PRODUCT INFORMATION

	(TYPICAL PROPERTIES) These should not be considered as specifications.						
PRODUCT	TOUGH-	SEAL 3	31 /	A/B	(KEY PC	2031A/B)	
	SEALANT F	OR THE	RMA	L CY	CLING		
DESCRIPTION							
	Tough-Seal 31 is a tough and durable two component, hybrid epoxy elastomer that features a lower viscosity than Tough-Seal 21. Tough-Seal is a superior electrical potting compound with excellent thermal cycling performance. Tough-Seal has the flexibility of a urethane and the service temperature of an epoxy. It maintains this exceptional flexibility from –40°C to 150°C (-40°F to 300°F) and it resists contraction and won't pull back during thermal cycles so it protects sensitive electronics. Since Tough-Seal is an epoxy and not a urethane, it does not incorporate isocyanates and Tough-Seal has a mild health and safety profile. Tough-Seal is ideal for electrical potting applications requiring thermal cycling and thermal shock resistance and low embedment stress.						
ADVANTAGES &	✓ Excellent Thermal	Cycling Perform	ance & T			nce	
APPLICATIONS	✓ Resilient, Tough, D			Cl : 1			
ALLEGATIONS	✓ Low Embedment S✓ Adhesion to Therm					on to Aluminum	
PHYSICAL	Adhesion to mem	Tough-Se			n-Seal 31 B	MIX	
	Color	Off W			Black	Grey / Black	
PROPERTIES	Viscosity at 25°C	3,500			,000 cP	5,000 cP	
(Typical)	Brookfield R	_	#5 @ 20 rpm		@ 20 rpm	#5 @ 20 rpm	
	Specific Gravity Density (lbs/gal)	1.15 9.6			1.02 8.5	1.07 8.9	
CLIDED				Temp			
CURED	Property	ASTM			erature	Value	
PROPERTIES				25°C			
	Property Elongation at Break Hardness, Shore A Comprehensive electric	ASTM D638 D2240 cal & thermal m	echanica	25°C 25°C I propert	erature (77°F) (77°F) ies are listed	Value 400% 37A on following pages.	
PROPERTIES (Typical)	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com	ASTM D638 D2240 cal & thermal m	echanica cussion c	25°C 25°C I propert on the fe	erature (77°F) (77°F) ies are listed atures of Tou	Value 400% 37A on following pages. gh-Seal 31.	
PROPERTIES (Typical) CURE	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g):	ASTM D638 D2240 cal & thermal m	echanical cussion o	25°C 25°C <i>I propert</i> on the fe 0-20 mi	erature (77°F) (77°F) ies are listed atures of Toughutes at 25°C	Value 400% 37A on following pages. gh-Seal 31. (77°F)	
PROPERTIES (Typical)	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g): Hard Cure	ASTM D638 D2240 cal & thermal m	echanical cussion d	25°C 25°C <i>I propert</i> on the fe 0-20 min Overnigh	erature (77°F) (77°F) ties are listed atures of Toughutes at 25°C t at 25°C (77°	Value 400% 37A on following pages. gh-Seal 31. (77°F) F)	
PROPERTIES (Typical) CURE	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g):	ASTM D638 D2240 cal & thermal m	echanicas cussion d	25°C 25°C I propert on the fe 0-20 min Overnigh 3 to 5 Da	erature (77°F) (77°F) ies are listed atures of Toughutes at 25°C (77° ys, Dependen	Value 400% 37A on following pages. gh-Seal 31. (77°F)	
PROPERTIES (Typical) CURE SCHEDULE (Typical)	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g): Hard Cure Full Cure	ASTM D638 D2240 cal & thermal m	echanicas cussion d	25°C 25°C I propert on the fe 0-20 min Overnigh 3 to 5 Da Yes, Mild	erature (77°F) (77°F) ies are listed atures of Toughutes at 25°C (77° ys, Dependen	Value 400% 37A on following pages. gh-Seal 31. (77°F) F) of on part size	
PROPERTIES (Typical) CURE SCHEDULE (Typical) INSTRUCTIONS	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g): Hard Cure Full Cure Accelerated Cure MIX RATIO By Tough-Seal 31 Part A	ASTM D638 D2240 cal & thermal m for greater dis WEIGHT 57 A	echanicas cussion d 1 (3) VOL	25°C 25°C / propert on the fee 0-20 min Overnigh 3 to 5 Da /es, Mild UME A	erature (77°F) (77°F) ies are listed atures of Toughutes at 25°C (77° ys, Dependen	Value 400% 37A on following pages. gh-Seal 31. (77°F) F) of on part size	
