

## Material Data Sheet

**Item:** CeQuin with Glass and Film

**Description:** CeQuin laminates are a series of unfired, ceramic-like non-asbestos, dielectric insulating papers that have been laminated to another material (substrate) for added strength and cut-through resistance.

The CeQuin series base papers, being principally inorganic, imparts the desired electrical insulation properties; the laminating substrate imparts the needed physical strength.

CeQuin I is a soft, flexible conformable paper; CeQuin V is a stiff, thermally-stabilized paper. CeQuin non-asbestos laminates are available in thicknesses from 3.5 to 60 mil, and in a variety of strengths and surface textures. They are tough, but conformable; with good tear, tensile and stretch properties.

**Application:** **CeQuin laminates are ideally suited for:**

- Ground, layer and end-turn insulation in dry-type transformers and stick and bobbin wound coils.
- Spiral and convolute wound tubes.
- Wire and cable manufacture as thermal, flame or electrical insulation.
- Conductor, coil and phase insulation in rotating equipment.

### **Temperature Resistance:**

Since CeQuin laminates are principally inorganic they are capable of satisfactory performance in the highest temperature electrical insulation systems. When impregnated with thermally stable electrical varnish they will assume the aging characteristics normal to the saturating resin.

### **Physical Characteristics:**

The physical and electrical characteristics are determined by the base paper, the reinforcing material, and the thickness. Polyester film laminates have the highest tear strength and excellent cut-through resistance. They also have strong "memory", meaning they will tend to spring back to their original shape when folded, bent or shaped.

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### Physical Characteristics:

Glass cloth laminates have the highest tensile strength and provide good cut-through resistance. They can be stiff or limp depending on the base paper in the lamination. In either case, glass laminates lack memory. If creased or wrapped they will retain the new shape.

CeQuin laminates have excellent thermal stability because of their primary inorganic composition. All show exceptional dimensional stability with negligible shrinkage after one week at 250 C°. Dielectric strength remains stable after exposure to high temperatures. They retain over 70% of their original dielectric strength after exposure to 330 C° for 1,000 hours.

In addition, CeQuin laminates exhibit exceptionally high initial thermal conductivity. When compared to aramid paper insulation, this property allows for more compact design of equipment with a similar temperature rise, or lower temperature rise in the same size equipment.

CeQuin laminates will compress slightly during winding. Wire will imbed in the paper surface, reducing slippage and increasing window fill. CeQuin laminates also readily absorb varnish which further increases thermal conductivity and results in a more tightly bonded coil thus reduction coil noise.

No special packaging or handling is required during assembly or fabrication because of CeQuin's excellent moisture resistance, but for maximum moisture resistance in a unit, a prebake and satisfactory impregnation or encapsulation with a resin is recommended.



## **Material Data Sheet**

**Item:** CeQuin I, II, III, V, GESAT

**Description:** The growing family of CeQuin electrical insulation has been the result of an intensive R&D program which led to the development of the first CeQuin family member, CeQuin I, which was commercially released in 1980.

After many years of costly research to discover the proper combination of materials to derive an inorganic electrical insulating material that does not use asbestos in its formulation but still exhibits the superior physical, electrical and thermal properties of bonded asbestos insulations, a unique unfired ceramic-like paper was discovered. This was the start of the CeQuin family.

The CeQuin products described herein are generically an aluminum silicate, unfired ceramic-like material which have had engineered into their structures a combination of synthetic fibers and high temperature binders.

This results in a family of products that have excellent electrical and physical characteristics for use in high temperature electrical insulation applications. They are cost-effective materials that will outperform competitive organic materials that cost substantially more.

### **Application:**

- Transformers, coils, reactors (layer, barrier and end-turn insulation)
- Motors and generators (conductor, coil and phase insulation)
- Sprial and convolute wound tubing
- Electrical insulation manufacturers (composites, coated products)
- Wire and cable manufacturing
- Stick and bobbin wound coil operations
- Layer and barrier insulation in transformers and coils
- Edge wound field coils

## Material Data Sheet

**Item:** CeQuin I, II, III, V, GESAT

### Physical Characteristics:

CeQuin family has a combination of tear, tensile and stretch properties that combine to yield a tough but conformable, flexible insulation sheet. Note the following advantages:

- CeQuin I and II are flexible and conformable.
- CeQuin I and III are available from 3 to 30 mil in thickness and suitable for a variety of coil insulation applications. They are well-suited for layer insulation in aluminum strip coils.
- CeQuin V is available in rolls up to 10 mil; 15 mil and above as sheets only.
- CeQuin V is stiff and has low stretch with a smooth, hard surface. Being stiff, it holds its shape and does not drape or conform.
- CeQuin V is useful in stick wound coils.
- The changes in CeQuin V are similar to those that would occur in a transformer or coil insulated with regular CeQuin I or III and then prebaked, varnished, and post-baked.
- CeQuin V is not recommended for small radius due to its high stiffness.
- CeQuin GESAT offers greater internal strength for applications where higher crush/extrusion resistance is important. Available in 3.5, 5, 7 and 10 mil.
- All the CeQuin insulations exhibit exceptional dimensional stability. Negligible shrinkage (less than 0.25%) after 1 week at 250 C°.
- All CeQuin insulations have high initial thermal conductivity. This allows for more compact design with a constant temperature rise. The CeQuin insulations impregnate easily further increasing thermal conductivity and bonding the coil tightly.
- CeQuin II and III 2-ply are stronger than CeQuin I and more suitable for heavier winding service. They are available in thicknesses from 7 to 60 mil.
- CeQuin III has improved stretch, crush resistance and surface properties as compared to CeQuin I.

## Material Data Sheet

**Item:** CeQuin I, II, III, V, GESAT

**Typical Properties:**

	<b>CeQuin I</b>					
Thickness						
mm	0.76	.125	----	.254	.380	.760
mil	3	5	----	10	15	30
MD Tensile Strength						
kN/m	0.8	1.0	1.7	2.7	3.4	4.4
lb/ 1 in.	4.5	5.7	9.7	15	19	25
Bursting Strength (Mullen)						
kPa	25	40	70	90	145	195
psi	4	6	10	13	21	28
MD Elongation						
%	less	less	less	less	less	less
	2%	2%	2%	2%	2%	2%
Grammage						
kq/sq m	.076	.14	.21	.27	.41	.81
lb/sq yd	.14	.26	.39	.50	.75	1.5
Dielectric Strength						
kV	0.6	1.3	1.9	2.3	3.0	5.0

	<b>CeQuin II</b>			<b>CeQuin GESAT</b>		
Thickness						
mm	.760	1.02	1.53	.125	.175	.254
mil	30	40	60	5.5	7	10
MD Tensile Strength						
kN/m	5.1	7.7	9.4	1.7	2.5	3.0
lb/ 1 in.	29	44	54	9.7	14	17
Bursting Strength (Mullen)						
kPa	200	250	400	75	95	125
psi	29	36	58	11	14	18
MD Elongation						
%	less	less	less	less	less	less
	2%	2%	2%	2%	2%	2%
Grammage						
kq/sq m	.81	1.1	1.8	.15	.22	.29
lb/sq yd	1.5	2.0	3.3	.27	.40	.53
Dielectric Strength						
kV	4.0	7.0	9.0	1.3	2.0	2.8

All of the information, suggestions, and recommendations pertaining to the properties and uses of the products herein are based upon tests and data believed to be accurate; however, the final determination regarding the suitability of any material described herein for the use contemplated, the manner of such use, and whether the use infringes any patents is the sole responsibility of the user. There is no warranty, expressed or implied, including, without limitation warranty of merchantability or fitness for a particular purpose. Under no circumstances shall we be liable for incidental or consequential loss or damage.

## Material Data Sheet

**Item:** CeQuin I, II, III, V, GESAT

**Typical Properties:**

	<b>CeQuin III</b>				
Thickness					
mm	.125	.175	.254	.380	.760
mil	5	7	10	15	30
MD Tensile Strength					
kN/m	1.2	1.6	2.8	3.4	5.0
lb/ 1 in.	6.8	9.1	16	19	29
Bursting Strength (Mullen)					
kPa	60	80	130	160	340
psi	9	12	19	23	49
MD Elongation					
%	less	less	less	less	less
	2%	2%	2%	2%	2%
Grammage					
kq/sq m	.13	.18	.27	.40	.76
lb/sq yd	.24	.34	.49	.73	1.4
Dielectric Strength					
kV	1.2	1.5	2.2	2.7	4.8

	<b>CeQuin V</b>				
Thickness					
mm	.125	.175	.254	.380	.760
mil	5	7	10	15	30
MD Tensile Strength					
kN/m	1.2	1.7	3.0	3.5	4.6
lb/ 1 in.	6.8	9.7	17	20	26
Bursting Strength (Mullen)					
kPa	48	70	100	150	250
psi	7	10	14	22	36
MD Elongation					
%	less	less	less	less	less
	1%	1%	1%	1%	1%
Grammage					
kq/sq m	.14	.21	.27	.41	.81
lb/sq yd	.26	.39	.50	.75	1.5
Dielectric Strength					
kV	1.1	1.4	2.1	2.6	4.7

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## Material Data Sheet

**Item:** TufQuin with Polyester Film

**Description:** Quin-T TFT composites are a family of laminates based on Quin-T'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.

