



IEC TC51 Activity

Summary
December 2009

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Questions of an Inductor or Transformer User...

“Which materials are equivalent? How do they differ?”

“What is the best way to test my parts?”

“Which sizes are interchangeable from many vendors?”

“How can I specify inductor reliability or current rating in a practical way?”

“How can I specify visuals, gaps, dimensions, & electricals, in a practical way?”

...answers are addressed by Standards

Overview of IEC Technical Committee 51

TC51: Magnetic Components and Ferrite Materials

- Originated in 1958
- 67 standards published and active
- Productive, active TC, in large part due to vigorous Japanese secretariat
- Participation from most leading ferrite producers, many leading inductor manufacturers
- Average of 5+ new or updated publications per year

Active Working Groups of TC-51

- **WG-1** **Ferrites and Powder Cores**
Co-convenors: Huisman/Lange – Netherlands/Germany
- **WG-9** **Inductive Components**
Convenor: Swihart - US
- **WG-10** **Magnetic Materials and Devices for
EMC Applications**
Co-convenors: Yoshida/Ono - Japan

Voting on Proposals and Standards

- TC51 has nine voting members
 - China, Germany, Japan, India, Korea, Russia, Slovenia, United Kingdom, and United States.
 - Votes are submitted by each national committee (NC)
 - In the US, votes and official comments are made by the USNC of IEC, an office of ANSI
 - USNC is advised regarding votes and comments by the Technical Advisory Group (TAG)

Development of a New Standard

- Testing/round robin as needed
- Consensus, compromises sought
- User acceptance given weight
- Existing standards considered



Recent Meetings

- TC-51 Plenary Meeting October 2009 Shenzhen, China
 - With ElectronicAsia
 - Hosted by TDG and China NC

 - TC-51 WGs-1, 9, 10 November 2008 Munich, Germany
 - With Electronica
 - Hosted by TDK/EPCOS

 - TC-51 Plenary Meeting February 2008 Austin, Texas, US
 - With APEC
 - Hosted by Enpirion, Steward, Magnetics

 - TC-51 WGs-1, 9, 10 September 2007 Hong Kong
 - With ElectronicAsia
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Upcoming Meeting

- TC-51 WGs-1, 9, 10 Nov. 8, 2010
 - Munich, Germany
 - With Electronica
- Meetings are once or twice per year, always in conjunction with an industry trade show, so that industry experts are available to participate.
- To be involved, it is not mandatory to attend the meetings.
- Productive discussion and planning is done at the meetings...
- ...but the most critical work is reviewing the draft standards for the purpose of offering comment and suggestions. That work progresses mainly via email.

Connections to IEC

- Some member national committees (e.g. Japan and Germany) maintain national working groups that mirror the IEC WGs.
- National standards have been the origin for TC-51 work; examples:
 - Half pot cores for proximity switches (Germany)
 - Inductor reliability (European, US and Japanese automotive and other standards)

Connections to IEC

- IEEE Electronics Transformer Technical Sub-committee (ETTC) has common members and a liaison with TC-51.
 - ETTC maintains IEEE-393, standard for test procedures for magnetic cores.
 - Several other transformer and inductor standards.
- ASTM A6 Committee on Magnetic Properties has 40+ standards including test methods and material classification.
- PSMA (Power Sources Manufacturers Association) has common members and liaison via the PSMA Magnetics Committee.
- IMA (International Magnetics Association) formerly published ferrite standards in harmony with IEC. IMA is now a committee within The Transformer Association (TTA).

