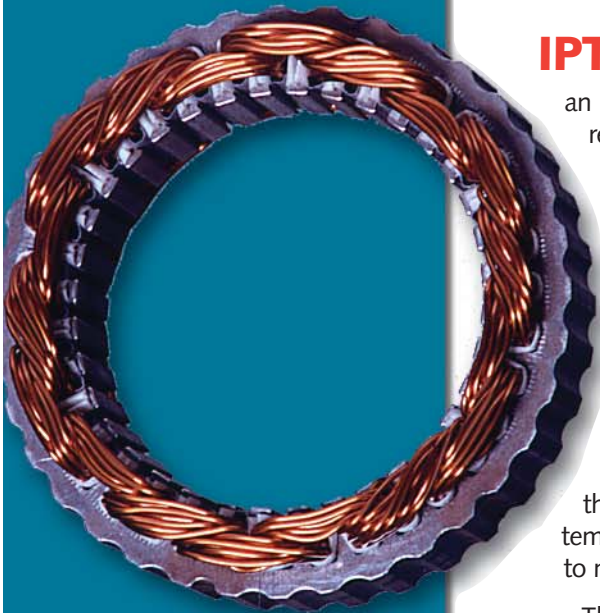




**INNOVATIVE PAPER TECHNOLOGIES, LLC**

# Insulation Solutions





## IPT is ...

an organization of specialists who research, design and manufacture high quality inorganic papers and boards for industrial applications.

At the manufacturing and R&D facilities in Tilton, New Hampshire, IPT has pioneered the development and production of a new generation of products which are performance engineered to meet the most rigorous applications at temperatures ranging from sub-zero to more than 250°C.

These state-of-the-art materials have been refined, tested and proven in a wide variety of applications – including use as high temperature electrical insulation in transformers, motors and generators; and as flame barriers in household appliances.

You are encouraged to challenge IPT with your most demanding applications. The IPT team is prepared with the materials, equipment and technological processes to develop and produce the high performance products you require.



## Our Mission...

is to provide our customers with a competitive advantage through innovation, technology and quality:

- by ensuring that our products meet or exceed our customers' expectations
- by maintaining a flexible organization that is responsive to our customer's needs
- by continually improving operations.

Our corporate policies are guided by the following principles:

- Quality will not be compromised.
- Customers are the guiding force for everything we do. Without customers, there is no business.
- We place a top priority on honesty, integrity and fairness in our relationships with employees, customers, suppliers and the community in which we operate.

### Table of Contents

MANUFACTURING CAPABILITIES .....	1
THERMAVOLT™ CALENDARED PAPERS .....	2
CeQUIN® INORGANIC-BASED ELECTRICAL INSULATION PAPERS .....	4
CeQUIN® I, II .....	3
CeQUIN® 3000 .....	7
CeQUIN®/FILM LAMINATES .....	8
CeQUINBORD® CGA .....	10
TufQUIN® INORGANIC-BASED ELECTRICAL INSULATION PAPERS .....	11
TufQUIN® 110, 120 .....	12
TufQUIN®/FILM LAMINATES .....	14
DMD180® HIGH-PERFORMANCE FLEXIBLE LAMINATES .....	17
TECHNOLOGY .....	20
STANDARDS COMPLIANCE .....	20
ENVIRONMENTAL SAFETY & HEALTH .....	20
QUALITY CONTROL & PRODUCT WARRANTY .....	21



# Manufacturing Capabilities

IPT operates a clean, efficient manufacturing facility with modern, well-maintained paper making and coating/laminating machinery. The equipment shown here gives IPT the design flexibility and production capacity to modify existing materials in the development of new products as well as provide full production runs for your manufacturing requirements.



Double disc refiner

Centrifugal cleaners on the 4-cylinder paper machine.



## Precision coater/laminator

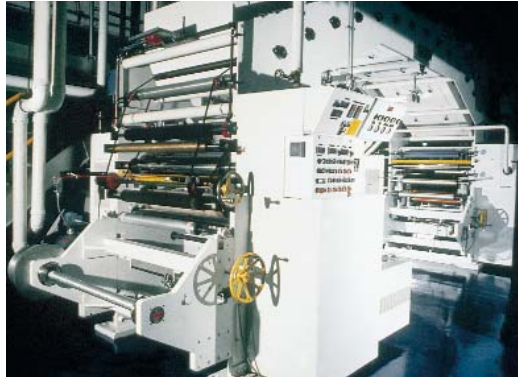
- Width: 40"
- Precision coating capabilities
- Duplex laminator

## Sheeter

- Thickness: 3 to 60 mil
- Width: 38"
- Sheet length: 12" to 72"

## 3 Slitter/rewind machines

- Thickness: 3 to 60 mil
- Width: Minimum 1/4" / Maximum 40"



Precision coater/laminator.

Tower coater/saturator.



## 4-cylinder paper machine

- Thickness: 3 to 30 mil
- Width: Maximum 38"
- Inorganic-based papers

## Single cylinder board machine

- Thickness: 1/32" to 3/8"
- Board size: Maximum 48" x 48"
- Inorganic-based boards

## Tower coater/saturator

- Width: Maximum 40"
- 3 Zone, 40' tower

## Wet combiner

- Width: 38"
- Wet lamination technique
- Triplex capabilities

## APPLICATIONS

Ground, phase and inter-winding insulation for dry-type transformers

Slot, phase and wedge insulation for electric motors and generators

Flame Barrier insulation for appliances

Voice coil insulation for loudspeakers

LENSWRAP for glass lens production

Wire and cable wrap

Coated papers for heat/pressure bonding applications

Specialty paper base for tamper-proof labels

Oil-filled transformers

Battery separators

Backing pads for heat-seal packaging

Cast Coil transformers

Switch gear



# ThermaVolt™

## Calendered Insulation Paper

### Major Features and Benefits of the newest innovation from Innovative Paper Technologies

- **UL Systems Recognition\* – Class 220 (R)**
- **High Inorganic Content**
- **Excellent Thermal Conductivity**
- **Good Dielectric Breakdown Resistance**
- **Reduce costs with improved processability**
- **Low Moisture Absorption**
- **Thicknesses: 3 mils (.08mm) to 10 mils (.25mm)**

\* All electrical insulation systems testing per UL 1446 and IEC 61857



### DESCRIPTION

ThermaVolt™ inorganic-based paper has been developed to meet the high-performance required for use in high-temperature, dry-type transformers. ThermaVolt offers good dielectric characteristics and thermal conductivity – making it especially suitable for use as interwinding insulation in strip-wound coils. ThermaVolt has been designed for use as major ground insulation in electrical insulation systems up to Class 220(R).

### APPLICATIONS

**High Temperature Electrical insulation for:**

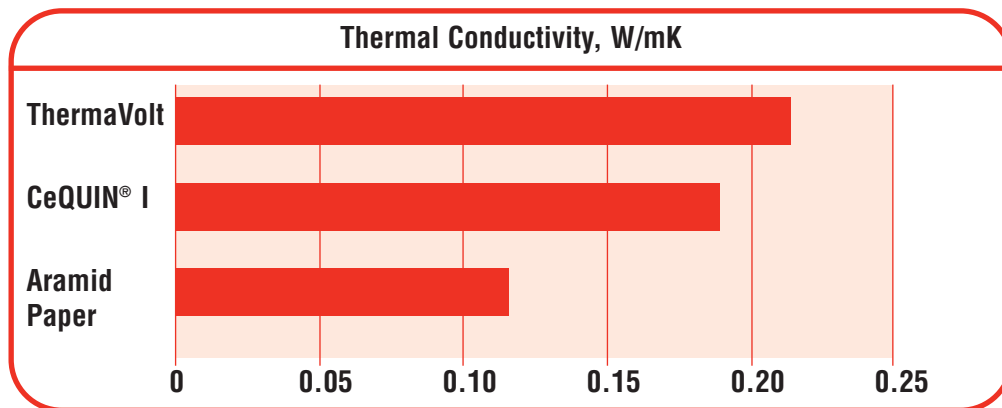
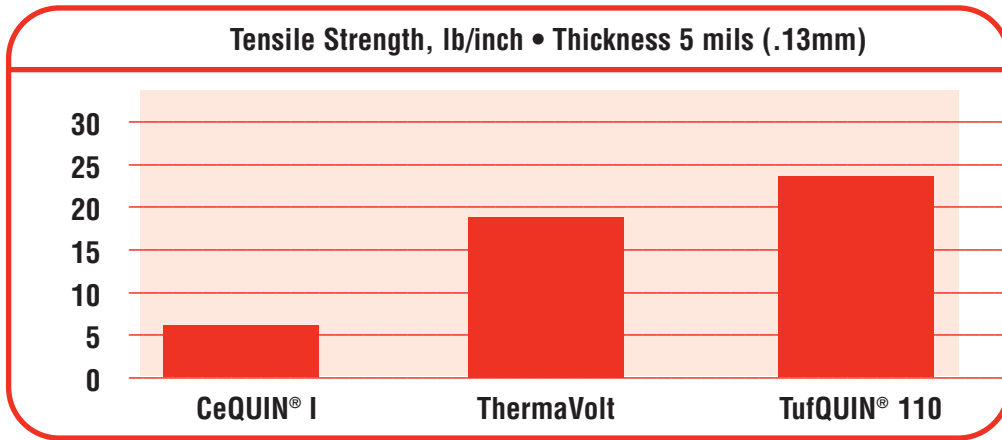
#### **Dry-Type Transformers**

- Ground Insulation
- Phase Insulation
- Layer Insulation
- Interwinding for foil wound designs

#### **Electromagnet Coils**

The data presented here are typical average values and are not to be used for specification purposes. No warranty is given or implied. It is the responsibility of the user to determine the material's suitability for use.