PROPERTIES (Typical) CURE SCHEDULE (Typical)	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g): Hard Cure Full Cure Accelerated Cure MIX RATIO By Tough-Seal 31 Part A Tough-Seal 31 Part B	ASTM D638 D2240 cal & thermal m for greater dis WEIGHT 57 A 100 B	echanicas cussion d 1 (3) VOL	25°C 25°C I propert on the fea 0-20 min Overnigh 3 to 5 Da (es, Mild UME A B	erature (77°F) (77°F) ies are listed atures of Toughutes at 25°C (77° ys, Dependen Heating 66 to	Value 400% 37A on following pages. gh-Seal 31. (77°F) F) ot on part size 0 80°C (150-175°F)	
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PROPERTIES (Typical) CURE SCHEDULE (Typical) INSTRUCTIONS FOR USE SAFETY & HANDLING	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g): Hard Cure Full Cure Accelerated Cure MIX RATIO By Tough-Seal 31 Part A Tough-Seal 31 Part B Combine Part A and B mixing. Scrape sides, v Bulk meter-mix dispense PLEASE READ MA Avoid all contact with seal	ASTM D638 D2240 cal & thermal man for greater dis WEIGHT 57 A 100 B and mix thorough valls and bottom sing machines a ATERIAL SA skin, eyes, clothing	echanicas cussion of 3 Y VOL 1 2 ghly, beirn n of contained converted FETY D	25°C 25°C 25°C 25°C 25°C 25°C 25°C 25°C	erature (77°F) (77°F) ies are listed atures of Toughutes at 25°C (77° ys, Dependent Heating 66 to at to limit entranger in the intridges proving the intri	Value 400% 37A on following pages. gh-Seal 31. (77°F) F) at on part size 0 80°C (150-175°F) apped air during to part and cure. de air free mixing. ORE USING. after handling.	
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PROPERTIES (Typical) CURE SCHEDULE (Typical) INSTRUCTIONS FOR USE SAFETY & HANDLING SHELF LIFE & STORAGE INFO For Unopened, Factory	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g): Hard Cure Full Cure Accelerated Cure MIX RATIO By Tough-Seal 31 Part A Tough-Seal 31 Part B Combine Part A and B mixing. Scrape sides, v Bulk meter-mix dispense PLEASE READ MA Avoid all contact with seal Tough-Seal 31A (PC2 Tough-Seal 31B (PC2)	WEIGHT 57 A 100 B and mix thorough and bottom sing machines and skin, eyes, clothin (031A) 3 Montition (031A) 12 Montition (031B) 12 Montition (031B) 12 Montition (031B)	echanical cussion of 1 2 2 3 4 4 5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	25°C 25°C I propert on the fet 0-20 min Overnigh B to 5 Da fes, Mild UME A B ag careful ainer. Po enient ca DATA S ood. Was Date of I a Date of	erature (77°F) (77°F) ies are listed atures of Toughutes at 25°C (77° ys, Dependent Heating 66 to the limit entranges proving the limit entran	Value 400% 37A on following pages. gh-Seal 31. (77°F) F) it on part size 0 80°C (150-175°F) apped air during to part and cure. de air free mixing. ORE USING. after handling. 15°C to 35°C) (-18°C to 35°C)	
PROPERTIES (Typical) CURE SCHEDULE (Typical) INSTRUCTIONS FOR USE SAFETY & HANDLING SHELF LIFE & STORAGE INFO	Property Elongation at Break Hardness, Shore A Comprehensive electric Visit tough-seal.com Gel Time (100g): Hard Cure Full Cure Accelerated Cure MIX RATIO By Tough-Seal 31 Part A Tough-Seal 31 Part B Combine Part A and B mixing. Scrape sides, v Bulk meter-mix dispense PLEASE READ MA Avoid all contact with seal 31A (PC2 Tough-Seal 31A (PC2)	D638 D2240 Cal & thermal man for greater disconnections WEIGHT 57 A 100 B and mix thorough valls and bottom sing machines and skin, eyes, clothin consistency of the constant	echanical cussion of 1	25°C 25°C I propertion the feators on the feators of the feators o	erature (77°F) (77°F) ies are listed atures of Toughutes at 25°C (77° ys, Dependent Heating 66 to at 25°C in the control of th	Value 400% 37A on following pages. gh-Seal 31. (77°F) F) at on part size 80°C (150-175°F) apped air during to part and cure. de air free mixing. ORE USING. after handling. 15°C to 35°C) (-18°C to 35°C) (-18°C to 35°C)	

KEY POLYMER

All sales subject DCO#r2440 Revision AE conditions on reverse side.

