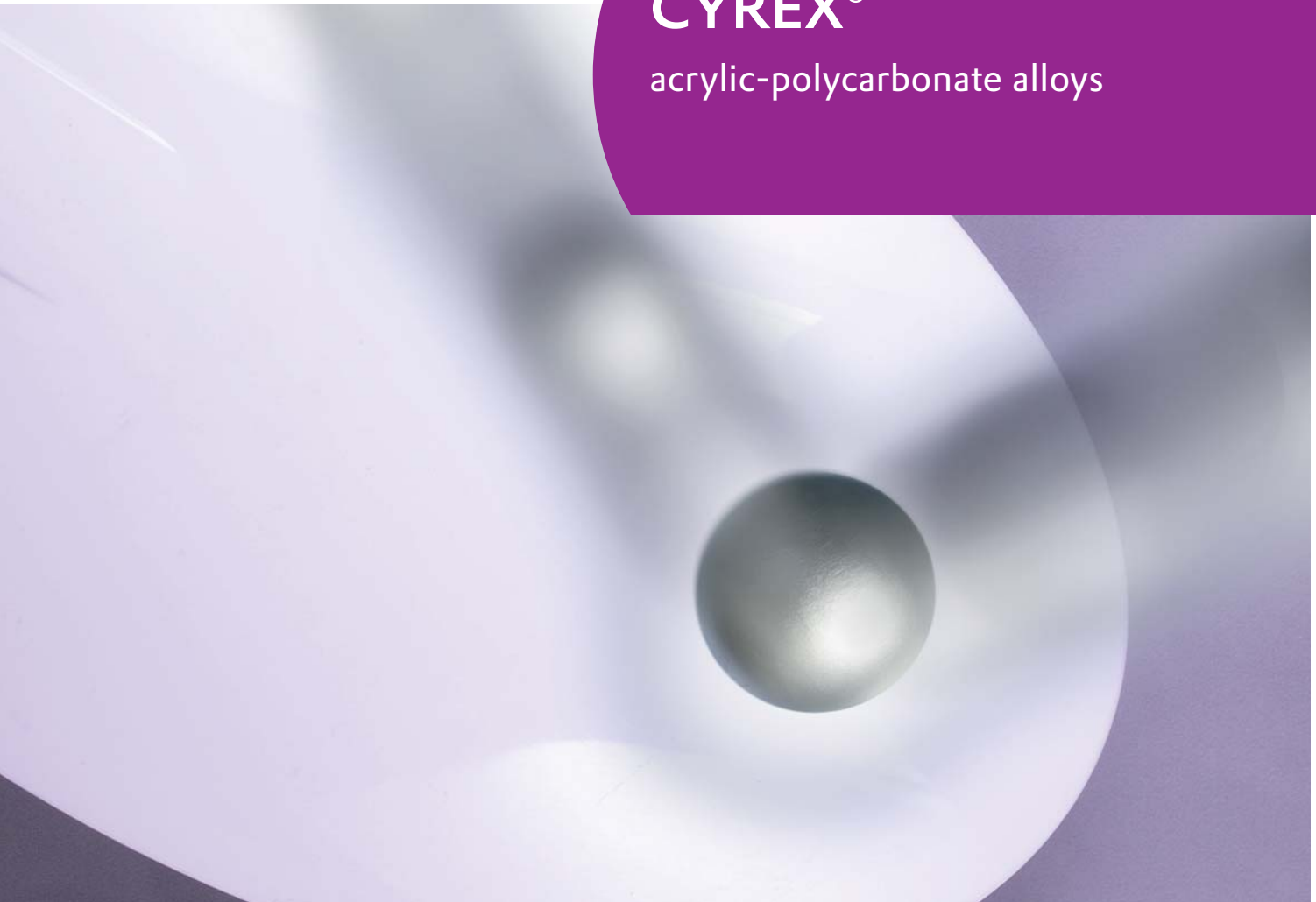


# CYREX<sup>®</sup>

acrylic-polycarbonate alloys



# CYREX®

## acrylic-polycarbonate alloys for impact performance applications

CYREX® is an opaque, acrylic-polycarbonate alloy. When the two components are combined with a proprietary compatibilizer, a synergistic effect is produced resulting in a product with impact strength that is higher than polycarbonate. CYREX alloys also maintain the ease of processing associated with acrylic materials. They can be processed at lower temperatures than straight polycarbonate which will decrease the cooling time and in turn decrease the cycle time of the injection molding process. CYREX alloys also exhibit a high degree of structural integrity, good heat resistance, good chemical resistance, and are gamma resistant. CYREX alloys are ideal materials for both thin and thick walled applications which require excellent toughness.