ThermaVolt™ Typical Product Properties					
Nominal Thickness	mils (mm)	3 (.08)	5 (.13)	7 (.18)	10 (.25)
Basis Weight	g/m <sup>2</sup>	92.	168.	260	385.
	lb/SY	0.17	0.31	0.48	0.71
Tensile Strength, MD	kN/m	1.1	3.2	4.4	7.0
	lb/inch	6	18	25	40
Elongation, MD	%, min	3	3	3	3
Dielectric Strength	kV	1.0	3.0	4.0	6.0
Thermal Conductivity	W/mK	0.21	0.21	0.21	0.21





# CeQUIN®

## HIGH PERFORMANCE INORGANIC-BASED ELECTRICAL INSULATION PAPERS

The information contained below is applicable to all CeQUIN papers, laminates and boards. Please refer to individual product pages for information specific to each CeQUIN product.

### FEATURES

#### UL® & CSA CERTIFICATION

- UL systems recognition through Class 220(R).
- CSA Component Acceptance: Temperature Class 220.

#### DIELECTRIC PERFORMANCE

CeQUIN® papers retain a high percentage of dielectric strength even after extended exposure to high operating temperatures. CeQUIN will also exhibit greater voltage endurance under continuous electrical stress than many other electrical insulation materials.

#### THERMAL CONDUCTIVITY

The high thermal conductivity of CeQUIN papers helps achieve the heat dissipation required in today's high efficiency electrical apparatus allowing the design of smaller, more cost effective equipment.

#### VARNISH ABSORPTION

The good varnish absorption characteristics of CeQUIN can enhance its already high thermal conductivity allowing equipment to run cooler, quieter, and last longer.

#### LOW MOISTURE ABSORPTION

Manufactured with less than 1% moisture content, CeQUIN papers exhibit low moisture absorption even in humid environments, thereby reducing the need for extended drying cycles.

### APPLICATIONS

High Temperature Electrical Insulation for:

#### Dry-Type Transformers

- Ground Insulation
- Phase Insulation
- Layer Insulation
- Barrier Insulation
- Core Wrap
- End Fill
- Interwinding for strip-wound coils

#### Traction Motors, Generators

- Interwinding for form wound coils
- Slot Fill
- Phase Insulation

#### Wire and Cable Wrap

#### Battery Separators

#### Capacitor and Electromagnet Layer Insulation

#### Switchgear Insulation

#### Spiral and Convolute Tubing

### UL RECOGNITION

CeQUIN inorganic papers are designed to provide high-temperature performance in electrical insulation systems. CeQUIN products have undergone extensive thermal aging evaluation per UL 1446, "Standard for Systems of Insulating Materials – General," and as a result are UL Recognized as suitable for use as major ground insulation in systems rated through Class 220(R).

Several UL Recognized Insulation Systems are listed under IPT File No. E65007 in the OBJS2 category for Class 130(B), Class 155(F), Class 180(H), Class 200 (N), and Class 220(R) applications and may be found on UL's Electrical Insulation Systems Database at <http://data.ul.com/systems/>. All systems listed on this database are available for use by any electrical apparatus manufacturer by contacting the nearest UL office.

## CeQUIN® I, II

### Cost-effective, High-temperature, High Performance Electrical Applications

#### DESCRIPTION

CeQUIN® I is IPT's highest inorganic-content paper; comprised primarily of glass fibers and microfibers, inorganic fillers, and less than 10% organic binder, CeQUIN I is capable of long-term performance at operating temperatures up to 250°C. CeQUIN I is a highly flexible paper available in continuous roll stock in thicknesses ranging from 5 mil (.13mm) to 30 mil (.76mm). See Table I for Typical Product Properties of standard thicknesses of CeQUIN I, II. Other thicknesses are available on special order. Contact your Regional Sales Manager for details.

#### CeQUIN I

The high inorganic content of CeQUIN I provides the excellent thermal and dielectric stability that is required for today's high performance designs. CeQUIN I electrical insulation papers will outperform competitive organic materials that cost substantially more.

#### CeQUIN II

CeQUIN II is a two-layer composite of CeQUIN I designed to provide thicker roll stock for barrier, end filler, and core wrap insulation applications. CeQUIN II exhibits enhanced physical and dielectric properties; it is available in thicknesses ranging from 30 mil (.76mm) to 60 mil (1.52mm).

#### PHYSICAL CHARACTERISTICS

The excellent thermal conductivity (see Graph 1) of CeQUIN materials helps dissipate heat build-up in electrical equipment resulting in reduced operating temperatures, longer life, and higher energy efficiency. Dry-type transformer coils wound with CeQUIN have exhibited 10-15°C lower average winding temperature rise as compared to coils of the same design wound with competitive high temperature insulation materials.

Alternatively, equipment design engineers can take advantage of the improved heat dissipation afforded by CeQUIN to design more compact coils and reduce overall costs.

CeQUIN inorganic papers exhibit low moisture content and very little moisture absorption even under high humidity conditions, especially when compared to aramid paper, thus reducing the need for extended drying cycles prior to varnishing. CeQUIN papers are not susceptible to hydrolytic degradation as are some organic-based insulation materials.

CeQUIN papers are easily impregnated and fully compatible with standard varnishes and resins, yielding tightly bonded coils and further improving thermal conductivity.

The high inorganic content of CeQUIN I and II equates to excellent dimensional stability, whether exposed to varying humidity conditions or long-term thermal aging.

#### ELECTRICAL CHARACTERISTICS

The thermal stability of CeQUIN inorganic papers is demonstrated in their retention of dielectric strength, even after thermal aging at temperatures in excess of 300°C. Graph 2 exhibits the performance of 10 mil (.25mm) CeQUIN I vs. 10 mil (.25mm) calendered aramid paper when aged at 310°C.

The inorganic content of CeQUIN papers reduces the effect of long-term electrical stress and partial discharge on their insulation qualities. For example, when exposed to a continuous electrical stress of 1.8kV, 10 mil CeQUIN I will typically exhibit over three times the voltage endurance of 10 mil calendered aramid paper (see Graph 3).

#### RECOMMENDED PRACTICE FOR USING CeQUIN PRODUCTS

Optimum performance of an electrical insulation system is dependent upon many factors including proper choice of materials, acceptable design criteria, and good manufacturing procedures. CeQUIN's resistance to moisture absorption can minimize drying time required prior to varnish impregnation or encapsulation. Varnishing is recommended for construction of equipment that may be exposed to the elements. CeQUIN papers are easily saturated and will tend to assume the aging characteristics of the resin or varnish that is used.

For design purposes, it is recommended that operating electrical stresses in electrical apparatus not exceed 40 V/mil (1.6 kV/mm) in order to minimize the risk of partial discharge.

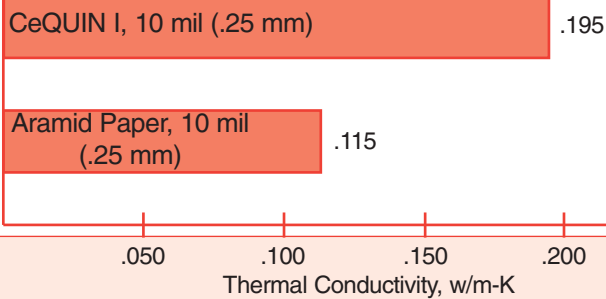


Table 1 - Typical Product Properties

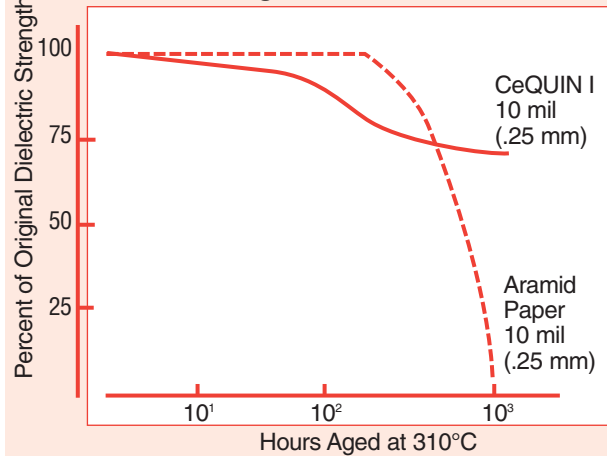
ASTM Test Method		CeQUIN® I						CeQUIN® II		
Nominal Thickness	mm	.13	.18	.25	.38	.63	.76	.76	1.0	1.5
	mil	5	7	10	15	25	30	30	40	60
Basis Weight	kg/m <sup>2</sup>	.13	.19	.27	.41	.67	.81	.81	1.08	1.67
	lb/sq yd	.24	.35	.50	.75	1.24	1.5	1.5	1.99	3.07
Tensile Strength	kN/m	1.0	1.6	2.1	2.8	3.5	4.0	8.9	9.6	10.6
	MD lb/inch	6	9	12	16	20	23	51	55	61
Elongation, MD	%	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dielectric Breakdown Strength	kV	1.0	1.3	1.8	2.6	3.2	3.8	6.5	8.8	9.2
Moisture Absorption%		<1	<1	<1	<1	<1	<1	<1	<1	<1