Examples of TC51 standards now in use

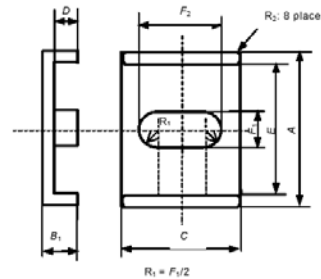
- 61631 – Ferrite breakstrength measurement
- 62333-2 – Noise suppression sheet measurement
- 62317-13 – Standard PQ core dimensions
- 62025-1 – Surface mount inductor mechanicals
- 60424 – Cracks, chips, visuals (-1: general, -2: RM, -3: E)
- 60205 – Calculation of effective parameters

See: www.iec.ch

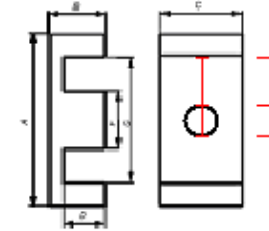
62313

Planar Cores for BMP

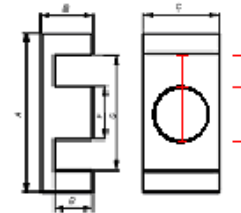
- Three new geometries now, additional to the traditional ELP.



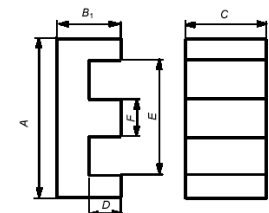
EL – This is a newer geometry; the shape of the centerleg is designed for the result of lower overall height. Also with I-cores (plates).



Small CP ER – (CP is Center Post) The diameter of the CP is less than 1.5 times the space between the CP and the outer leg (such as ER 23). Outer legs may be straight or concave on the inside. Also with I-cores (plates).



Large CP ER – (CP is Center Post) The diameter of the CP is more than 1.5 times the space between the CP and the outer leg (such as ER 11). Outer legs may be straight or concave on the inside. Also with I-cores (plates).

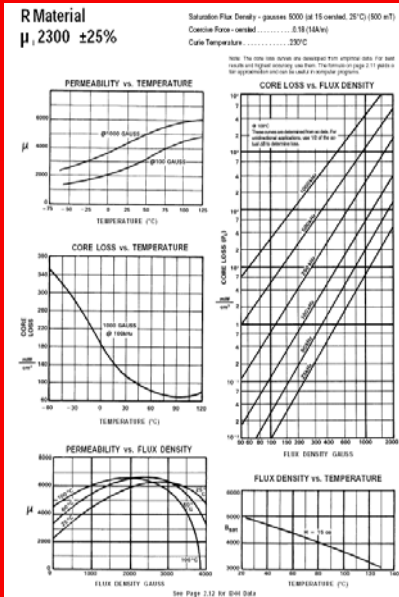


ELP – This is the most common planar core today (sizes 14, 18, 22, 32, 38, 43, 58, 64, and 102 mm). Also with I-cores (plates).

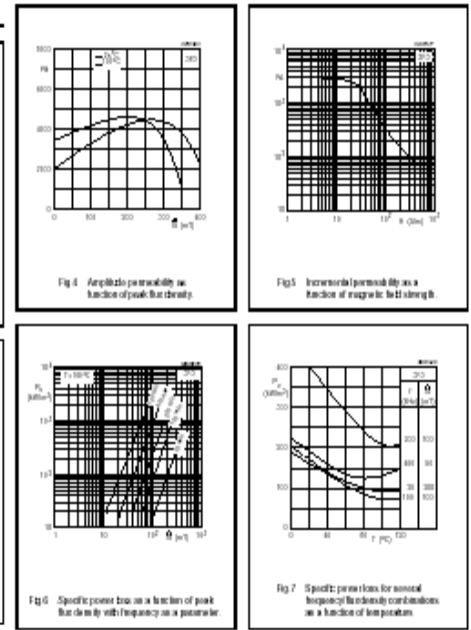
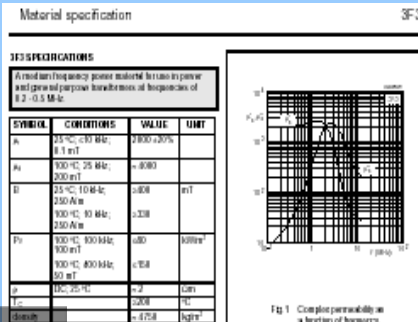
61332

Soft Ferrite Material Classification

- Purpose is helping users of ferrites to make relevant comparisons among grades offered from various manufacturers.