### Applications:

- medical devices
- housings for personal electronic devices
- appliances
- toys
- furniture
- automotive components
- protective casings



### CYREX 200-8000 alloy

is an exceptionally tough material with a deflection temperature of 214°F and a Vicat softening point of 277°F.

### CYREX 200-8005 alloy

was formulated specifically for the medical industry. It exhibits excellent resistance to both alcohol and lipids, it has good heat resistance so it can be ethylene oxide sterilized, and it is both gamma and E-beam radiation resistant.

### CYREX 953 alloy

is designed for both thin wall and cold temperature applications. Similar to the other CYREX alloys, it is very tough with good heat resistant properties.

### CYREX® Alloys: Processing Conditions – Injection Molding

Condition	Suggested Range	Starting Point
Drying Temperature, °F (3 – 4 hours)	180	180
Feed Section Temperature, °F	395 – 445	410
Center Section Temperature, °F	445 – 485	450
Front Section Temperature, °F	460 – 510	480
Nozzle Temperature, °F	460 – 510	480
Melt Temperature, °F	460 – 510	480
Mold Temperature, °F	150 – 210	180
Injection Pressure, psi	8,000 – 18,000	10,000
Clamp Pressure	2.5 tons/in <sup>2</sup> of projected area for flow – Length/wall thickness < 100/1 5 tons/in <sup>2</sup> of projected area for flow – Length/wall thickness > 100/1	
Screw Speed, rpm		
2:1 compression ratio	75 – 150	100
3.5:1 compression ratio	60 – 130	80
Ram Speed, in/sec		
small gates	0.5 – .5	1
large gates	1 – 4	2
Back Pressure, psi	50 – 300	100



## Property Comparison of CYREX Alloys Versus other Plastics

	ASTM Method	CYREX Alloys <sup>1</sup>	PC/ABS <sup>1</sup>	Polycarbonate <sup>1</sup>
<b>Rheological</b>				
Average Melt Flow @230°C/3.8 kg <sup>2</sup> @300°C/1.2 kg <sup>3</sup>	D-1238	1.9 – 3.9 –	– 5 – 35	– 3 – 22
<b>Mechanical</b>				
Tensile Strength, Psi	D-638	7860 – 8850	5800 – 8700	8500 – 9600
Tensile Modulus, x 10 <sup>6</sup> psi	D-638	.30 – .35	.32 – .40	.325 – .45
Tensile Elongation @ Yield, %	D-638	4.2 – 4.7	3.0 – 5.0	6.5 – 9.0
Tensile Elongation @ Break, %	D-638	57 – 88	50 – 150	90 – 150
Flexural Strength, psi	D-790	11300 – 12500	9400 – 16000	12000 – 14200
Flexural Modulus, x 10 <sup>6</sup> psi	D-790	.30 – .35	.29 – .41	.32 – .35
Izod Impact Strength 1/8" @ 73°F	D-256	26 – 30	2 – 12	10 – 18
<b>Physical</b>				
DTL, °F on 1/4" bar @264 psi, annealed	D-648	214 – 217	185 – 265	252 – 285
Specific Gravity	D-792	1.15	1.10 – 1.19	1.20
Mold Shrinkage, in/in	D-955	.004 – .008	.004 – .008	.005 – .007

Note:

1. Typical range of properties listed not to be construed as specifications.
2. CYREX alloys listed under melt conditions associated with acrylics.
3. Higher test temperatures required for polycarbonate and PC/ABS due to the resin's higher processing temperatures.

CYREX 200 8005 alloy complies with ISO 10993 (Tripartite), USP and FDA regulations. CYREX 200-8005 alloy as been found to be non-hemolytic, non-cytotoxic, non-pyrogenic, non-sensitizing and non-mutagenic as tested. Other grades of CYREX alloys can also be made available that meet these requirements.