GRAPH 1 – Thermal Conductivity

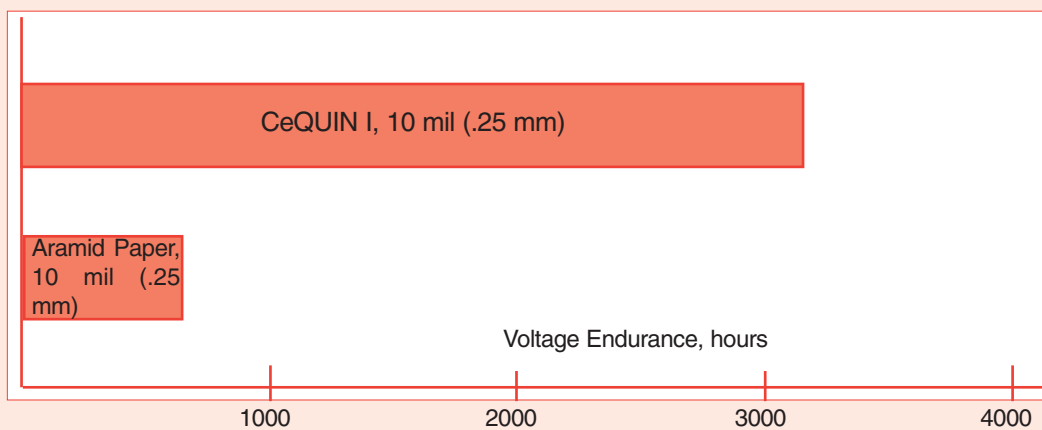
Thermal Conductivity of CeQUIN I vs. calendered aramid paper; tested at 180°C per ASTM E 1530.



GRAPH 2 – Effect of Thermal Aging on Dielectric Strength



GRAPH 3 – Voltage Endurance at 7 kV/mm



Voltage endurance of CeQUIN I vs. calendered aramid paper; average of five data points for each material; materials tested concurrently on same machine at 20°C, 50% RH.



## CeQUIN® 3000

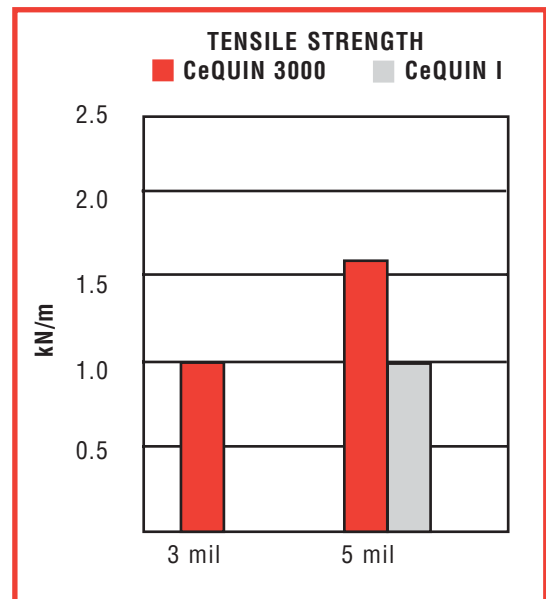
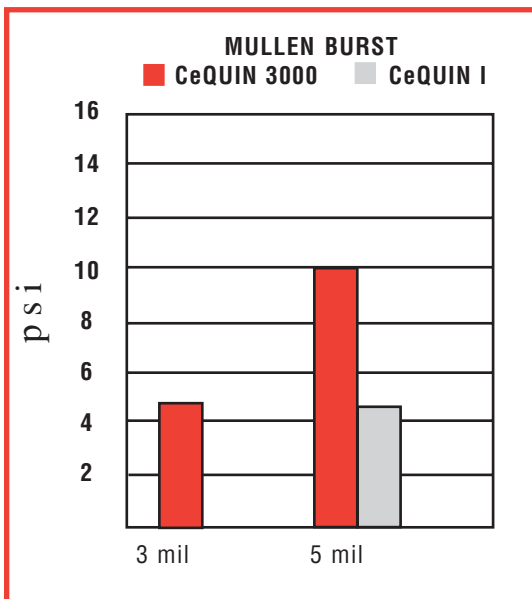


### DESCRIPTION

CeQUIN® 3000 is a modified version of CeQUIN® I developed by IPT's research and development team to provide high strength thin papers. By introducing a small percentage of organic fiber reinforcement along with a high-strength binder system, CeQUIN 3000 papers may be produced in 3 mil and 5 mil thicknesses. CeQUIN 3000 is composed of approximately 74% inorganic content as compared to the 90% inorganic content of CeQUIN I. CeQUIN 3000 may be laminated with polyester film, or glass fabric to enhance initial dielectric strength or improve mechanical manageability. CeQUIN 3000 is available in continuous roll stock, up to 36 inches wide, as slit tapes or sheets.

**CeQUIN® 3000**  
Typical Product Properties

Nominal Thickness	mm	0.08	0.13
	mil	3	5
Basis Weight	kg/m <sup>2</sup>	0.07	0.11
	lb/yd <sup>2</sup>	0.13	0.19
Tensile Strength, MD	kN/m	1	1.6
	lb/inch	5.5	9
Elongation to Break, MD	%	1.4	1.4
Dielectric Breakdown Strength	kV	0.6	1.0
Moisture Absorption	%	<1	<1





# CeQUIN® LAMINATE INSULATIONS

## For High Performance Electrical Applications

### CeQUIN® with PET Polyester Film

#### BENEFITS OF CeQUIN INORGANIC PAPERS

- High temperature capabilities
- Long-term dielectric strength
- Good thermal conductivity
- Low moisture absorption
- Cost effective

#### ... COMBINED WITH THE ADDED BENEFITS OF POLYESTER FILM

- Higher mechanical strength
- Improved cut-through resistance
- High initial dielectric strength

#### UL® AND CSA CERTIFICATION

- UL Systems Recognition Through Class 220(R)
- CSA Component Acceptance Temperature Class 220C

#### DESCRIPTION

IPT composites of CeQUIN® inorganic-based papers laminated with polyester film have been developed to provide a balanced blend of electrical, physical, and thermal capabilities on a cost effective basis. The polyester film is bonded to either CeQUIN I or CeQUIN 3000 using a high temperature resin system. A variety of two-ply and three-ply laminates are available; the different constructions are designated as follows:

##### CeQUIN IF:

a two-ply composite of CeQUIN I inorganic paper bonded to polyester film.

##### CeQUIN IFI:

a three-ply composite of CeQUIN I paper bonded to both sides of a polyester film.

##### CeQUIN FIF:

a three-ply composite of polyester film bonded to both sides of CeQUIN I paper.

##### CeQUIN 30F:

a two-ply composite of CeQUIN 3000 inorganic paper bonded to polyester film.

##### CeQUIN 30F30:

a three-ply composite of CeQUIN 3000 paper bonded to both sides of a polyester film.

#### PHYSICAL CHARACTERISTICS

CeQUIN® paper/polyester film laminate insulations are designed to meet the high performance requirements of Class 220(R) coil winding applications, as well as wrapping for wire and cable applications rated 250°C and above.

CeQUIN inorganic papers provide the long-term thermal stability and dielectric strength required for continuous operations at temperatures up to 220°C. The polyester film provides added mechanical strength, improving the overall handleability of the CeQUIN paper, makes it easier to use in coil winding and wire wrapping processes.

Together the materials form a flexible laminate uniquely suited for high temperature electrical insulation applications.

Note the following advantages of using CeQUIN paper with polyester film laminates:

- CeQUIN/film laminates exhibit high tensile strength and excellent resistance to tear initiation for ease of handling in manufacturing operations.
- The high inorganic content of CeQUIN papers provides excellent long-term voltage endurance when compared to other high temperature insulation materials such as aramid papers.
- CeQUIN/film laminates are non-hygroscopic and exhibit low moisture absorption characteristics, thus reducing the need for extended drying cycles prior to varnishing or encapsulation.
- The high thermal conductivity of CeQUIN papers and film laminates promotes cooler running equipment, leading to longer insulation life, better reliability, and more efficient use of power.
- The lamination of polyester film to CeQUIN papers yields improved initial dielectric strength making it easier to proof test coils at high voltages prior to varnishing or encapsulation.

CeQUIN inorganic papers laminated to polyester film are available in a wide variety of standard constructions. Nonstandard combinations are available on special order to meet your specific requirements. No need to overdesign; choose the combination that is most cost effective for your application. See table 1 for typical product properties of some of the standard CeQUIN/film combinations.

### Why use polyester film?

This is one of the most frequent questions we hear from equipment manufacturers. The answer is simple – the polyester film component is considered to be mechanical support for the CeQUIN paper, in essence, a processing aid to help you better utilize IPT’s high performance papers. However, the explanation is quite complex when considering thermal, mechanical, electrical, and UL factors.

### What are the thermal capabilities of polyester film?

The major concern of most people is the thermal capabilities of polyester film. It is true that polyester film is component rated as a 130°C material, and that it will shrink and embrittle when aged at high temperatures. The primary mode of this degradation is oxidation. However, lamination will help slow this process, as will a properly varnished or impregnated unit, and as the film slowly oxidizes, it breaks down into its constituent chemicals. These chemicals do not attack other components, such as the magnet wire coating or the varnish, nor does the film carbonize. This “friendly” degradation is one of the reasons that polyethyleneterephthalate (PET) polyester film is so widely used in electrical insulation applications. Others are concerned that it will melt because it is “only a 130°C material.” The actual melting point of PET polyester film is over 240°C. Although it will begin to lose mechanical strength at high temperatures, polyester film can withstand short-term thermal excursions if protected from oxidation.