CORPORATION

PRODUCT INFORMATION

(TYPICAL PROPERTIES)

These should not be considered as specifications.

PRODUCT

TOUGH-SEAL 31 A/B (KEY PC2031A/B) SEALANT FOR THERMAL CYCLING

CURED PROPERTIES

(Typical) Page 2

Electrical Properties		ASTM	Temperature	Value
Dielectric Strength		D149	25°C (77°F)	325 Volts/mil
Volume Resistivity		D257	25°C (77°F)	$2.1 \times 10^{-12} \Omega$ -cm
Dielectric Constant	1 MHz	D150	25°C (77°F)	4.75
	1 kHz	D150	25°C (77°F)	5.2
	60 Hz	D150	25°C (77°F)	5.35
Dissipation Factor	1 MHz	D150	25°C (77°F)	0.024
•	1 kHz	D150	25°C (77°F)	0.021
	60 Hz	D150	25°C (77°F)	0.044
Thermal Properties		ASTM	Condition	Value
Heat Capacity, Cp		E1461	25°C (77°F)	1.75 J/g°K
Thermal Conductivity		E1461	25°C (77°F)	0.18 W/m°K
Coefficient of Thermal Expansion			-65°C to 75°C	168 ppm/°C
	•	E831 E1545	75°C to 100°C	168 ppm/°C
			100°C to 150°C	168 ppm/°C
Mechanical Propertie	S	ASTM	Condition	Value
Tensile Strength		D638	25°C (77°F)	800 psi
Elongation at Break		D638	25°C (77°F)	400 %
Linear Shrinkage (Upon	Cure)	D2256	25°C (77°F)	<0.001 in/in
Hardness vs Temperature		D2240	-75°C (-103°F)	87 A
Shore A		D2240	-25°C (-13°F)	50 A
		D2240	5°C (41°F)	44 A
		D2240	25°C (77°F)	37 A
		D2240	50°C (122°F)	37 A
		D2240	66°C (150°F)	37 A
		D2240	80°C (176°F)	37 A
		D2240	100°C (212°F)	37 A
		D2240	120°C (248°F)	35 A
		D2240	150°C (302°F)	33 A
Hardness vs RT Cure	1 Hour	D2240	25°C (77°F)	4 A
	2 Hours	D2240	25°C (77°F)	6 A
	4 Hours	D2240	25°C (77°F)	11 A
	8 Hours	D2240	25°C (77°F)	14 A
	12 Hours	D2240	25°C (77°F)	14 A
	1 Day	D2240	25°C (77°F)	16 A
	2 Days	D2240	25°C (77°F)	19 A
	3 Days	D2240	25°C (77°F)	22 A
	4 Days	D2240	25°C (77°F)	23 A
	1 Week	D2240	25°C (77°F)	30 A
	1 Month	D2240	25°C (77°F)	41 A

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PRODUCT INFORMATION

(TYPICAL PROPERTIES)

These should not be considered as specifications.