**Application:** TufQuin TFT laminates insulations are designed for use as slot cell, phase and wedge insulation for motors and generators through Class 180 C° (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.

### **Applications:**

- Slot cell, phase and wedge insulation for motors and generators through class 180 C° (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

## Material Data Sheet

**Item:** TufQuin with Polyester Film

Typical Properties:	TFT-3-3-3	TFT-3-5-3	TFT-3-71/2-3
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Thickness			
mm	.23	.28	.36
mil	9	11	14
Basis Weight			
kg/m <sup>2</sup>	.30	.37	.45
lb/sq yd	.55	.68	.83
Dielectric Breakdown Strength			
kv	10.8	14.5	16.1
Tensile Strength (MD)			
kN/m	17.5	30.3	34.3
lb/1 inch	100	173	196
Elongation, MD			
%	22	20	20
Elmendorf Tear (grams)			
MD	405	544	552
CD	920	1459	1830
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Typical Properties:	TFT-3-14-3	TFT-5-3-5	TFT-5-5-5	TFT-5-10-5
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Thickness				
mm	.51	.33	.38	.51
mil	20	13	15	20
Basis Weight				
kg/m <sup>2</sup>	.66	.39	.47	.67
lb/sq yd	1.22	.71	.87	1.23
Dielectric Breakdown Strength				
kv	19.5	11.8	15.0	19.1
Tensile Strength (MD)				
kN/m	42.0	19.6	25.0	40.1
lb/1 inch	240	112	143	229
Elongation, MD				
%	18	22	21	20
Elmendorf Tear (grams)				
MD	1450	760	1056	960
CD	1493	2640	3060	2725
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## Material Data Sheet

**Item:** TufQuin with Polyester Film

### Physical Characteristics:

TufQuin TFT laminate insulations are designed to meet the high performance requirements found in Class 180 C° (H) rotating electrical apparatus and dry-type transformers.

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.
- Good elongation characteristics allow TFT laminates to absorb the stress incurred in 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.
- 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.

## Material Data Sheet

**Item:** TufQuin 110, 120

**Description:** This family of innovative electrical insulation materials is the result of Quin-T'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 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 slightly different manufacturing process that yields thicker constructions while maintaining conformability.

### **Applications:**

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

## Material Data Sheet

**Item:** TufQuin 110, 120

**Typical Properties:**

**TufQuin 110:**

Thickness				
mm	.064	.076	.127	.254
mil	2.5	3	5	10
Tensile Strength (MD)				
kN/m	2.8	3.5	4.9	8.8
lb/1 inch	16	20	28	50
Elongation, MD				
%	12	15	19	18
Basis Weight				
kg/m <sup>2</sup>	.08	.09	.13	.29
lb/sq yd	.14	.16	.24	.53
Dielectric Breakdown Strength				
kV	.7	.8	.9	2.0

**Typical Properties:**

**TufQuin 120:**

Thickness				
mm	.190	.305	.381	.508
mil	7.5	12	15	20
Tensile Strength (MD)				
kN/m	6.3	9.6	13.1	19.3
lb/1 inch	36	55	75	110
Elongation, MD				
%	14	14	14	15
Basis Weight				
kg/m <sup>2</sup>	.21	.36	.46	.66
lb/sq yd	.39	.66	.78	1.22
Dielectric Breakdown Strength				
kV	1.1	2.0	2.5	3.3

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## **Material Data Sheet**

**Item:** TufQuin 110, 120

### **Physical Characteristics:**

TufQuin 110 and 120 have a combination of tensile strength, tear resistance, stretch and stiffness that yields a tough but still conformable sheet.

### **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.
- TufQuin exhibits low moisture content and very little moisture absorption, especially when compared to aramid paper, 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. TufQuin is easily impregnated with varnish, further enhancing thermal conductivity and coil bonding characteristics.
- TufQuin 110 is available in thicknesses from 2.5 to 10 mils; TufQuin 120 is available in thicknesses from 7.5 to 20 mils.