### Won't polyester film shrink and embrittle at high temperatures?

Shrinkage and embrittlement due to thermal aging can be addressed through equipment design. In a tightly wound unit, the CeQUIN/polyester film laminate will be held in place, greatly reducing shrinkage. Likewise, a tightly wound, well-varnished coil will significantly reduce mechanical stress and vibration that could affect the polyester film portion of the laminate as it ages.

### How long have polyester film laminates been used?

From a historical perspective, inorganic papers laminated with polyester film have been used successfully for more than 30 years in Class 220(R) coil applications ranging from small H.I.D. ballast transformers to medium size dry-type distribution transformers. CeQUIN IF is used as a wire wrap in the manufacture of a 250°C rated appliance wiring material (UL Style 5288/CSA Class 1, Group A/B) for use in high temperature, severe environments. The acceptance of CeQUIN paper/polyester film laminates for use in these high performance applications speaks for itself.

### Recommended Practices For Using CeQUIN Products

Optimum performance of an electrical insulation system is dependent upon many factors including proper choice of materials, acceptable design criteria, and good manufacturing procedures. CeQUIN's resistance to moisture absorption can minimize drying time required prior to varnish impregnation or encapsulation. Varnishing is recommended for construction of equipment that may be exposed to the elements. CeQUIN papers are easily saturated and will tend to assume the aging characteristics of the resin or varnish that is used.

**Table 1 - Typical Properties of CeQUIN/Film Laminates**

	ASTM Test Method	IF			IFI	FIF	30F		30F30
<b>Laminate Construction</b>		5-2	7-1	10-1	5-1-5	2-15-2	3-1	5-1	3-1-3
<b>Nominal Thickness</b> mm mil	D-645	.18 7	.20 8	.28 11	.28 11	.48 19	.10 4	.15 6	.18 7
<b>Basis Weight</b> kg/m <sup>2</sup> lb/sq yd	D-202	.20 .38	.22 .41	.31 .58	.29 .54	.57 1.05	.10 .19	.16 .29	.17 .31
<b>Tensile Strength</b> kN/M MD lb/inch	D-828	7.0 40	3.5 20	5.2 30	5.2 30	15.7 90	3.5 20	3.5 20	5.2 30
<b>Dielectric Breakdown Strength</b>	kV D-149	7.5	4.5	5.0	5.5	13	4.5	4.5	4.5
<b>Moisture Absorption %</b>	D-644	<1	<1	<1	<1	<1	<1	<1	<1

*These are just a few of the CeQUIN/Film Laminates available from IPT. Please contact your local IPT Sales Representative for a complete listing or call IPT Headquarters in Tilton, New Hampshire.*



## TufQUIN®

# HIGH PERFORMANCE INORGANIC-BASED ELECTRICAL INSULATION PAPERS

### TOUGH, FLEXIBLE, HIGH-TEMPERATURE PAPERS AND LAMINATES

The information contained below is applicable to all TufQUIN® papers and laminates. Please refer to individual product pages for information specific to each TufQUIN product.

### DESCRIPTION

This family of innovative electrical insulation materials is the result of IPT's continued investment in R&D to develop safe, cost-effective, high-performance products for the electrical/electronic industry.

TufQUIN products are a hybrid inorganic/organic paper based upon advanced manufacturing techniques. TufQUIN offers the high-temperature capabilities of inorganic materials combined with the high mechanical strength gained by the use of organic fiber. TufQUIN papers can be combined with polyester film to form a flexible laminate uniquely suited for high temperature electrical insulation applications.

### PRODUCT FEATURES

- Physically tough
- Maintains dielectric strength under high humidity
- Cost effective
- Excellent stiffness
- High thermal conductivity
- UL® Systems Recognition through Class 200(N)
- CSA Component Acceptance: Temperature Class 200°C

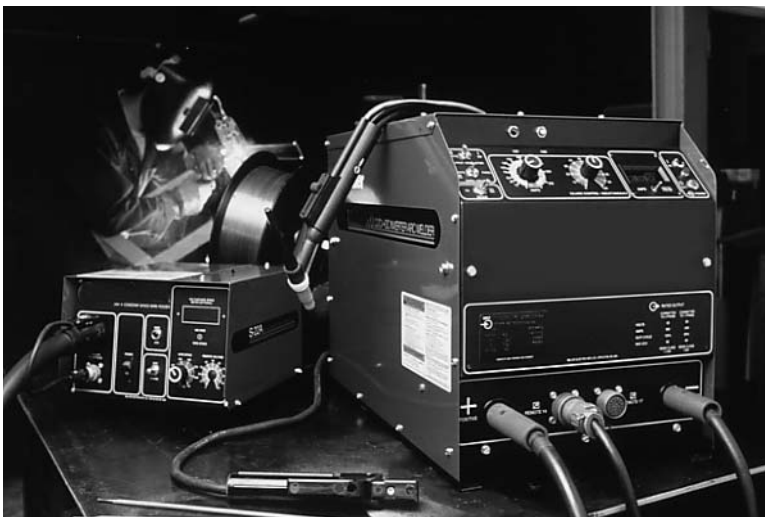
### APPLICATIONS

- Transformers, Coils, Reactors (layer, barrier and end-turn insulation for dry-type)
- Spiral- and Convoluted-wound Tubing
- Motors and Generators (slot, phase and wedge insulation)
- Wire and Cable Wrap
- Switchgear Insulation
- Capacitor Layer Insulation
- Pressure Sensitive Tapes

### UL RECOGNITION

TufQUIN products are a combination of inorganic and organic ingredients designed to optimize the thermal and mechanical properties required in today's demanding applications. TufQUIN products have undergone extensive thermal aging evaluation per UL 1446, "Standard for Systems of Insulating Materials – General," and as a result are UL Recognized as suitable for use as major insulation in electrical insulation systems through Class 200(N).

Several UL Recognized Insulation Systems are listed under IPT File No. E65007 in the OBJS2 category for Class 130(B), Class 155(F), Class 180(H) and Class 200(N) applications and may be found on UL's Electrical Insulation Systems Database at <http://data.ul.com/systems/>. All systems listed on this database are available for use by any electrical apparatus manufacturer by contacting the nearest UL office. TufQUIN TFT laminate insulations utilizing at least the minimum total thickness of TufQUIN per UL System requirements are acceptable for use in these systems.





## TufQUIN® 110, 120 For High Performance Electrical Applications

### TufQUIN® 110

TufQUIN 110 is flexible, conformable paper exhibiting physical toughness in the form of high tensile strength and excellent tear resistance. TufQUIN 110 offers good dielectric characteristics and thermal conductivity in conjunction with high temperature performance.

### TufQUIN® 120

Generically the same as TufQUIN 110, TufQUIN 120 employs a modified manufacturing process that yields thicker constructions while maintaining conformability.

### PHYSICAL CHARACTERISTICS

TufQUIN 110 and 120 have a combination of tensile strength, tear resistance, stretch and stiffness that yields a tough but conformable sheet. Typical Product Properties are shown in Table 1. Note the following advantages:

TufQUIN products offer improved tear resistance and toughness that make them suitable for use in more rigorous winding applications. TufQUIN is especially well suited for layer insulation in aluminum strip coils.

TufQUIN retains a high percentage of its dielectric strength after extended thermal aging. See Graph 1.

TufQUIN exhibits low moisture content and very little moisture absorption, especially when compared to aramid paper (see Table 2), thus reducing the need for extended drying cycles prior to varnishing.

Good thermal conductivity allows more compact design, resulting in lower cost, cooler running units. See Graph 2. TufQUIN is easily impregnated with varnish, further enhancing thermal conductivity and coil bonding characteristics.

TufQUIN 110 is available in thicknesses from 2 to 10 mil; TufQUIN 120 is available in thicknesses from 7.5 to 20 mil.

### RECOMMENDED PRACTICE FOR USING TufQUIN PRODUCTS

Optimum performance of an electrical insulation system is dependent upon many factors including proper choice of materials, acceptable design criteria, and good manufacturing procedures. TufQUIN's composition provides for very good resistance to moisture absorption thereby minimizing the drying time required prior to varnish impregnation or encapsulation. Varnishing is recommended for construction of equipment that may be exposed to the elements.

Due to the organic content in TufQUIN 110 and 120, they are not recommended for use in applications above Class 200(N). TufQUIN 110 and 120 will undergo some shrinkage at elevated temperatures as noted in Graph 3. This shrinkage factor should be considered in designing end-use equipment. Varnishing will minimize the shrinkage characteristics of TufQUIN products.