PRODUCT

TOUGH-SEAL 31 A/B (KEY PC2031A/B) SEALANT FOR THERMAL CYCLING

CURED PROPERTIES

(Typical) Page 3

METALLIC ADHESION	ASTM	Temperature	Value				
Tensile Lap Shear Strength, 1							
Co = Cohesive Bond Mode Ad = Adhesive Bond Mode							
Aluminum Bare	D1002	25°C (77°F)	470 psi [Co]				
Steel Bare	D1002	25°C (77°F)	260 psi [Ad]				
Steel Ground	D1002	25°C (77°F)	280 psi [Ad]				
Primed Steel	D1002	25°C (77°F)	150 psi [Ad]				
Galvanized Steel	D1002	25°C (77°F)	260 psi [Ad]				
Tin Plated Steel	D1002	25°C (77°F)	250 psi [Co]				
Chrome Plated Steel	D1002	25°C (77°F)	250 psi [Co]				
FRP ADHESION	ASTM	Temperature	Value				
Tensile Lap Shear Strength, 1	" x 4" Adheran	ds, 20 mil bondline	gap, 1 inch overlap				
Co =	= Cohesive Bo		dhesive Bond Mode				
FRP – Polyester Fiberglass	D3163	25°C (77°F)	180 psi [Ad]				
Garolite G-9 Melamine/Glass	D3163	25°C (77°F)	130 psi [Ad]				
Garolite G-10 Epoxy/Glass	D3163	25°C (77°F)	130 psi [Ad]				
Garolite XX Phenolic/Paper	D3163	25°C (77°F)	190 psi [Ad]				
THERMOPLASTIC ADHESION	ASTM	Temperature	Value				
Tensile Lap Shear Strength, 1" x 4" Adherands, 20 mil bondline gap, 1 inch overlap							
Co = Cohesive Bond Mode Ad = Adhesive Bond Mode							
Acrylic	D3163	25°C (77°F)	110 psi [Ad]				
Acrylic / PVC	D3163	25°C (77°F)	120 psi [Ad]				
PVC - Polyvinyl Chloride	D3163	25°C (77°F)	150 psi [Ad]				
CPVC - Chlorinated PVC	D3163	25°C (77°F)	170 psi [Ad]				
ABS	D3163	2F0C (770F)	120 nai [14]				
Acrylonitrile Butadiene Styrene	D3103	25°C (77°F)	120 psi [Ad]				
PETG Polyethylene	D2162	2FoC (77oF)	100 pgi [Ad]				
Terephthalate	D3163	25°C (77°F)	100 psi [Ad]				
Lexan - Polycarbonate	D3163	25°C (77°F)	90 psi [Ad]				
Nylon 6/6 - Polyamide	D3163	25°C (77°F)	160 psi [Ad]				
Polypropylene	D3163	25°C (77°F)	40 psi [Ad]				
Polyethylene LDPE	D3163	25°C (77°F)	10 psi [Ad]				
Polyethylene HDPE	D3163	25°C (77°F)	40 psi [Ad]				
Teflon PTFE	D2462						
Polytetrafluoroethylene	D3163	25°C (77°F)	20 psi [Ad]				
Noryl	D2162	2506 (7705)	170 [4]				
Polyphenylene Oxide/Polystyrene	D3163	25°C (77°F)	170 psi [Ad]				
Ultem - Polyetherimide	D3163	25°C (77°F)	100 psi [Ad]				



All sales subject to terms & conditions on reverse side.

CONDITIONS

Seller does not accept any terms or conditions of sale or make any warranties, expressed or implied, other than those contained in this Statement or in any existing written contract between the seller and buyer covering Key Polymer Corporation Products.

ORDER ACCEPTANCE:

Orders are accepted upon the understanding that seller is not obligated to make delivery by any specified date nor liable for damage due to delay or failure in filling order caused by contingencies beyond its control. If delivery dates are specified, they are estimates only and not guaranteed. In the event of unreasonable delay in filling order, buyer may cancel same on written notice to seller, provided said order is not then in process of manufacture.

EXCISE TAXES:

The amount of excise taxes on the production, sale, delivery or transportation of material covered hereby shall be paid by the buyer.

DISCLAIMER OF LIABILITY:

As the conditions or methods of use are beyond our control, we do not assume any responsibility and expressly disclaim any liability for any use of this material. Information contained herein is believed to be true and accurate, but all statements or suggestions are made without warranty, express or implied, regarding accuracy of the information, the hazards connected with the use of the material or the results to be obtained from the use thereof. Compliance with all applicable federal, state and local laws and regulations remains the responsibility of the user.

Buyer shall make an examination both as to quantity and quality of any material delivered hereunder immediately upon receipt and failure of buyer to give notice of any claims within 15 days after receipt of such material shall be an unqualified acceptance of such material and a waiver by buyer of all claims with respect hereto.

USERS RESPONSIBILITY:

Key Polymer product usage suggestions, bulletins and manuals cannot cover all possible situations which the user may experience during processing. Each aspect of your operation should be examined if or where additional precautions or procedures may be necessary. All health and safety information contained in Key Polymer's Material Safety Data Sheets for the products being used should be provided to all employees with exposure to the product. It is the responsibility of the user to provide this information in this manner and to use the information to develop appropriate work practice guidelines and employee instructional programs.

LIABILITY LIMITATION:

Buyer assumes all risk and liability for the results obtained by the use of any material delivered by Key Polymer in the manufacturing processes of buyer or in combination with other substances in manufacturing and repair processes of buyer or in combination with other substances. No claim of any kind, whether as to material delivered or for non-delivery of material, shall be greater in amount than the purchase price of this material in respect of which such claim is made.

KEY POLYMER CORP. LAWRENCE, MA 01843

> REV AA DCO # 0588 February 3, 2003