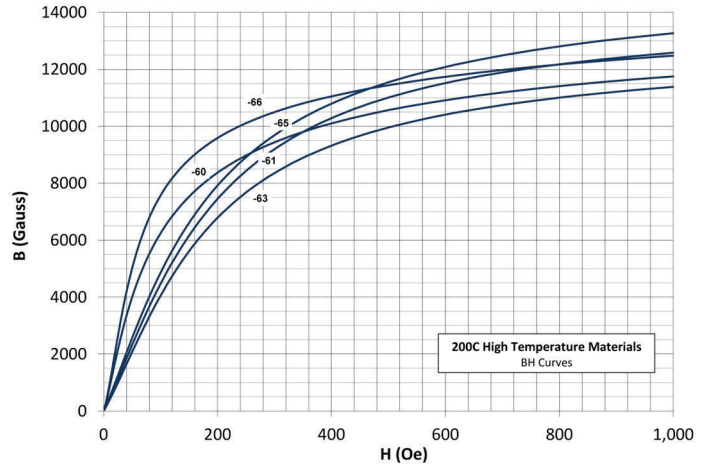
Percent Initial Permeability (%μi) vs. Peak AC Flux Density



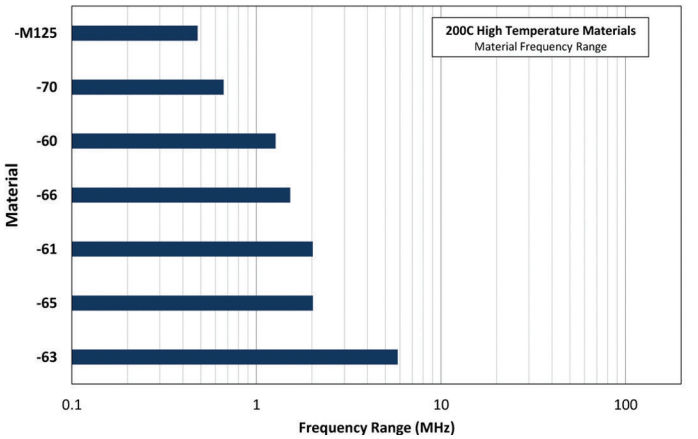
Initial Permeability (μi) vs Frequency (Hz)



BH Curves



Material Frequency Range



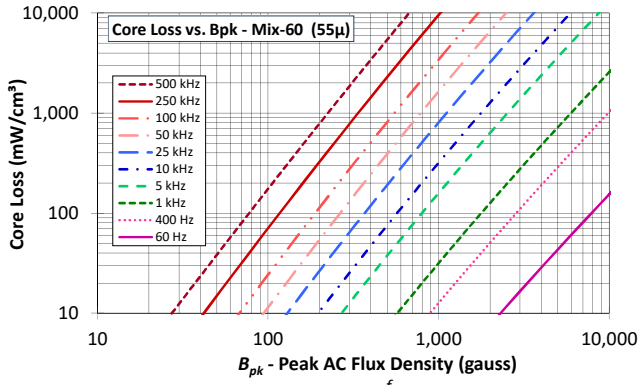
Mix:	-60

Revision 20171219 - Generated 2017-Dec-21

The **-60 Material** has 55 permeability and can be considered as a high temperature substitute for -18 material.

-60 material exhibits low core losses with higher permeability at a lower cost. Good DC saturation characteristics.

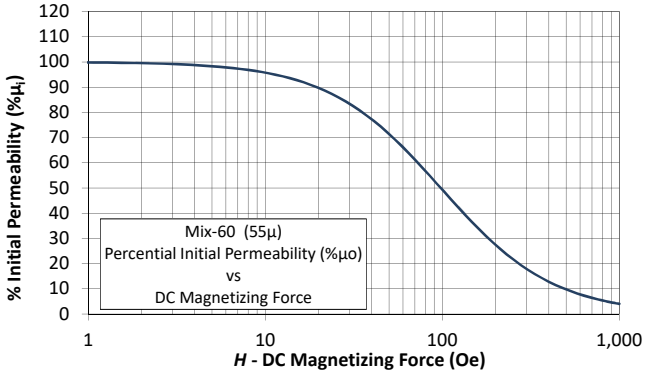
µi(reference)	55
Color Code	Brown/Black
Density	6.1 g/cm³
Bsat	14.4kG
Core Loss (100kHz, 140g)	52 mW/cm³ (nom) 59 mW/cm³ (max)
%Perm at DC Bias (100 Oe)	49.3% (nom) 43.2% (min)



$$Core\ Loss\ (mW/cm^3) = \frac{f}{\frac{a}{B_{pk}^{\ 3}} + \frac{b}{B_{pk}^{\ 2.3}} + \frac{c}{B_{pk}^{\ 1.65}}} + d \cdot B_{pk}^{\ 2} \cdot f^2$$

where B_{pk} expressed in gauss, f expressed in hertz, and:

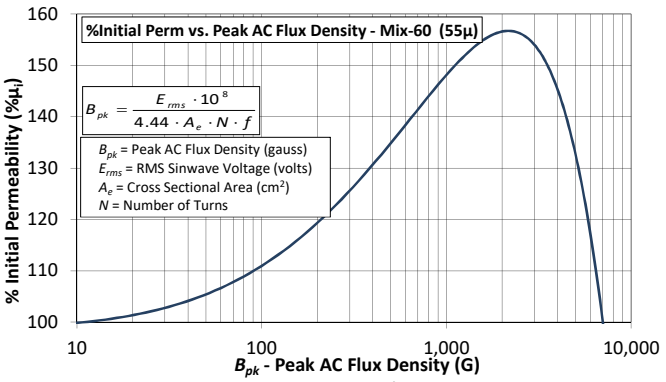
a=5.30E+08, b=1.40E+08, c=1.20E+06, d=2.70E-14



$$\%\mu_i = \frac{1}{a + b \cdot H^c} + d$$

where H expressed in oersteds, and:

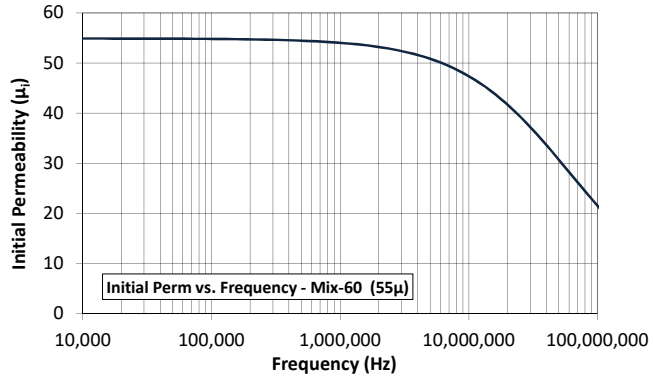
a=1.00E-02, b=1.94E-05, c=1.36, d=0.00



$$\%\mu_i = \frac{1}{\frac{1}{a + bB_{pk}^{\ c}} + \frac{1}{dB_{pk}^{\ e}} + \frac{1}{f}}$$

where B_{pk} expressed in gauss, and:

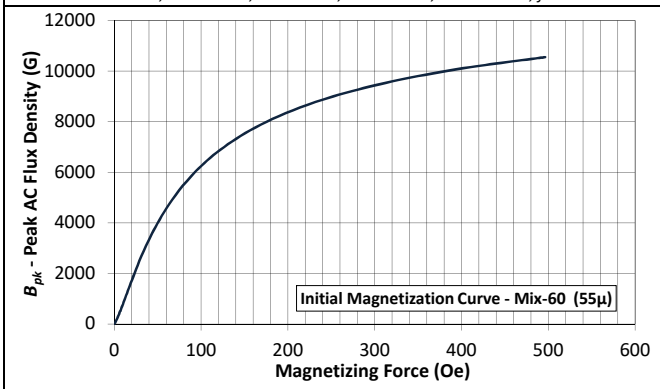
a=2.09E+02, b=8.71E-01, c=9.33E-01, d=1.44E+11, e=-2.27E+00, f=1.86E+02



$$\mu_i = \frac{1}{a + bf^{\ c}} + d$$

where f expressed in hertz, and:

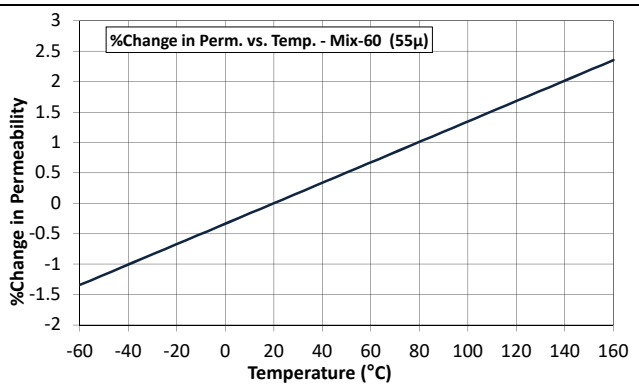
a=1.86E-02, b=2.96E-10, c=1.00E+00, d=1.00E+00



$$B_{pk} = \frac{\mu_i}{\frac{1}{H + aH^{\ b}} + \frac{1}{cH^{\ d}} + \frac{1}{e}}$$

where B_{pk} expressed in gauss, H in oested, and:

a=1.57E-01, b=1.81E+00, c=1.41E+01, d=6.43E-01, e=2.61E+02



$$\left(\frac{\Delta\mu_i}{\mu_i}\right) ppm = a(T - 20)$$

where T expressed in celsius, and:

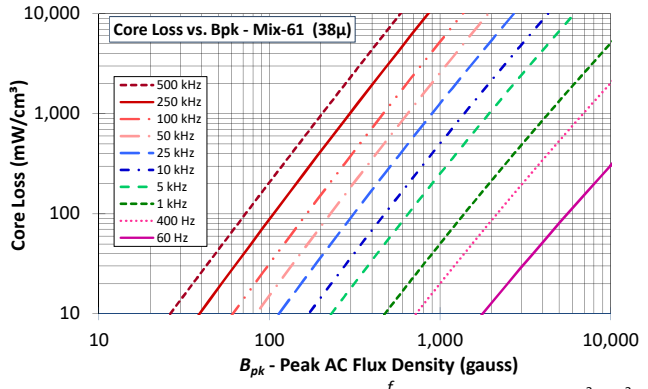
a=168

-61 material has an initial permeability of 35. and has excellent high frequency properties allowing operation past 10MHz. -61 material exhibits no thermal aging under 200C.

Mix:	-61

Revision 20171219 - Generated 2017-Dec-21

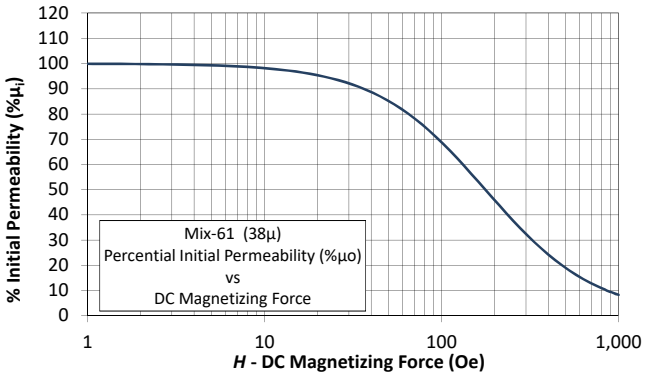
µi(reference)	38
Color Code	Brown/Gray
Density	6.1 g/cm³
Bsat	14.4kG
Core Loss (100kHz, 140g)	69 mW/cm³ (nom) 79 mW/cm³ (max)
%Perm at DC Bias (100 Oe)	68.8% (nom) 63.1% (min)



$$Core\ Loss\ (mW/cm^3) = \frac{f}{\frac{a}{B_{pk}^{\ 3}} + \frac{b}{B_{pk}^{\ 2.3}} + \frac{c}{B_{pk}^{\ 1.65}}} + d \cdot B_{pk}^{\ 2} \cdot f^2$$

where B_{pk} expressed in gauss, f expressed in hertz, and:

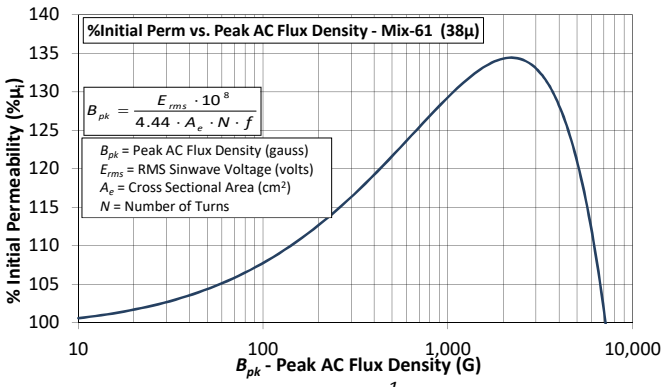
a=4.00E+08, b=1.10E+08, c=5.10E+05, d=2.40E-14



$$\%\mu_i = \frac{1}{a + b \cdot H^c} + d$$

where H expressed in oersteds, and:

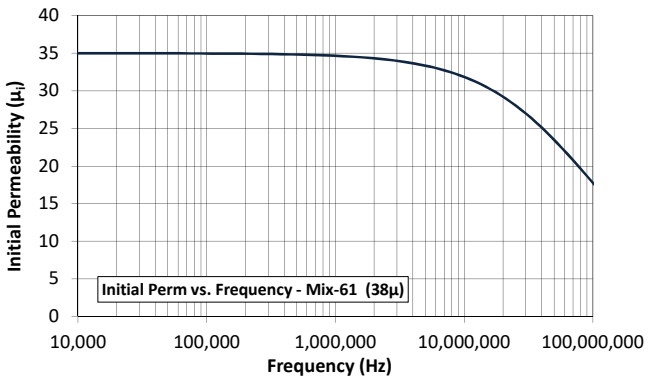
a=1.00E-02, b=7.60E-06, c=1.39, d=0.00



$$\%\mu_i = \frac{1}{\frac{1}{a + bB_{pk}^{\ c}} + \frac{1}{dB_{pk}^{\ e}} + \frac{1}{f}}$$

where B_{pk} expressed in gauss, and:

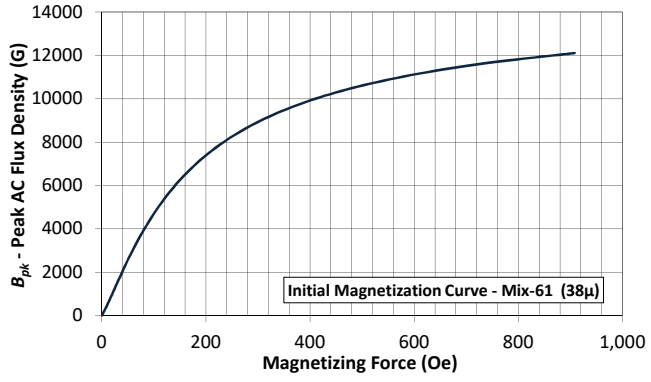
a=1.97E+02, b=3.67E+00, c=5.89E-01, d=5.72E+11, e=-2.45E+00, f=1.90E+02



$$\mu_i = \frac{1}{a + bf^{\ c}} + d$$

where f expressed in hertz, and:

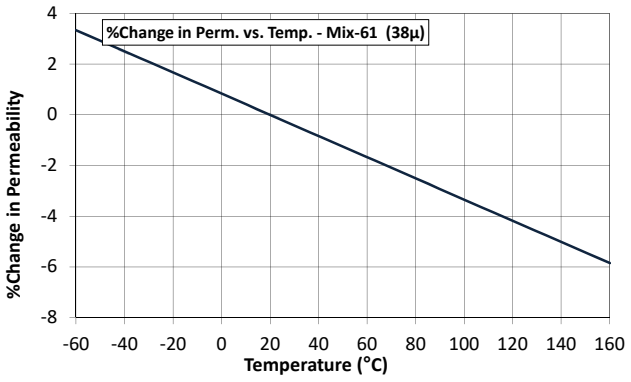
a=2.94E-02, b=2.96E-10, c=1.00E+00, d=1.00E+00



$$B_{pk} = \frac{\mu_i}{\frac{1}{H + aH^{\ b}} + \frac{1}{cH^{\ d}} + \frac{1}{e}}$$

where B_{pk} expressed in gauss, H in oested, and:

a=8.80E-02, b=1.69E+00, c=2.24E+01, d=6.33E-01, e=4.11E+02



$$\left(\frac{\Delta\mu_i}{\mu_i}\right) ppm = a(T - 20)$$

where T expressed in celsius, and:

a=-418

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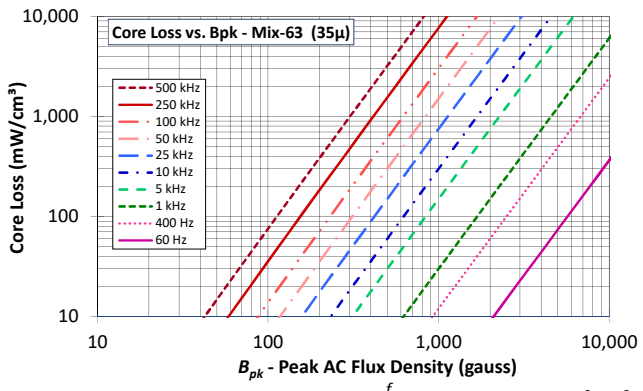
-63 material has an initial permeability of 35, excellent high frequency properties, and can be used in applications past 10MHz. -63 Material can be considered for high temperature alternate to -8 Material. -63 materials experiences no thermal aging under 200C.

Mix:	-63

Revision 20171219 - Generated 2017-Dec-21

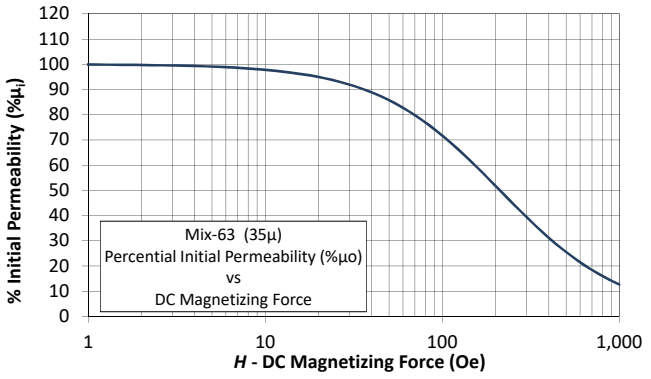
µi(reference)	35
Color Code	Brown/Beige
Density	5.9 g/cm³
Bsat	14.1kG
Core Loss (100kHz, 140g)	31 mW/cm³ (nom) 35 mW/cm³ (max)
%Perm at DC Bias (200 Oe)	51.7% (nom) 46.1% (min)



$$\text{Core Loss (mW/cm}^3) = \frac{f}{\frac{a}{B_{pk}^{\ 3}} + \frac{b}{B_{pk}^{\ 2.3}} + \frac{c}{B_{pk}^{\ 1.65}}} + d \cdot B_{pk}^{\ 2} \cdot f^2$$

where B_{pk} expressed in gauss, f expressed in hertz, and:

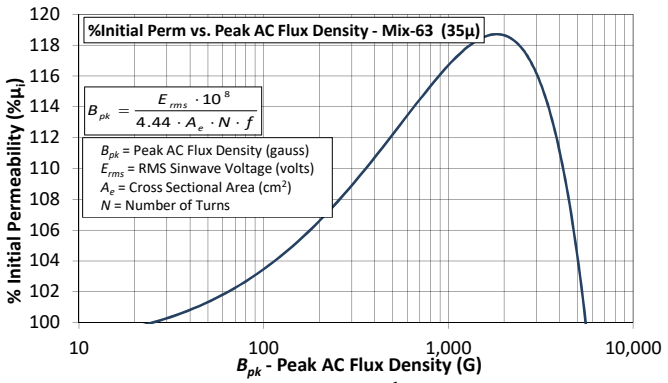
a=9.94E+08, b=2.56E+08, c=1.00E+04, d=3.34E-15



$$\%\mu_i = \frac{1}{a + b \cdot H^c} + d$$

where H expressed in oersteds, and:

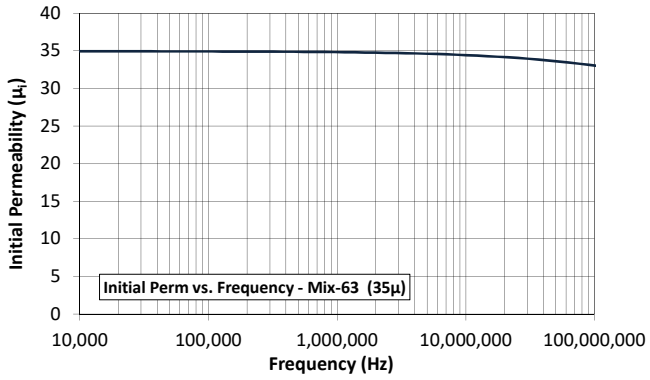
a=1.00E-02, b=1.29E-05, c=1.24, d=0.00



$$\%\mu_i = \frac{1}{\frac{1}{a + bB_{pk}^{\ c}} + \frac{1}{dB_{pk}^{\ e}} + \frac{1}{f}}$$

where B_{pk} expressed in gauss, and:

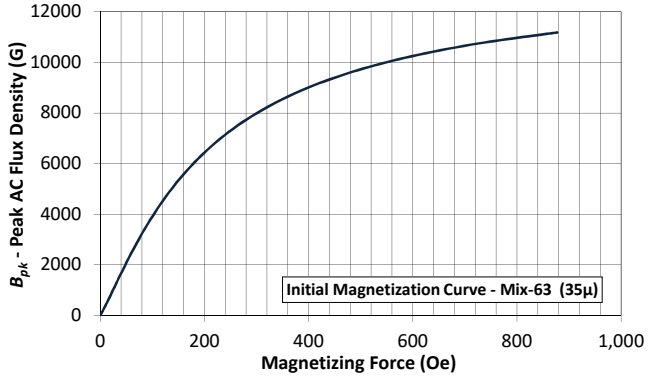
a=5.04E+02, b=1.06E-01, c=1.39E+00, d=5.71E+11, e=-2.43E+00, f=1.25E+02



$$\mu_i = \frac{1}{a + bf^{\ c}} + d$$

where f expressed in hertz, and:

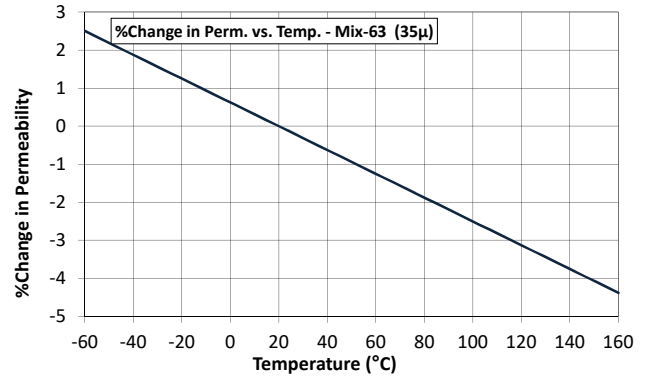
a=1.27E-01, b=1.98E-07, c=6.64E-01, d=2.70E+01



$$B_{pk} = \frac{\mu_i}{\frac{1}{H + aH^{\ b}} + \frac{1}{cH^{\ d}} + \frac{1}{e}}$$

where B_{pk} expressed in gauss, H in oested, and:

a=6.65E-02, b=1.65E+00, c=1.84E+01, d=7.04E-01, e=4.02E+02



$$\left(\frac{\Delta\mu_i}{\mu_i}\right) ppm = a(T - 20)$$

where T expressed in celsius, and:

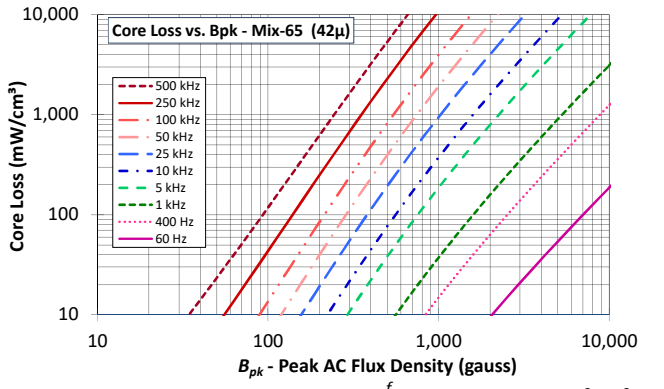
a=-313

-65 material offers a permeability of 42 and is most popular in Microcube geometries. It offers higher core losses at high frequencies compared to -66 Material but with better DC saturation. No thermal aging concerns.

Mix:	-65

Revision 20171219 - Generated 2017-Dec-21

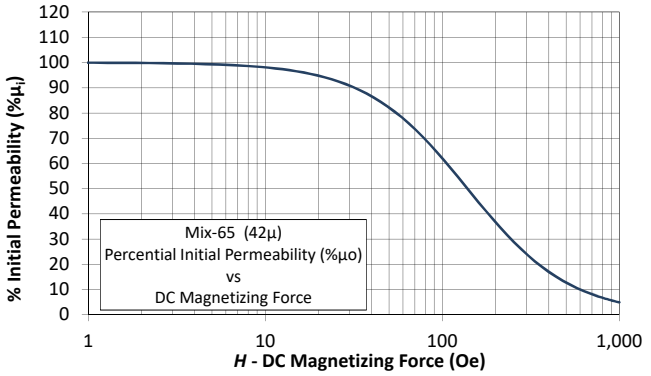
µi(reference)	42
Color Code	Brown/Yellow
Density	6.1 g/cm³
Bsat	16.0kG
Core Loss (100kHz, 140g)	33 mW/cm³ (nom) 38 mW/cm³ (max)
%Perm at DC Bias (100 Oe)	62.1% (nom) 55.5% (min)



$$\text{Core Loss (mW/cm}^3) = \frac{f}{\frac{a}{B_{pk}{}^3} + \frac{b}{B_{pk}{}^{2.3}} + \frac{c}{B_{pk}{}^{1.65}}} + d \cdot B_{pk}{}^2 \cdot f^2$$

where B_{pk} expressed in gauss, f expressed in hertz, and:

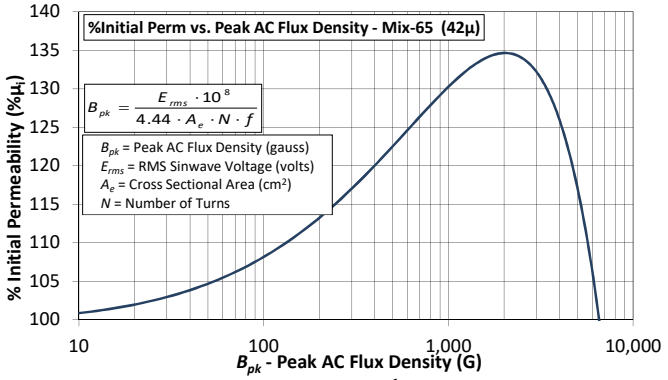
a=6.90E+09, b=6.00E+07, c=1.10E+06, d=2.50E-14



$$\%\mu_i = \frac{1}{a + b \cdot H^c} + d$$

where H expressed in oersteds, and:

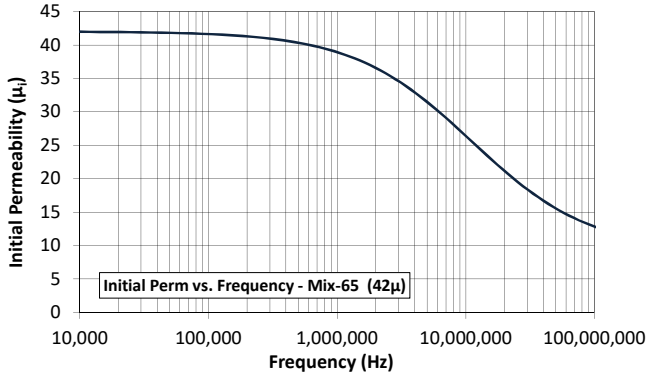
a=1.00E-02, b=6.16E-06, c=1.50, d=0.00



$$\%\mu_i = \frac{1}{\frac{1}{a + bB_{pk}{}^c} + \frac{1}{dB_{pk}{}^e} + \frac{1}{f}}$$

where B_{pk} expressed in gauss, and:

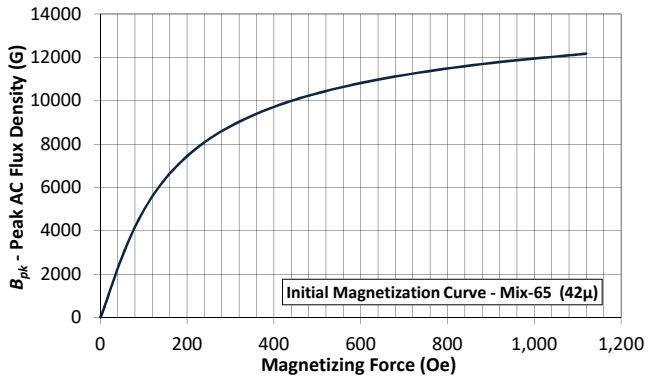
a=1.97E+02, b=3.67E+00, c=5.89E-01, d=5.72E+11, e=-2.45E+00, f=1.90E+02



$$\mu_i = \frac{1}{a + bf^c} + d$$

where f expressed in hertz, and:

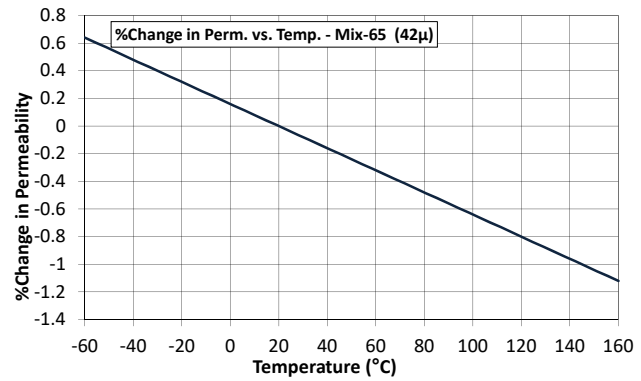
a=3.04E-02, b=7.09E-09, c=9.41E-01, d=9.13E+00



$$B_{pk} = \frac{\mu_i}{\frac{1}{H + aH^b} + \frac{1}{cH^d} + \frac{1}{e}}$$

where B_{pk} expressed in gauss, H in oested, and:

a=9.23E-02, b=1.72E+00, c=2.39E+01, d=5.70E-01, e=3.80E+02



$$\left(\frac{\Delta\mu_i}{\mu_i}\right) ppm = a(T - 20)$$

where T expressed in celsius, and:

a=-80

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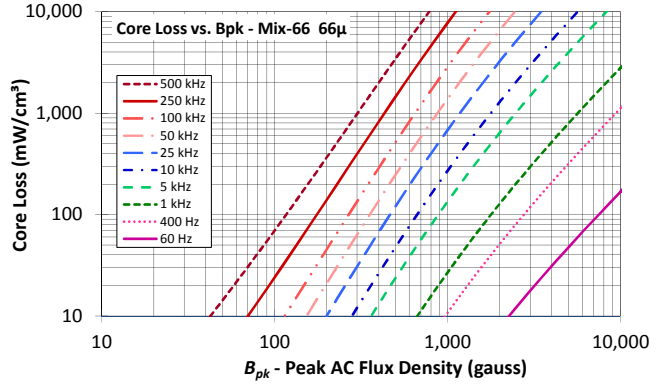
-66 material offers low core losses and is well suited from 100kHz to 500kHz. -66 material experiences no thermal aging under 200C.

Mix:	-66

Revision 20160429 - Generated 2016-Jun-09

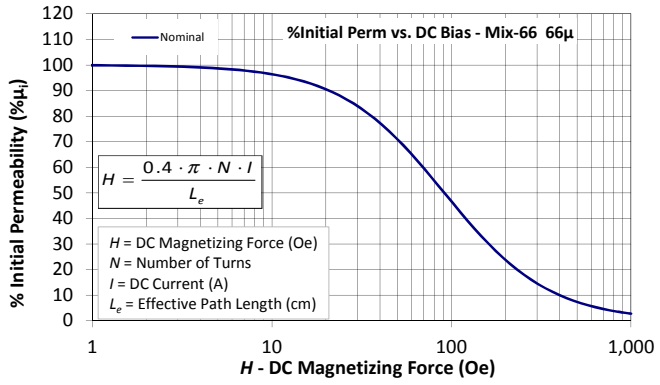
µi(reference)	66
Color Code	Brown/Brown
Density	6.2 g/cm³
Bsat	16.2kG
Core Loss (100kHz, 140g)	17 mW/cm³ (nom) 20 mW/cm³ (max)
%Perm at DC Bias (50 Oe)	71.0% (nom) 65.1% (min)



$$\text{Core Loss (mW/cm}^3) = \frac{f}{\frac{a}{B_{pk}^{\ 3}} + \frac{b}{B_{pk}^{\ 2.3}} + \frac{c}{B_{pk}^{\ 1.65}}} + d \cdot B_{pk}^{\ 2} \cdot f^2$$

where B_{pk} expressed in gauss, f expressed in hertz, and:

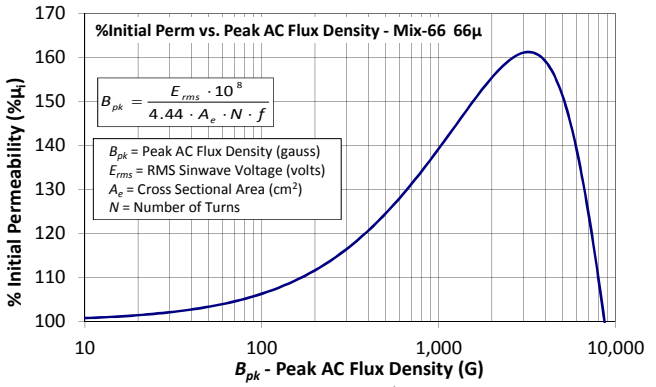
a=1.72E+10, b=4.96E+07, c=1.23E+06, d=1.73E-14



$$\%\mu_i = \frac{1}{a + b \cdot H^c} + d$$

where H expressed in oersteds, and:

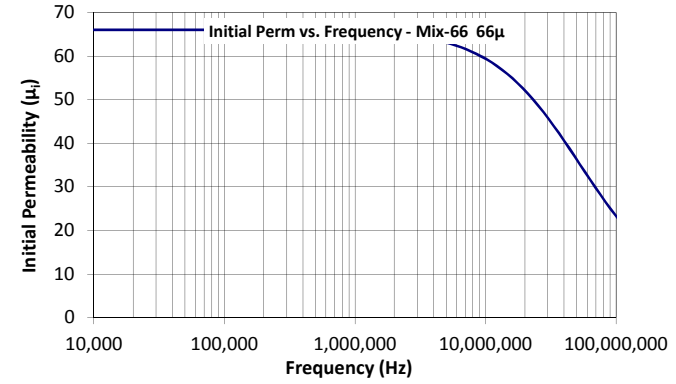
a=1.00E-02, b=1.23E-05, c=1.48, d=0.00



$$\%\mu_i = \frac{1}{\frac{1}{a + bB_{pk}^{\ c}} + \frac{1}{dB_{pk}^{\ e}} + \frac{1}{f}}$$

where B_{pk} expressed in gauss, and:

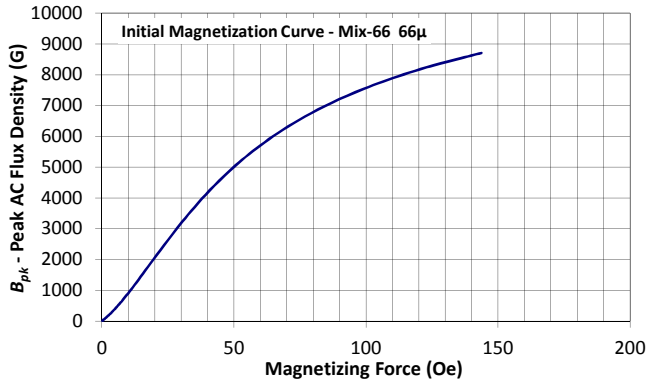
a=1.91E+02, b=2.79E-01, c=9.70E-01, d=1.54E+13, e=-2.76E+00, f=2.10E+02



$$\mu_i = \frac{1}{a + bf^{\ c}} + d$$

where f expressed in hertz, and:

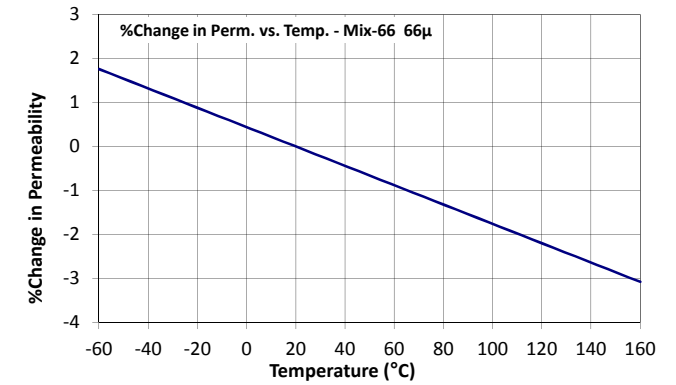
a=1.62E-02, b=2.46E-12, c=1.27E+00, d=4.20E+00



$$B_{pk} = \frac{\mu_i}{\frac{1}{H + aH^{\ b}} + \frac{1}{cH^{\ d}} + \frac{1}{e}}$$

where B_{pk} expressed in gauss, H in oested, and:

a=6.85E-02, b=2.00E+00, c=3.72E+01, d=4.51E-01, e=2.45E+02



$$\left(\frac{\Delta\mu_i}{\mu_i}\right) ppm = a(T - 20)$$

where T expressed in celsius, and:

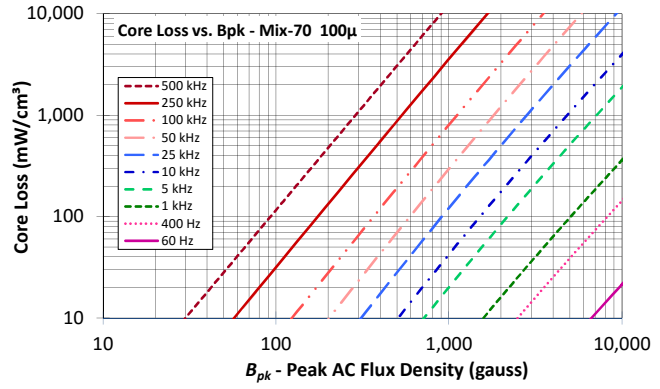
a=-220

The **-70 material** has higher permeability than the 60 Series with excellent losses up to 400kHz. This is a relatively expensive material, most competitively priced in smaller sizes. No thermal aging concerns.

