Low No-Load Loss Transformer Applications

Amorphous cores have been available since the early 1980's, and until recently, have primarily been used in the Asia Pacific region where, the growing demand for electric power exceeds the generating capacity. In this region, the ability to radically reduce transformer no-load losses by utilizing transformers with amorphous cores is seen as an easy way to reduce transmission and distribution system losses, thereby maximizing the available generating capacity.

Elsewhere, global environmental initiatives and government legislation are now forcing compliance with mandatory minimum efficiency levels, and this is creating a demand for amorphous cores which are a cost effective way to redesign specific transformers to meet these new levels. Energy Star and ecoACTION are two North American projects designed to raise public awareness and promote energy efficiency. At Cogent, we consistently monitor the latest changes from the DOE, and others, to ensure we provide current solutions that meet the following efficiency standards:

- USA: DOE 10 CFR431 and NEMA TP-1
- Canada: CSA C802.1 and CSA C802.2
- Mexico: NOM-002-SEDE

COGENT POWER AMORPHOUS CORES

Cogent Power manufactures high quality amorphous cores to client specification, using Metglas™ amorphous ribbon. The cores are distributed gap (wound) type, and are partially epoxy coated to give the finished core mechanical rigidity, whilst sealing the edges. Cogent has test capability as well as full traceability back to the point of origin.

AVAILABLE AMORPHOUS GRADES

Two grades of amorphous are now available which are ideally suited to power/distribution transformer cores,

1. 2605-SA1 is the standard grade, which has been available for many years
2. 2605-HB1M is a relatively new, Hi-B grade, which has the advantage that it saturates at a higher flux density, thus allowing the transformers to be more compact

As one would expect, HB1M carries a premium, therefore the grade which represents the best value in a particular application will depend on at least two things,

1. The loss evaluation factors (how the cost of no-load loss is weighted against the cost of load loss)
2. The existence of dimensional restrictions (a need to make the unit more compact)

AMORPHOUS KEY DESIGN DATA (TYPICAL)

	SiFe	AMORPHOUS		Comments
	23M3	SA1	HB1M	
Core Loss 1.3T, 60Hz (w/lb)	0.284	0.0973	0.0944	HB1M is 3% lower than SA1 at 1.3T
Core Loss 1.4T, 60Hz (w/lb)	0.332	0.1156	0.1097	HB1M is 5% lower than SA1 at 1.3T
Saturation B (60Hz)	2.03T	1.56T	1.63T	HB1M saturation B is 4.5% higher than SA1
Resistivity (μΩ-cm)	45	130	120	SA1 and HB1 are less sensitive to harmonics than SiFe
Thickness/sheet	0.009"	0.000905" (23micron)	0.000985" (25micron)	HB1M is 8.8% thicker than SA1
Stack Factor	0.96	0.85	0.87	HB1M has a 2.4% higher stack factor than SA1
Density (lb/in³)	0.276	0.2594	0.2648	HB1M is 2.1% denser than SA1
Standard Widths	Up to master coil width	3 widths: 5.6", 6.7", 8.4"		

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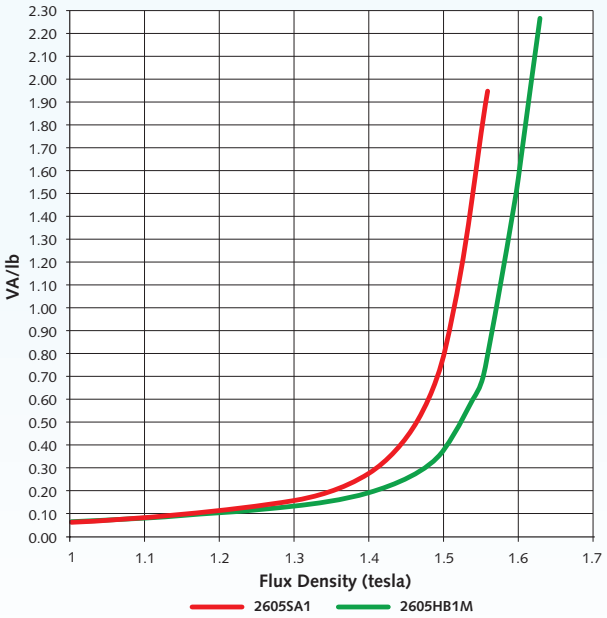
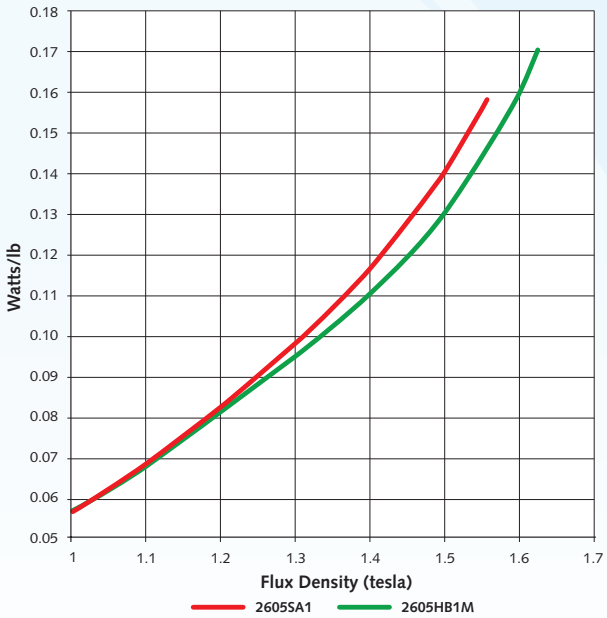
Typical Specific Exciting Power (VA/lb) vs Flux Density at 60Hz
AMORPHOUS CORES - Grade 2605SA1 vs 2605HB1M



Typical Specific Loss (WATTS/lb) vs Flux Density at 60Hz
AMORPHOUS CORES - Grade 2605SA1 vs 2605HB1M



THESE CURVES REPRESENT THE TYPICAL VA PER LB OF AN AMORPHOUS CORE AT 25DegC.

A "Destruction Factor" of approximately, +15%, must be added to the measured magnetizing VA to allow for the effect of the mechanical stresses, introduced to the core, when it is suspended within a single-phase, core and winding assembly.

THESE CURVES REPRESENT THE TYPICAL WATTS PER LB OF AN AMORPHOUS CORE AT 25DegC.

A "Destruction Factor" of approximately +10%, must be added to the measured core loss to allow for the effect of the mechanical stresses, introduced to the core, when it is suspended within a single-phase, core and winding assembly.

HIGH FREQUENCY PERFORMANCE

In addition to having ultra low, 60Hz, transformer no-load (core) loss properties, amorphous ribbon also performs exceptionally well at very high frequencies. As a result, it is used in specialty transformers in electronics applications and where miniaturization is required.

A summary of the specific core loss at a flux density of 1.0 tesla and various frequencies, is tabulated below.

Frequency	Watts/lb
60 Hz	0.055
400 Hz	0.7
1 kHz	2.5
5 kHz	28.0
10 kHz	90.0

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