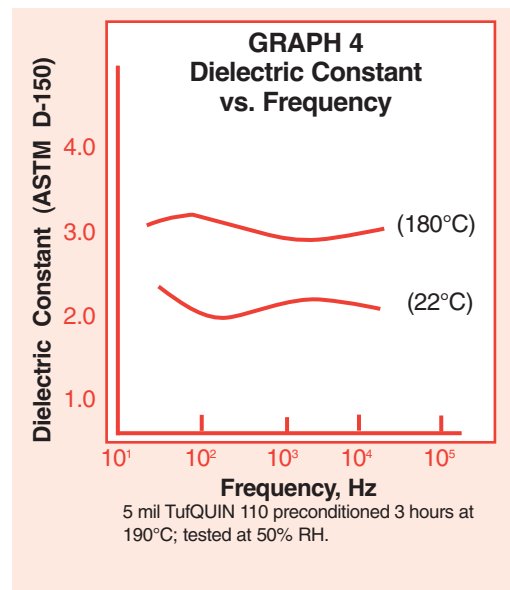
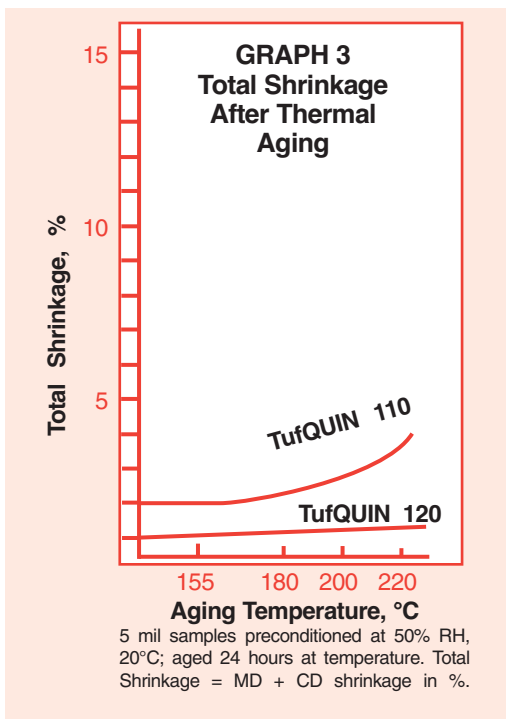
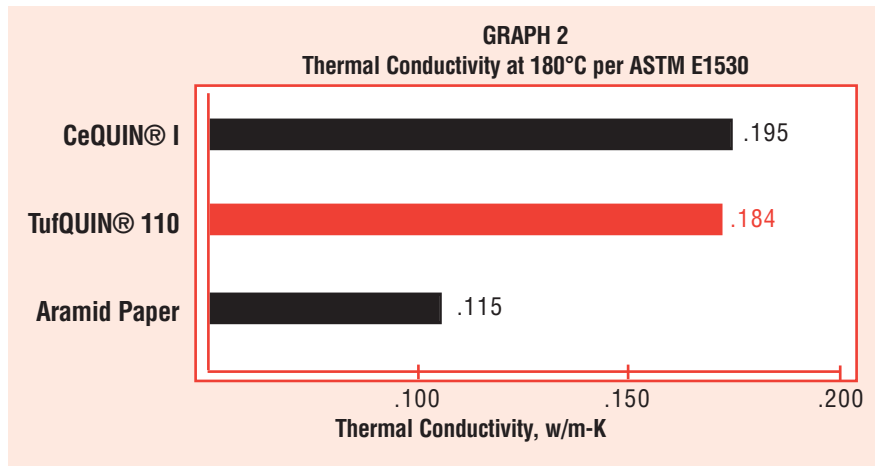
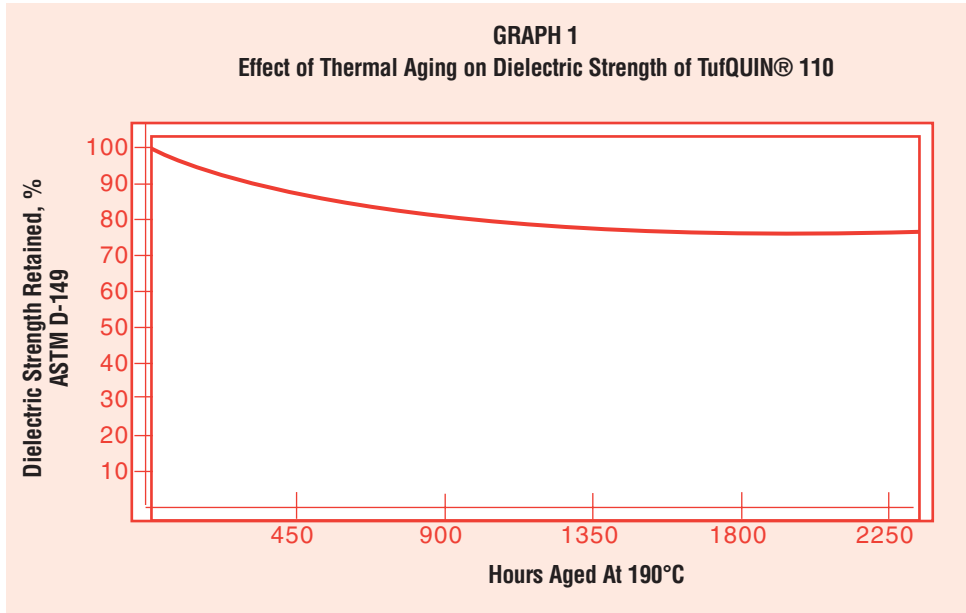
Table 1 - Typical Product Properties

ASTM Test Method	TufQUIN 110					TufQUIN 120				
	Nominal Thickness	mm	.05	.06	.08	.13	.25	.19	.30	.38
	mil	2	2.5	3	5	10	7.5	12	15	20
Basis Weight	kg/m <sup>2</sup>	.044	.07	.09	.14	.29	.19	.35	.43	.60
	lb/sq yd	.10	.13	.16	.26	.53	.35	.64	.79	1.1
Tensile Strength	kN/m	2.1	2.6	3.5	4.2	8.7	6.3	9.6	13	19
	MD lb/inch	12	15	20	24	50	36	55	75	110
Elongation, MD	%	10	12	15	19	18	14	14	14	15
Dielectric Breakdown Strength	kV	.4	.6	.7	.8	2.0	1.0	1.9	2.1	3.3

TABLE 2. Moisture Absorption TufQUIN® vs. Aramid Paper

Material	Moisture Absorption, 1 %	Total Moisture Content, %
TufQUIN 110	1.0	1.5
Aramid Paper	2.2	6.3

1.005" samples preconditioned at 50% RH, 20°C; conditioned 24 hours at 95% RH, 20°C.



## TufQUIN® LAMINATE INSULATIONS For High Performance Electrical Applications

### COST-EFFECTIVE, HIGH-TEMPERATURE FLEXIBLE PET POLYESTER FILM LAMI- NATES

#### PRODUCT FEATURES

- Physically tough
- Excellent dielectric properties
- High thermal conductivity
- Ease of insertion
- Stiffness and snapback
- UL® Systems Recognition through Class 200(N)
- CSA Component Acceptance: Temperature Class 180°C & 200°C

#### DESCRIPTION

IPT TFT® composites are a family of laminates based on IPT's advanced high performance hybrid insulation material, TufQUIN® 110, combined with polyester film. Typical constructions consist of a thin ply of TufQUIN 110 hybrid inorganic/organic paper bonded to both sides of polyester film using a high temperature resin system.

Typical product properties for standard combinations of TufQUIN 110/polyester film/TufQUIN 110 (TFT) laminates are shown in Table 1.

#### APPLICATIONS

TufQUIN TFT laminate insulations are designed for use as slot cell, phase and wedge insulation for motors and generators through Class 180(H). They may also be used as layer and ground insulation in dry-type transformers.

TFT laminates provide excellent value in use as they exhibit a balanced blend of electrical, physical, and thermal capabilities on a cost effective basis. They are the product of choice for manufacturers seeking to improve the reliability of their equipment by upgrading the performance of the flexible electrical insulation used.

#### PHYSICAL CHARACTERISTICS

TufQUIN® TFT laminate insulations are designed to meet the high performance requirements found in Class 180(H) rotating electrical apparatus and dry-type transformers rated up to Class 200(N).

TufQUIN 110 provides a tough, tear resistant, thermally stable outer layer that protects the polyester film core. The smooth, abrasion resistant surface of TufQUIN 110 lends itself well to automatic insertion operations, yet bonds well to standard dipping varnishes and encapsulating resins.

The polyester film middle ply provides an excellent dielectric barrier and adds stiffness and snapback characteristics to the composite.

Together the two materials form a flexible laminate that is uniquely suited for high temperature electrical insulation applications. Note the following advantages of using TufQUIN TFT laminate insulation:

- TFT laminates exhibit excellent resistance to tear initiation and tear propagation in both the machine direction and across the machine direction. See graph 1.
- Good elongation characteristics let TFT laminates absorb the stress of heavy duty winding applications.
- The inorganic content in TufQUIN provides excellent resistance to hot cut-through in high temperature applications.
- The high thermal conductivity of TufQUIN/film laminates promotes cooler running equipment, leading to longer insulation life, better reliability, and more efficient use of power. See graphs 2 & 3.
- TFT laminates are non-hygroscopic and exhibit low moisture absorption characteristics, thus reducing the need for extended drying cycles prior to varnishing or encapsulation. See Table 2.

TufQUIN film laminates are available in a variety of standard constructions. Non-standard combinations are available on special order to meet your specific requirements. No need to over-design; choose the combination that is most cost effective for your application.