Initial Permeability	μ	R
Maximum Usable Frequency (50% roll-off)	f	2300 \pm 25%
Relative Loss Factor	$\frac{\tan \delta}{\mu_{dc}}$	< 1.5
Cure Temperature	T_c	> 220
Relative Temp. Factor -30°C to +20°C +20°C to +70°C		
Flux Density @ 1194 Am (15 Oe)	B_m	5000
Romanence	B_r	500
Coercivity	H_c	0.18
Disaccommodation Factor	D_F	14
Resistivity	ρ	
Density	δ	
Power Loss (P_L), Sine Wave, in mW/cm ² (typical)		25kHz 200mT (2000G) 100kHz 100mT (1000G) 500kHz 50mT (500G) 700kHz 50mT (500G)



62044-2

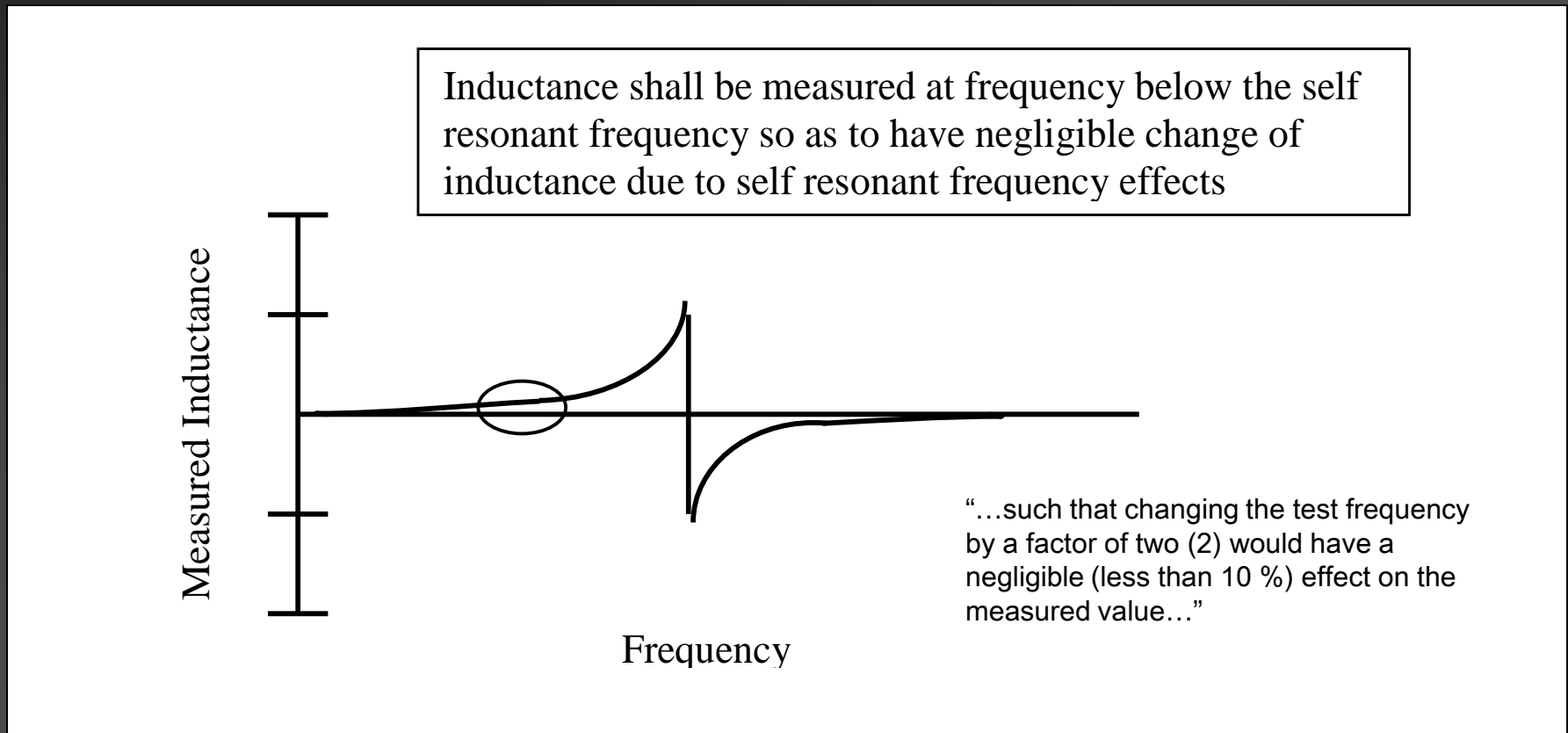
Measurement at Low Drive Levels

- Definitions of ferrite low level measurements (not power measurements).
- Examples:
 - A_L
 - THD
 - Curie temp
 - Disaccommodation.
- Took several years development time due to technical difficulty in several areas, especially THD.

62044-2

Measurement at Low Drive Levels

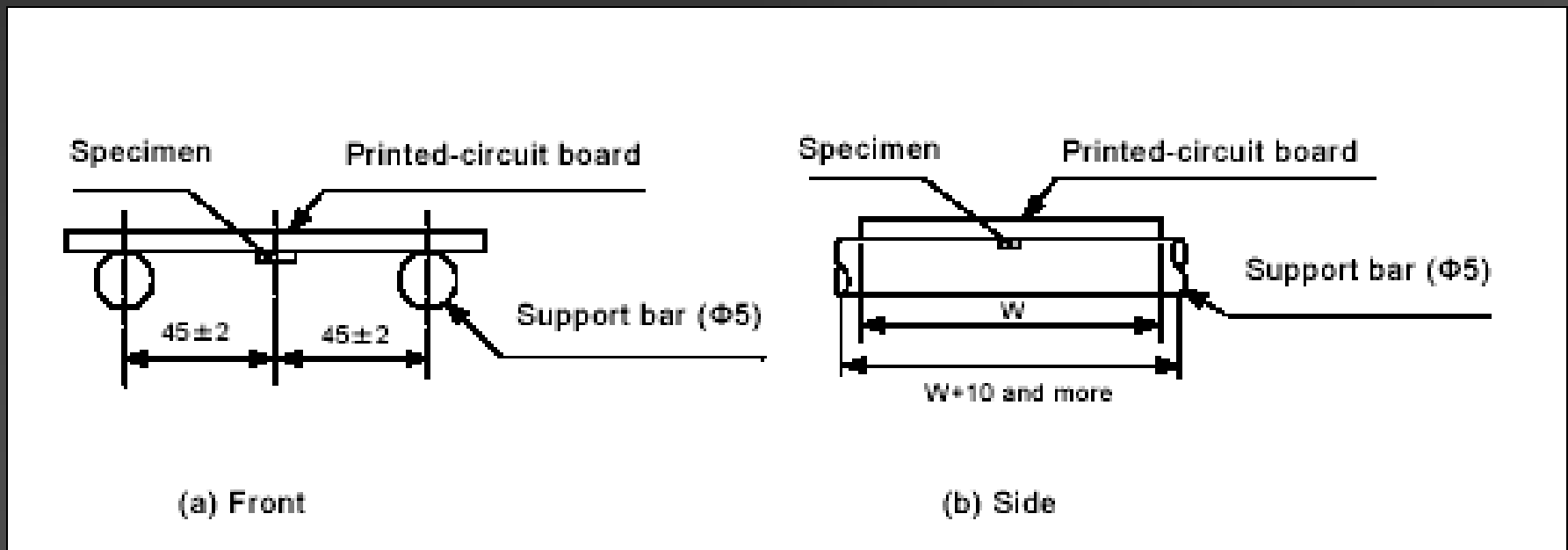
Example – common user question regarding A_L measurement.