## CYREX® Acrylic-Polycarbonate Alloys – Physical Properties

Property	Test Method	CYREX 200-8000 alloy	CYREX 200-8005 alloy	CYREX 953 alloy
<b>Rheological</b>				
Avg Melt Flow Rate, g/10 min @ 230°C & 3.8 kg	ASTM D-1238	3.9	3.5	1.9
<b>Mechanical</b>				
Tensile Strength, psi (MPa)	ASTM D-638	8,850 (61.0)	8,000 (55.2)	7,860 (54.2)
Tensile Modulus, x10 <sup>6</sup> psi (GPa)	ASTM D-638	0.350 (2.4)	0.320 (2.2)	0.300 (2.1)
Tensile Elongation @ Yield, %	ASTM D-638	4.7	4.3	4.2
Tensile Elongation @ Break, %	ASTM D-638	58	57	88
Flexural Strength, psi (MPa)	ASTM D-790	12,500 (86.2)	11,300 (78.9)	12,500 (86.2)
Flexural Modulus, x10 <sup>6</sup> psi (GPa)	ASTM D-790	0.35 (2.4)	0.32 (2.2)	30 (2.1)
Notched Izod ft-lb / in 1/8" @ 73°F	ASTM D-256	30.0	26.0	26.1
Notched Izod ft-lb / in 1/8" @ 32°F	ASTM D-256	4.0	–	5.2
Notched Izod ft-lb / in 1/4" @ 73°F	ASTM D-256	13.5	11.5	17.1
Notched Izod ft-lb / in 1/4" @ 32°F	ASTM D-256	2.2	–	6.0
Rockwell Hardness, M scale	ASTM D-785	46	49	44
<b>Physical</b>				
DTL, °F (°C) @ 264 psi, annealed	ASTM D-648	214 (101)	214 (101)	217 (103)
Vicat Softening Point, °F (°C)	ASTM D-1525	277 (136)	286 (141)	275 (135)
Specific Gravity	ASTM D-792	1.15	1.15	1.15
Water Absorption, % max	ASTM D-570	0.26	0.26	0.26
Mold Shrinkage, in/in, mm/mm	ASTM D-551	0.004 – 0.008	0.004 – 0.008	0.004 – 0.008
Coefficient of Linear Expansion in/in/°F, 32 – 212°F (mm/mm/°C – 100°C)	ASTM D-696	0.000052 (0.0000936)	0.000052 (0.0000936)	0.000052 (0.0000936)
Flammability		UL 94 HB	UL 94 HB	UL 94 HB