### APPLICATIONS

- Slot cell, phase and wedge insulation for motors and generators through Class 180(H)
- Layer and ground insulation for dry-type transformers
- End laminates
- Spiral wound tubes
- Wire & cable wrap
- Breaker panels
- Buss bar insulation
- Capacitor insulation
- Current carrying and wire devices
- DC field coil insulation

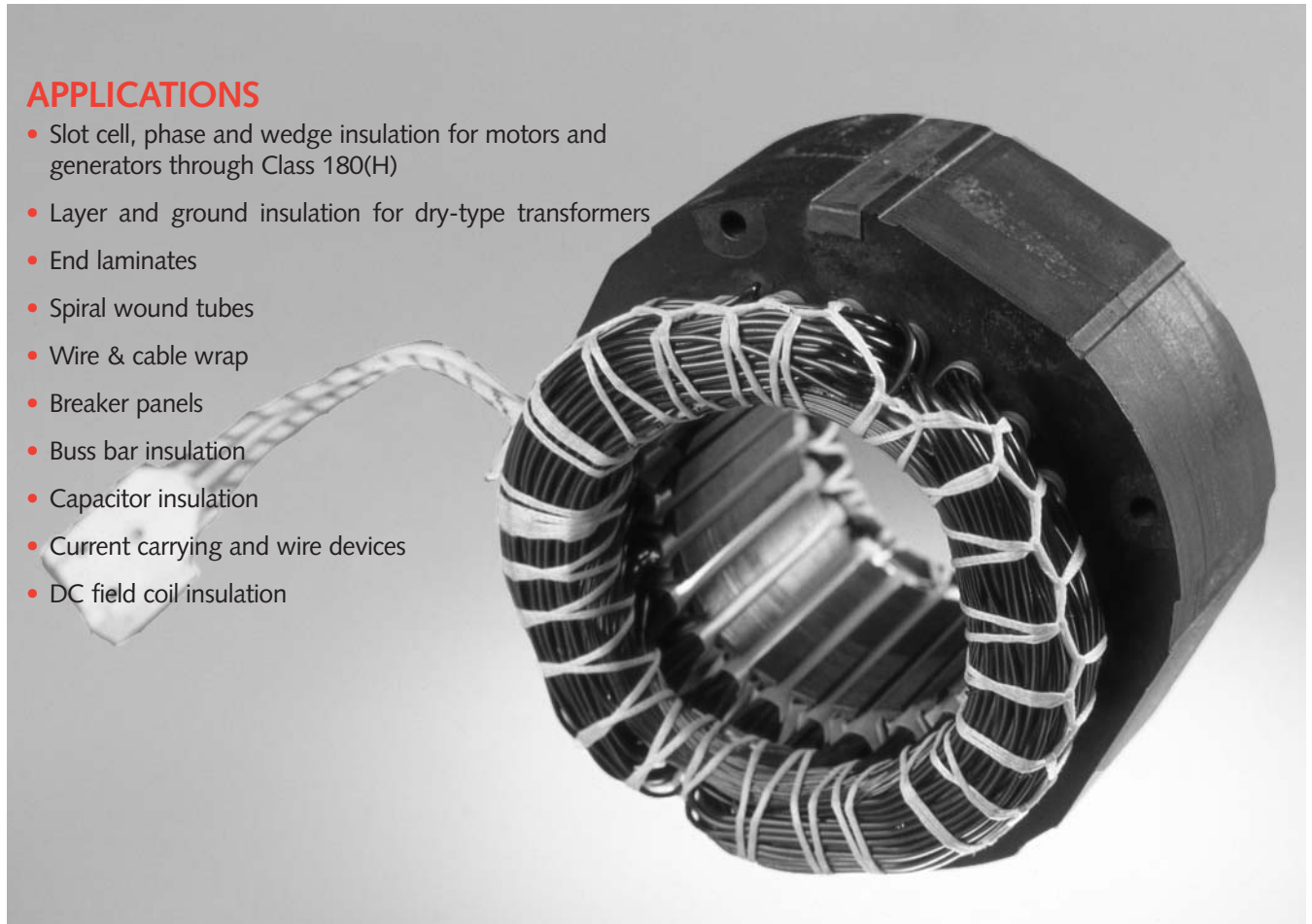


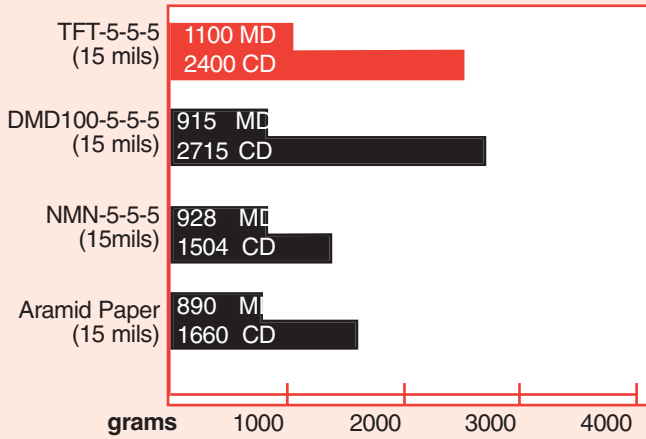
Table 1 - Typical Product Properties

		ASTM Test Method	TFT-3-3-3	TFT-3-5-3	TFT-3-7.5-3	TFT-3-14-3	TFT-5-3-5	TFT-5-5-5	TFT-5-10-5
Thickness	mm mil	D-645	.23 9	.28 11	.36 14	.51 20	.33 13	.38 15	.51 20
Basis Weight	kg/m <sup>2</sup> lb/sq yd	D-202	.30 .55	.37 .68	.46 .84	.68 1.25	.40 .74	.47 .87	.64 1.18
Tensile Strength, MD	kN/m lb/inch	D-828	18 100	23 130	30 170	47 270	18 105	23 134	39 220
Elongation, MD	%	D-828	22	22	23	30	40	46	50
Dielectric Breakdown Strength	kV	D-149	10	14	16	20	10	14	22
Elmendorf Tear grams	MD CD	D-689	320 960	320 1280	990 1180	750 2100	640 2400	1100 2400	1100 2725

Material	Moisture Content, %
TFT-5-5-5	0.8
NMN-5-5-5	1.8
Aramid Paper	4.1

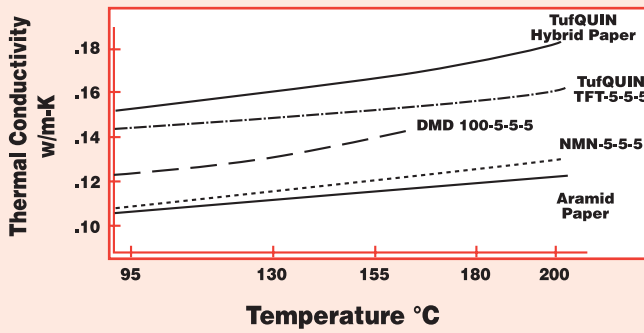
.015" samples preconditioned at 50% RH, 20°C; dried 24 hours at 155°C

**GRAPH 1  
Elmendorf Tear Strength**

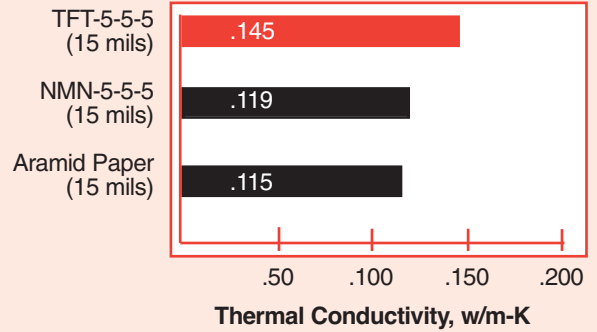


**GRAPH 2**

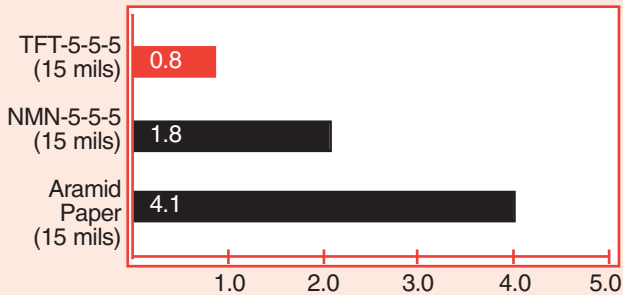
**Comparison of Thermal Conductivity**



**GRAPH 3  
Thermal Conductivity at 180°C**



**GRAPH 4  
Moisture Content of Insulation Materials**



## DMD180<sup>®</sup>

# High-Performance Flexible Laminates

## COST-EFFECTIVE, HIGH RELIABILITY MOTOR AND GENERATOR INSULATION

### PRODUCT FEATURES

- Excellent dielectrics
- Physical toughness
- Good thermal conductivity
- Stiffness and snapback
- UL<sup>®</sup> Systems Recognition for Class 130(B), Class 155(F), Class 180(H)
- CSA Component Acceptance: Temperature Class 180°C

### DESCRIPTION

IPT DMD180<sup>®</sup> composites are a family of three-ply laminates of non-woven polyester fiber mat bonded to both sides of polyester film, then over-coated with a high performance inorganic-filled resin system. This proprietary product is based on the technology developed at IPT for our TufQUIN<sup>®</sup> high temperature product line.

The result is a tough, formable motor insulation that will provide the high reliability found in our Class 180(H) materials at a price competitive with standard Class 155(F) materials. DMD180 laminates are designed to provide the same physical and handling characteristics that have made standard DMD laminates the material of choice in Class 155(F) motors and generators for over thirty years. Typical properties for standard combinations of DMD180 laminates are presented in Table 1.