62025-2

Surface Mount Inductors

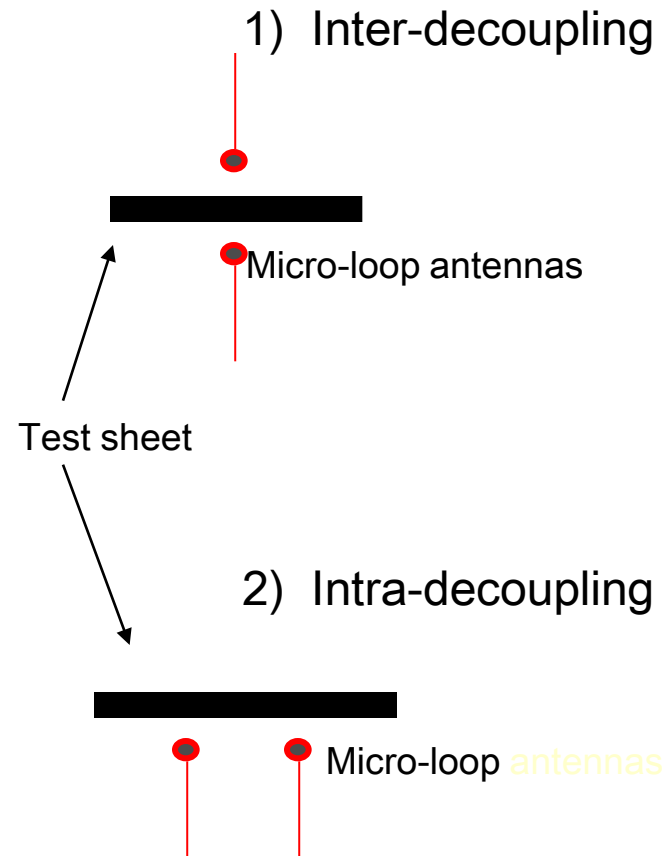
- Test methods for non-electrical characteristics.
- E.g. peeling test, substrate test, bending test, free drop test.



62333-1
62333-2

Noise Suppression Sheet

- Driven by Japanese market and research
- Addresses shields applied directly on the board, e.g. on top of the CPU



60401-3

Presentation of Catalog Data

- Standard format and units for display of ferrite catalog data.
- Purpose is to promote useful comparison data from one manufacturer to another.

Material Characteristics (cont.) (1)			INDUCTORS AND POWER TRANSFORMERS		
			MATERIALS →	K	R
Initial Permeability	μ_j	—	1500 ± 25%	2300 ± 25%	2500 ± 25%
Maximum Usable Frequency (50% roll-off)	f	MHz	< 2	< 1.5	< 1.2
Relative Loss Factor	$\frac{\tan \delta}{\mu_{iac}}$	10 ⁻⁶			
* Curie Temperature	T _C	°C	>230	>230	>230
* Relative Temp. Factor -30°C to +20°C +20°C to +70°C	f _C	10 ⁻³ /°C			
* Flux Density @ 1194 A/m (15 Oe)	B _m	G mT	4600 460	5000 500	5000 500
* Remanence	B _r	G mT	900 90	1100 110	1100 110
* Coercivity	H _c	Oe A/m	0.2 16	0.18 14	0.18 14
Disaccommodation Factor	D _F	10 ⁻⁶			
* Resistivity	ρ	Ω·m	20	6	5
* Density	δ	g/cm ³	4.7	4.8	4.8
* Power Loss (P _L), Sine Wave, in mW/cm ² (typical)	25kHz 200mT (2000G)	@25°C @60°C @100°C @120°C		130 85 70 85	120 90 95 130
	100kHz 100mT (1000G)	@25°C @60°C @100°C @120°C	100 90 110 130	140 100 70 90	125 90 125 165
	500kHz 50mT (500G)	@25°C @60°C @100°C @120°C	100 100 120 140	375 300 250 300	300 250 275 350
	700kHz 50mT (500G)	@25°C @60°C @100°C @120°C	180 200 220 290		

62211

Inductive Components Reliability Testing

- Specs relate to temperatures, humidities, number of test cycles, vibration. These are defined differently in different application categories.
- Japanese and European views were at odds. Europe cautious about test expense, Japan cautious about maintaining rigorous standard limits.
- Compromises suitable to all were reached.