Mix:	-70

Revision 20160823 - Generated 2016-Aug-29

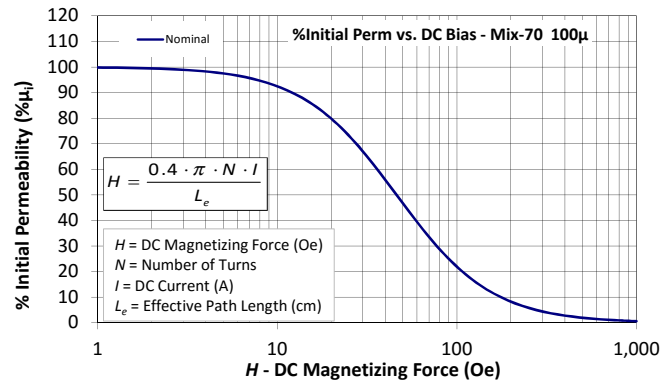
µi(reference)	100
Color Code	Beige/Black
Density	7.4 g/cm³
Bsat	8.6kG
Core Loss (100kHz, 140g)	13 mW/cm³ (nom) 15 mW/cm³ (max)
%Perm at DC Bias (50 Oe)	46.8% (nom) 39.4% (min)



$$Core\ Loss\ (mW/cm^3) = \frac{f}{\frac{a}{B_{pk}^{\ 3}} + \frac{b}{B_{pk}^{\ 2.3}} + \frac{c}{B_{pk}^{\ 1.65}}} + d \cdot B_{pk}^{\ 2} \cdot f^2$$

where B_{pk} expressed in gauss, f expressed in hertz, and:

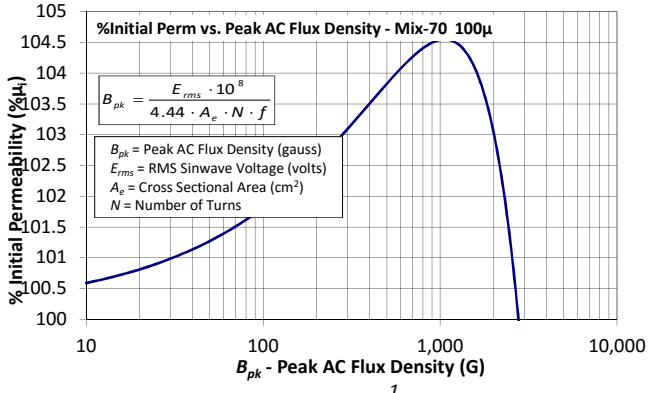
a=1.00E+10, b=1.30E+09, c=7.90E+06, d=4.20E-14



$$\%\mu_i = \frac{1}{a + b \cdot H^c} + d$$

where H expressed in oersteds, and:

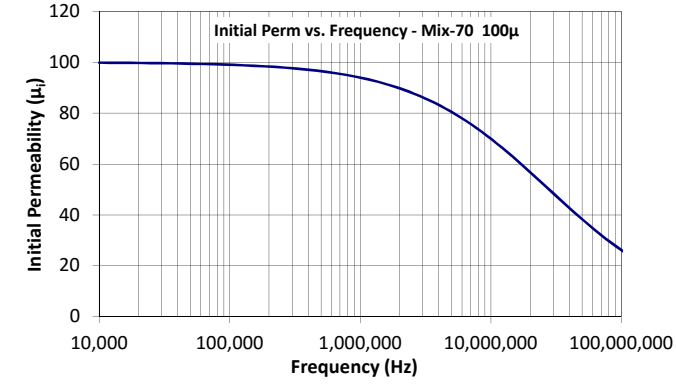
a=1.00E-02, b=1.85E-05, c=1.64, d=0.00



$$\%\mu_i = \frac{1}{\frac{1}{a + bB_{pk}^{\ c}} + \frac{1}{dB_{pk}^{\ e}} + \frac{1}{f}}$$

where B_{pk} expressed in gauss, and:

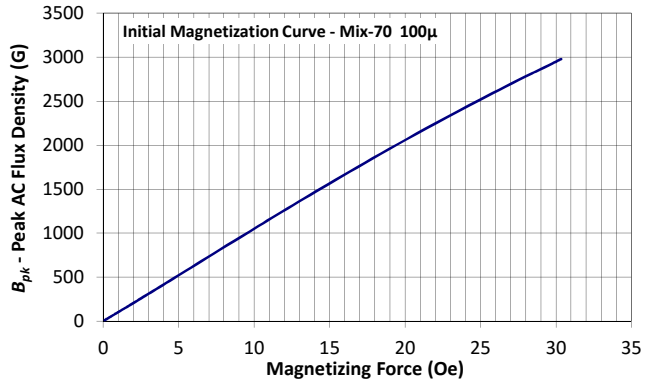
a=6.29E+02, b=4.10E+00, c=6.20E-01, d=1.76E+10, e=-2.07E+00, f=1.19E+02



$$\mu_i = \frac{1}{a + bf^{\ c}} + d$$

where f expressed in hertz, and:

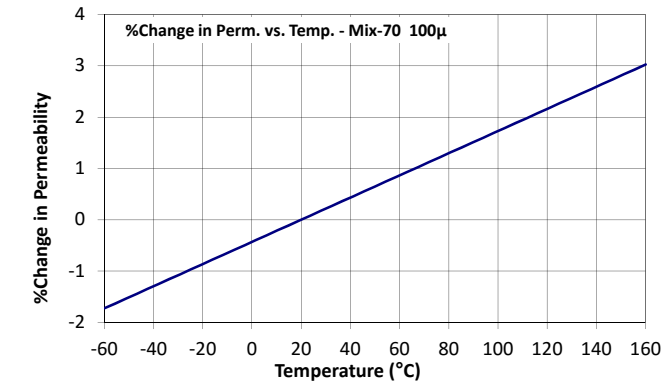
a=1.01E-02, b=7.01E-09, c=8.28E-01, d=1.00E+00



$$B_{pk} = \frac{\mu_i}{\frac{1}{H + aH^{\ b}} + \frac{1}{cH^{\ d}} + \frac{1}{e}}$$

where B_{pk} expressed in gauss, H in oested, and:

a=2.75E-02, b=1.85E+00, c=1.40E+09, d=2.27E-04, e=8.59E+01



$$\left(\frac{\Delta\mu_i}{\mu_i}\right) ppm = a(T - 20)$$

where T expressed in celsius, and:

a=216

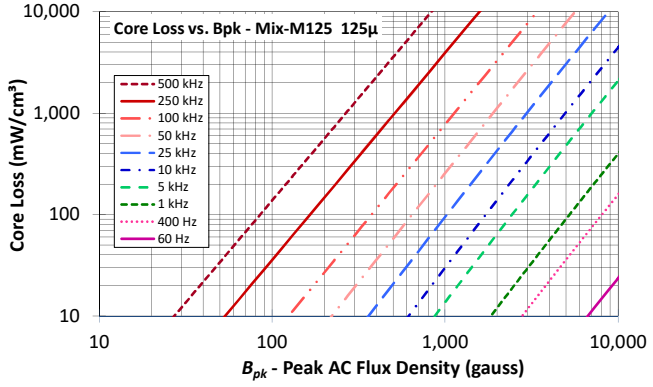
TEL (714) 970-9400 | FAX (714) 970-0400

-M125 material this is a molypermalloy powder material and will have the highest permeability and lowest losses below 200kHz. Similar to the -70 Material in cost, the -M125 material will be most competitively priced in smaller sizes.