### APPLICATIONS

DMD180 laminate insulations are designed for use as slot cell, phase and wedge insulation for motors and generators.

DMD180 laminates offer exceptional value and performance. They allow electrical equipment manufacturers presently using standard DMD100 materials to upgrade to the high reliability of a Class 180(H) material without any subsequent cost penalties.

DMD180 laminates may be formed, cuffed or punched to meet the specific requirements of your electrical insulation application. They are also suitable for automatic insertion operations.

### PHYSICAL CHARACTERISTICS

DMD180 flexible electrical insulation laminates are designed to provide high reliability in insulation systems rated through Class 180(H). The smooth, abrasion-resistant surface of DMD180 lends itself to automatic insertion operations, yet allows excellent bonding to standard dipping varnishes and encapsulating resins. DMD180 is a tough, tear-resistant, thermally stable insulation that is well suited to the rigorous demands of high-speed coil winding applications.

The center core of polyester film provides an excellent dielectric barrier, as well as adding stiffness and snapback characteristics to the composite. Note the following advantages of using DMD180 laminate insulation:

- DMD180 laminates exhibit excellent resistance to tear initiation and tear propagation in both the machine direction and across the machine direction. See Graph 1.
- Good tensile strength and elongation characteristics allow DMD180 laminates to absorb the stress incurred in heavy-duty winding applications.
- The inorganic content in DMD180 overcoating provides resistance to hot cut-through in high stress areas.
- The high thermal conductivity of DMD180 promotes cooler running equipment, leading to longer insulation life, better reliability, and more efficient use of power. See graph 2.

DMD180 laminates are non-hygroscopic and exhibit low moisture absorption, thus reducing the need for extended drying cycles prior to varnishing or encapsulation. See Graph 3.

DMD180 laminates are available in a variety of standard constructions. Non-standard combinations are available on special order to meet your specific requirements. No need to over-design; choose the combination that is most cost effective for your application.

## UL RECOGNITION

DMD180 laminates have undergone extensive thermal aging evaluation per ANSI/UL 1446, "Standard for Systems of Insulating Materials – General," and as a result are UL Recognized for use as major insulation in electrical insulation systems designated QT-130PLUS and QT-155PLUS as listed under IPT File No. E65007 and may be found on UL's Electrical Insulation Systems Database at <http://data.ul.com/systems/>. All systems listed on this database are available for use by any electrical apparatus manufacturer by contacting the nearest UL office.

To demonstrate the high reliability capabilities of DMD180, these laminates were also evaluated as the major insulation component of a Class 180(H) electrical insulation system per ANSI/UL 1446. Motorettes were constructed utilizing DMD180 laminates as one of the major components and were then thermally aged at three different temperatures – 200°C, 220°C, 240°C – to evaluate their life expectancy under accelerated conditioning. As a result of this testing, DMD180 laminates are recognized for use as a major insulation component in the Class 180(H) insulation system designated QT-180PLUS.

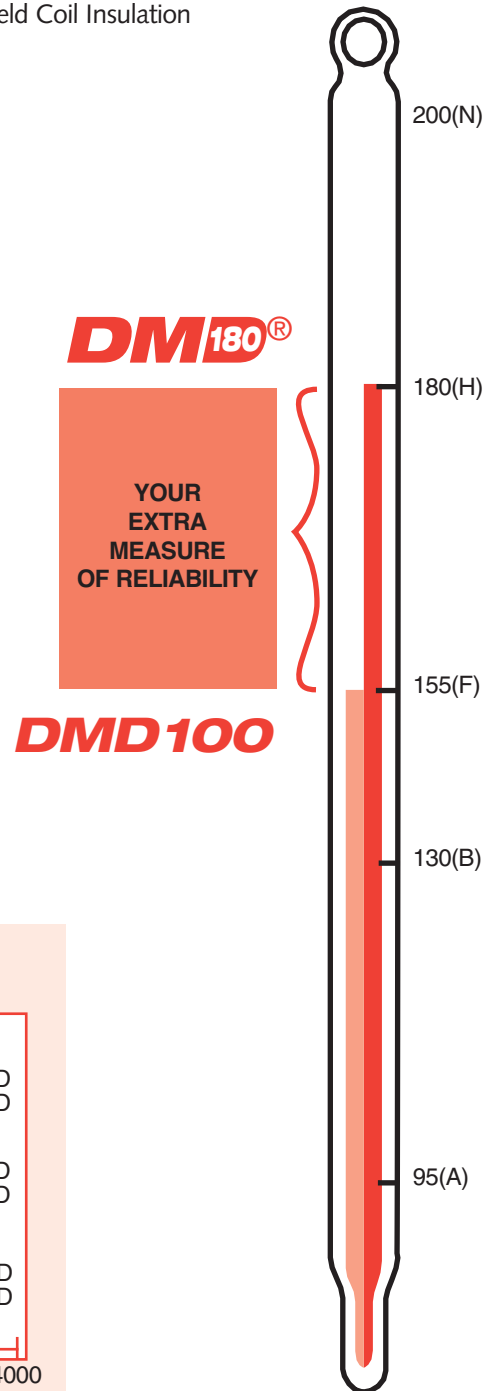
Thus, you may be rest assured that DMD180 will give you that extra measure of performance and reliability available from a recognized Class 180(H) components when used in your motor and generator insulation applications.

## ADDITIONAL INFORMATION

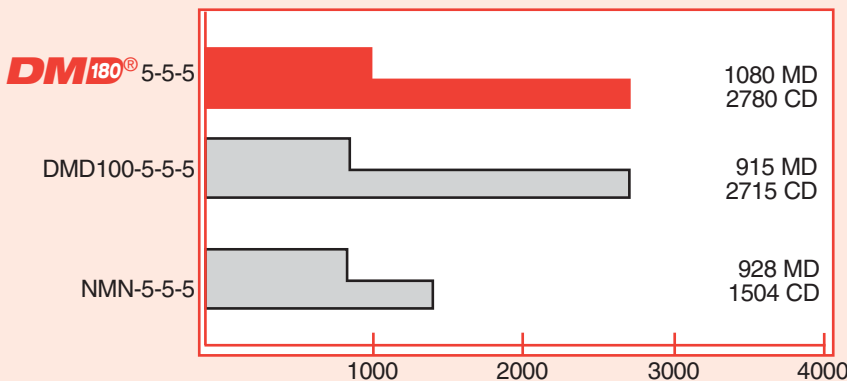
The DMD180 constructions listed in Table 1 are typical thickness combinations. Additional combinations may also be produced for your specific insulating requirements. IPT has an active R&D staff eager to develop custom-made products for unique customer requirements. Please contact your IPT Sales Representative for further information or call IPT Headquarters in Tilton, New Hampshire.

## APPLICATIONS

- Slot Cell, Phase and Wedge Insulation for Motors and Generators
- End Laminates
- Spiral Wound Tubes
- Wire & Cable Wrap
- Breaker Panels
- Buss Bar Insulation
- Capacitor Insulation
- Current Carrying and Wire Devices
- DC Field Coil Insulation



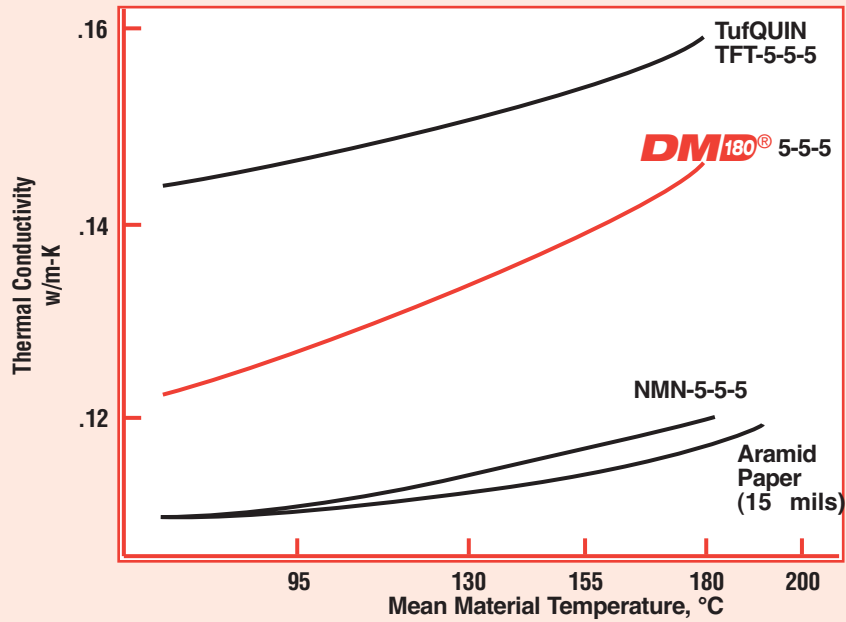
**GRAPH 1**  
Elmendorf Tear Strength



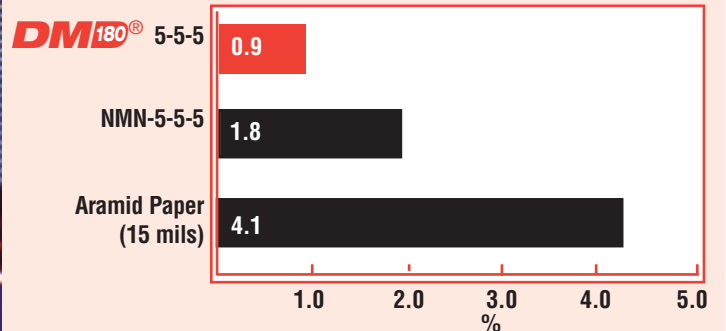
**Table 1 - Typical Product Properties**