Recent publications and updates

- Inductor rated currents
 - Nanohenry chip inductor electricals
 - Updated effective parameter calculations
 - Updated dimensional references by type
 - EFD core dimensions
 - Updated pot core dimensions
 - Planar ferrite visuals (surface irregularities)
 - Noise suppression sheet materials characterization
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United States Technical Advisory Group

- Mark Swihart, Magnetics - serves as TA (Chair)
 - Engineers from power supply, inductor/transformer, and magnetic core manufacturers participate.
 - Workload is generally quite light for participants; the focus is on providing technical comment on the standards in development.
 - *To become involved, contact:*
 - Mark Swihart
 - mswihart@spang.com
 - Phone 412/963-5652
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TC51 Published Standards – Transformers and Inductors

Inductors

Specifying Inductors	61248-6	
Rated Current	62024-2	Update in 2010
Chip Inductors	62024-1	Update in 2010
Surface Mount Performance	62025-1	Update in 2010
Surface Mount Testing	62025-2	Update in 2010
Reliability	62211	
Marking Codes	61605	

Transformers

Transformers & Inductors Test & Meas	61007
Transformers & Inductors - General	61248-1
Signal Transformers	61248-2
Power Transformers	61248-3
SMPS Transformers	61248-4
Pulse Transformers	61248-5
High Freq Transformers	61248-7

TC51 Published Standards – Ferrites – Dimensions

Core Dimensions

Reference Definitions	60401-2	
General Specifications	62317-1	
Pot Cores	62317-2	Future (2010), replaces 60133
Half Pot Cores	62317-3	Future, replacing 62323
RM Cores	62317-4	
EP Cores	62317-5	Future (2010), replaces 61596
ETD Cores	62317-6	Future, replacing 61185
EER Cores	62317-7	
E Cores	62317-8	
Planar Cores	62317-9	
PM Cores	62317-10	Future, replacing 61247
EC Cores	62317-11	Future, replacing 60647
Ring Cores (Toroids)	62317-12	Future, replacing 61604
PQ Cores	62317-13	
EFD Cores	62317-14	
Lamination sizes	61021-1	

TC51 Published Standards – Ferrites – Testing and Materials

Ferrite Cores

Electrical Measurements - General	62044-1	
Low Level Measurements	62044-2	
High Level Measurements	62044-3	
Standard AL Values	62358	Update in 2009
Ferrite Material Classification	61332	Update in 2010
Effective Parameters	60205	
Ferrite Catalog Data Presentation	60401-3	
Cylinder, Tube, Screw Cores	60732	
Technology Approval Schedule	62398	Published as IECQ/CECC QC210018

TC51 Published Standards – Ferrites – Physical Properties

Core Physical Properties

Ferrite Physical Inspection Nomenclature	60401-1
Ferrite Surface Irregularities	60424-1
RM Cores	60424-2
E & ETD Cores	60424-3
Toroid Cores	60424-4
Planar Cores	60424-5
Marking (Ferrite U & E)	61333
Ferrite Break strength testing	61631

TC51 Published Standards – High Frequency

Noise Suppression Sheet

Terms & Definitions	62333-1	
Measurement	62333-2	
Material Classification	62333-3	New for 2010 – Publication Approved

High frequency materials

Microwave Ferrites	60392	
Microwave Ferrites – Measuring Methods	61830	Will be withdrawn in 2010
Microwave Ferrites - Specifications	61609	
Gyromagnetic Materials	61843	
Gyromagnetic Materials - Measurement	60556	Update in 2010

TC51 Published Standards – Lamination Cores

Laminated Cores

Mechanical and Electrical Performance	60740-1
Permeability	60740-2
YEE-2 Electricals	61021-2
Coil Formers	61797-1
Silicon Steel Cut Cores	60329
Toroidal Strip Wound Cores	60635

Telecomm Laminations

Sizes YEI-1	60852-1
Sizes YEx-2	60852-2
Sizes YUI-1	60852-3
Sizes YUI-2	60852-4
Series Q (C-cores)	60852-5