Mix:	-M125

Revision 20171027 - Generated 2017-Nov-08

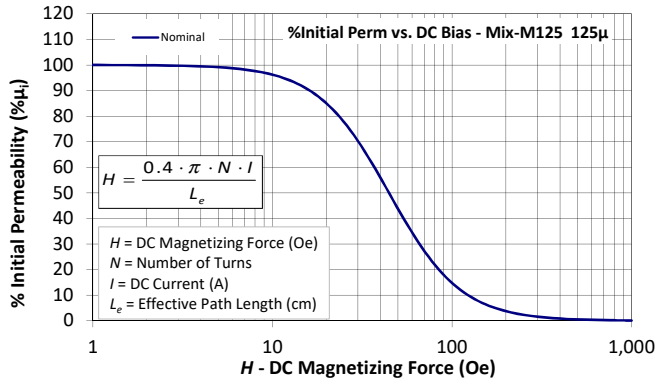
µi(reference)	125
Color Code	Lt.Blue/Lt.Blue
Density	7.7 g/cm³
Bsat	8.8kG
Core Loss (100kHz, 140g)	13 mW/cm³ (nom) 15 mW/cm³ (max)
%Perm at DC Bias (50 Oe)	43.9% (nom) 34.5% (min)



$$\text{Core Loss (mW/cm}^3) = \frac{f}{\frac{a}{B_{pk}^{\ 3}} + \frac{b}{B_{pk}^{\ 2.3}} + \frac{c}{B_{pk}^{\ 1.65}}} + d \cdot B_{pk}^{\ 2} \cdot f^2$$

where B_{pk} expressed in gauss, f expressed in hertz, and:

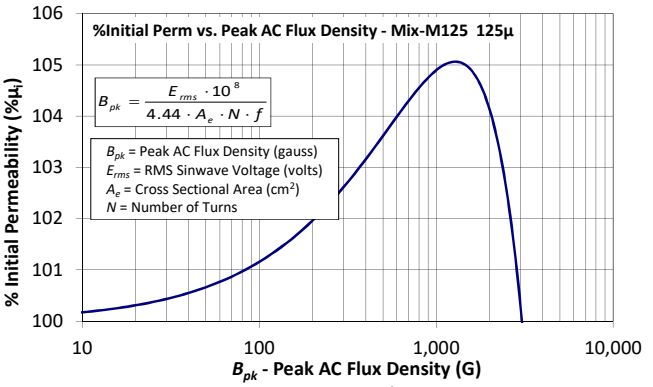
a=3.10E+10, b=2.70E+09, c=3.30E+06, d=5.30E-14



$$\%\mu_i = \frac{1}{a + b \cdot H^c} + d$$

where H expressed in oersteds, and:

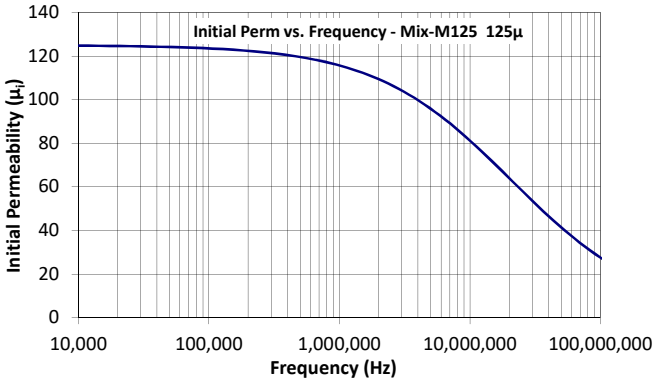
a=1.00E-02, b=2.70E-06, c=2.16, d=0.00



$$\%\mu_i = \frac{1}{\frac{1}{a + bB_{pk}^{\ c}} + \frac{1}{dB_{pk}^{\ e}} + \frac{1}{f}}$$

where B_{pk} expressed in gauss, and:

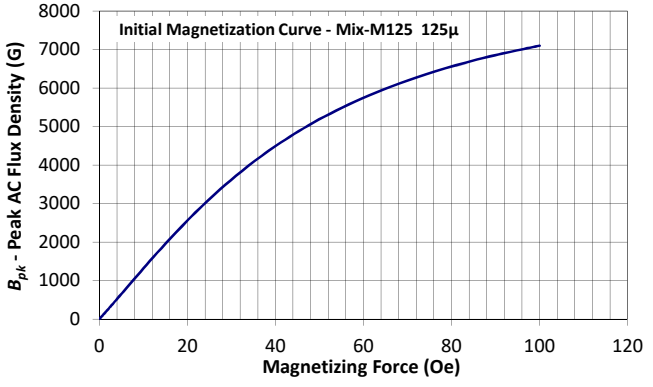
a=6.29E+02, b=4.10E+00, c=6.20E-01, d=1.76E+10, e=-2.07E+00, f=1.19E+02



$$\mu_i = \frac{1}{a + bf^{\ c}} + d$$

where f expressed in hertz, and:

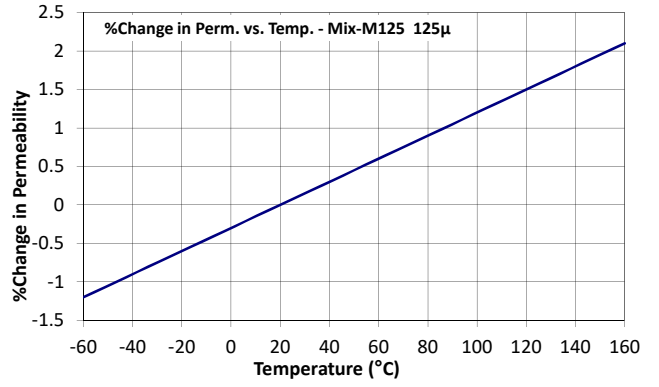
a=8.06E-03, b=7.01E-09, c=8.28E-01, d=1.00E+00



$$B_{pk} = \frac{\mu_i}{\frac{1}{H + aH^{\ b}} + \frac{1}{cH^{\ d}} + \frac{1}{e}}$$

where B_{pk} expressed in gauss, H in oested, and:

a=2.87E-02, b=1.91E+00, c=2.00E+09, d=1.00E-08, e=7.06E+01



$$\left(\frac{\Delta\mu_i}{\mu_i}\right) ppm = a(T - 20)$$

where T expressed in celsius, and:

a=150