		ASTM Test Method	3-3-3	3-5-3	3-7.5-3	3-14-3	5-3-5	5-5-5	5-10-5
Thickness	mm mil	D-645	.23 9	.28 11	.36 14	.51 20	.33 13	.38 15	.51 20
Basis Weight	kg/m <sup>2</sup> lb/sq yd	D-202	.27 .50	.34 .63	.42 .78	.66 1.22	.37 .68	.44 .81	.63 1.17
Tensile Strength, MD	kN/m lb/inch	D-828	18.6 106	26.3 150	29.6 169	42.0 240	20.5 117	25.0 143	38.7 221
Elongation, MD	%	D-828	42	40	40	38	36	36	40
Dielectric Breakdown Strength	kV	D-149	8.5	11.0	15.0	20.5	8.8	11.5	18.8
Elmendorf Tear grams	MD CD	D-689	455 770	470 830	490 1050	1060 1400	570 1340	1080 2780	1120 3200

**GRAPH 2 – Thermal Conductivity of Insulation Materials**



**GRAPH 3 Moisture Content**



## TECHNOLOGY

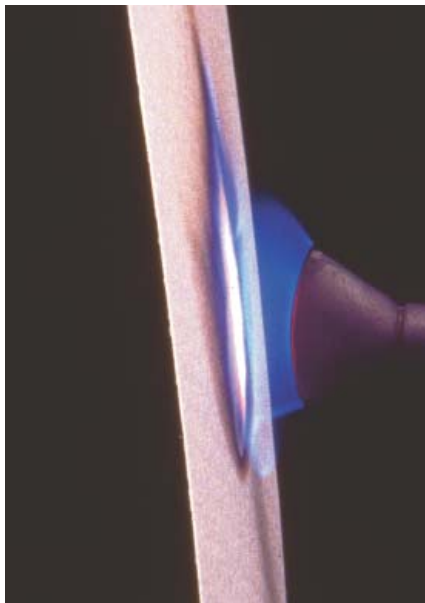
IPT's R&D objective is to develop specialty materials which meet precise performance standards for specific applications.

With a fully staffed and equipped laboratory, IPT is working on tomorrow's solutions today — developing products for the future. By working with your design and applications engineers, IPT engineers are involved in the continuous improvement of existing products, modification of products to meet special applications, and the development of completely new base materials, compounds, coatings and laminates.

Keep in mind that, as you develop your future product lines, you don't need to be constrained by the capabilities of today's materials. IPT welcomes the opportunity to work with you in the development of better products to give you a competitive edge.

IPT offers pilot coater/laminator and pilot paper machine prototype work for your pre-production runs and your new product and application needs.

The IPT R&D team is motivated to continually discover ways to achieve greater product performance. This motivation keeps IPT at the forefront of technological advancement.



## STANDARDS COMPLIANCE

All IPT inorganic-based electrical insulation materials have undergone extensive thermal aging evaluation per UL 1446, "Standard for Safety for Systems of Insulating Materials – General," and as a result are UL Recognized as suitable for use as major ground insulation in electrical insulation systems (EIS) listed under IPT UL File No. E65007 in the OBJS2 category.

All IPT Systems are also in compliance with IEC 62114 "Electrical Insulation Systems – Thermal Classification" having been evaluated per IEC 61857-1, "EIS – Procedures for Thermal Evaluation – Part 1: General Requirements – Low-Voltage" and IEC 61858, "EIS – Thermal Evaluation of Modifications to an Established Wire-Wound EIS."

Specifications for IPT inorganic-based papers may be Found in IEC 60819-3, "Non-Cellulosic Papers for Electrical Purposes – Part 3: Specifications for Individual Materials." Specifications for flexible laminates involving IPT inorganic-based papers may be found in IEC 60626-3, "Specifications for Combined Flexible Materials for Electrical Insulation – Part 3: Specifications for Individual Materials."

Temperature Class ratings for IPT electrical insulation materials are listed in CSA Component Acceptance Report #183351 as "Class 9052 30 – Insulating Devices and Materials – Component – Transformer and Motor Insulation."

*GARDBORD, a flame-barrier used in household appliances, is a UL Recognized Component with a 94-5VA Flame Class Rating. GARDBORD is a cost-effective, inorganic-based product which is closely related to the company's popular CeQUIN®, but with additional mechanical strength and stiffness to allow fabrication. GARDBORD is an example of IPT's capability to modify and enhance existing products to meet new application needs.*

## ENVIRONMENTAL SAFETY AND HEALTH

IPT products meet all current OSHA requirements for health and safety with normal handling and good work practices. IPT papers, boards and laminates fall within the Threshold Limit Values for Chemical Substances in the Work Environment as specified by the American Conference on Governmental Industrial Hygienists. Notwithstanding this, it is incumbent upon the customer to use suitable work practices, good housekeeping and proper industrial hygiene. If necessary, protective clothing, safety glasses, face masks and a dust collection system should be used in order to provide a safe work environment. It is a prudent practice to reduce the workers' exposure to any respirable material to the lowest practical level.

For all IPT products Material Safety Data Sheets are available upon request.

The particulates and fibers in IPT products are encapsulated in saturants and binders. This minimizes the amount of airborne dust generated during handling and fabrication. Any dust which is generated contains a small amount of glass fiber which sometimes will cause itchiness or a mild case of dermatitis in some individuals. This discomfort is usually temporary. Most workers become acclimated after several days of working with the material.

All waste should be disposed of in accordance with local landfill requirements.

## QUALITY

IPT has an unwavering commitment to quality. More than 20% of the annual operating budget is devoted to installing new equipment and refining processes to produce better quality products more efficiently.

Woven throughout the process of design, manufacturing and marketing is a common thread ... quality.

The quality system at IPT is certified to be in accordance with ISO 9001 requirements. In addition, IPT is continually monitoring and improving its quality system to meet or exceed customer requirements.

IPT products meet many national and international performance standards. They are also recognized for use in numerous electrical insulation systems.

Your call and your challenge are both welcome at IPT. Among the standards met by IPT products are those of:

- IEC
- UL
- IEEE
- ANSI
- ASTM
- MIL SPEC
- NEMA

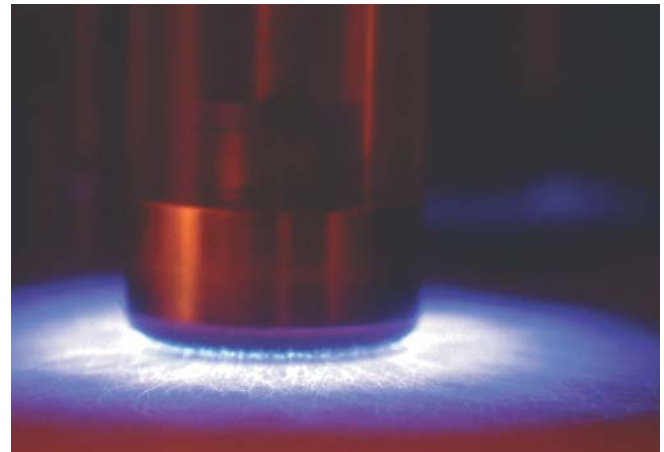


ISO 9001 REGISTERED FIRM



*Our state-of-the-art, high-resolution Gamma gauge, based on the principle of photon backscatter, allows real-time monitoring of web thickness or basis weight, and provides a hard copy record for traceability.*

*Dielectric withstand testing is one of the many standard tests used to characterize IPT materials.*



**Your call and your challenge are both welcome at IPT.**

## PRODUCT WARRANTY

IPT products are warranted free from defects in workmanship and in material. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

The sole and exclusive remedy against IPT for breach of its limited product warranty shall be, at the option of IPT, either refund of the invoice value of defective products, or repair or replacement F.O.B its plant or other shipping point.

IN NO EVENT SHALL IPT BE LIABLE TO ANY BUYER OR ANY THIRD PARTY FOR ANY SPECIAL, INCIDENTAL, AND/OR CONSEQUENTIAL DAMAGES.

IPT assumes no obligation of liability for any advice furnished by it or results obtained with respect to these products. All such advice is given and accepted at the buyer's risk. It is subject to revision as additional knowledge and experience are gained.

This information, based on our experience, is offered as a part of our service to customers. It is intended for use by persons having technical skill at their discretion and risk. We do not guarantee results, and we assume no liability in connection with its use. Publication of this information is not intended as a license to operate under or a recommendation to infringe any existing patents.

**TECHNICAL DATA PRESENTED HEREIN ARE TO BE CONSIDERED NOMINAL VALUES AND ARE NOT FOR SPECIFICATION PURPOSES.**



## **INNOVATIVE PAPER TECHNOLOGIES, LLC**

Innovative Paper Technologies, LLC

One PaperTrail • P.O. Box 739 • Tilton, NH 03276-0739

Toll-Free: 866-357-2737 • Fax: 603-286-4859

[www.iptllc.net](http://www.iptllc.net) • [info@iptllc.net](mailto:info@iptllc.net)