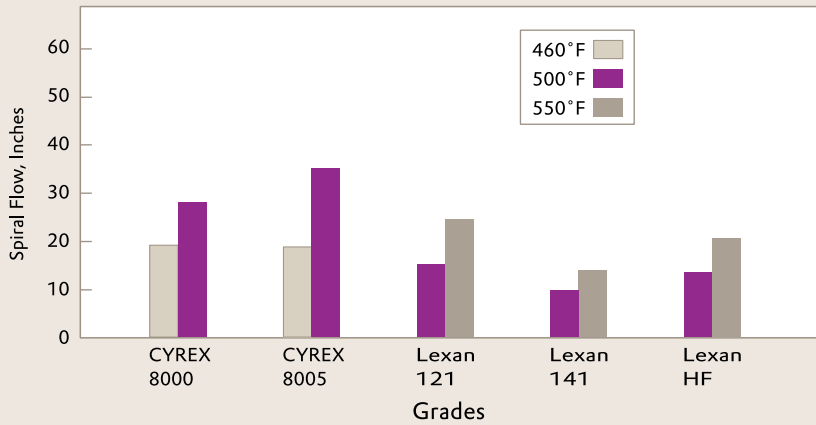


## CYREX Alloys – Chemical Resistance

IPA/Water 50%/50%	Visual Inspection, Immersion 1 hr	+
Ethylene Glycol	Visual Inspection, Immersion 1 hr	+
Baking Soda Paste	Visual Inspection, Exposed 92 hrs	+
Toothpaste	Visual Inspection, Exposed 92 hrs	+
Fluorides	Visual Inspection, Exposed 92 hrs	+
Glycerin	Visual Inspection, Immersion 170 hrs @ 150°F	+
Palmolive Dishwasher/Water 25%/75%	Visual Inspection Immersion 24 hrs	+
Palmolive Dishwasher/Water 50%/50%	Visual Inspection Immersion 24 hrs	+
Acetone	Visual Inspection Immersion 24 hrs	-
Heavy Duty Detergent	Visual Inspection, Immersion 1000 hrs	+
Bleach (10%) Solution	Tensile Elongation Retention, Immersion 24 hrs	+
Heptane	Tensile Strength, Immersion 1000 hrs	+
Gasoline	Tensile Strength, Immersion 500 hrs	X
Gasoline	Tensile Strength Immersion 1000 hrs	-
Ethanol	Tensile Strength, Immersion 500 hrs	+
Ethanol	Tensile Strength, Immersion 1000 hrs	X
Octane/Toluene 75%/25%.	Tensile Strength, Immersion 500 hrs	+
Octane/Toluene 75%/25%.	Tensile Strength, Immersion 1000 hrs	X
Ammonia	Tensile Elongation Retention, Immersion 24 hrs	X
Ammonia	Tensile Elongation Retention, Immersion 100 hrs	-
Ammonia	Tensile Strength Retention, Immersion 24 hrs	+
Ammonia	Tensile Strength Retention, Immersion 100 hrs	+
Ammonia	Resistance under Tensile Strength	X
Fantastic Cleaner	Tensile Elongation Retention, Immersion 24 hrs	+
Fantastic Cleaner	Tensile Elongation Retention, Immersion 100 hrs	+
Fantastic Cleaner	Tensile Strength Retention, Immersion 24 hrs	+
Fantastic Cleaner	Tensile Strength Retention, Immersion 100 hrs	+
Fantastic Cleaner	Resistance under Tensile Strength	X
Soap and Water	Tensile Elongation Retention, Immersion 24 hrs	+
Soap and Water	Tensile Elongation Retention, Immersion 100 hrs	+
Soap and Water	Tensile Strength Retention, Immersion 24 hrs	+
Soap and Water	Tensile Strength Retention, Immersion 100 hrs	+
Soap and Water	Resistance under Tensile Strength	+
Lipids	Resistance under Tensile Strength	+
Lipids	Resistance under Tensile Strength (3100 psi, 70 hrs)	X
IPA	Resistance under Tensile Strength	+
IPA	Resistance under Tensile Strength (3100 psi 70 hrs)	-
Igepal (1%) solution	Resistance under Tensile Strength (3750 psi 70 hrs)	+
Diesel Fuel	Resistance under Tensile Strength (1750 psi, 170 hrs)	X
DOP (Phthalate)	Time to Craze under Stress (4000 psi)	-
Kerosene	Resistance under Tensile Strength (3100 psi, 10 hrs)	+
Butter	Resistance under Tensile Strength (3100 psi, 24 hrs)	X
Butter	Stain Resistance, 24 hrs	+
Vinyl Gasket	Resistance under Tensile Strength (3100 psi 24 hrs)	+
Citric Acid Solution (0.1%)	Stain Resistance, 24 hrs	+
Coffee	Stain Resistance, 24 hrs	+
Lipstick	Stain Resistance, 24 hrs	+
French's Mustard	Stain Resistance, 24 hrs	+
Sodium hydroxide (0.5%)	Stain Resistance, 24 hrs	+
Tea	Stain Resistance, 24 hrs	+
Rust Inhibitor Veto # 4224	Resistance under Tensile Strength (3100 psi, 170 hrs)	-
Rust Inhibitor Veto # 53359	Resistance under Tensile Strength (3100 psi, 170 hrs)	X
Transmission Fluid	Resistance under Tensile Strength (3100 psi, 170 hrs)	+
Antifreeze	Resistance under Tensile Strength (3100 psi, 170 hrs)	-

Key: + Resistance x Limited Resistance - Non Resistant  
 Testing done at the Evonik Cyro Technical Center

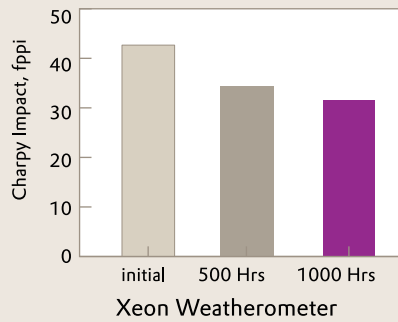
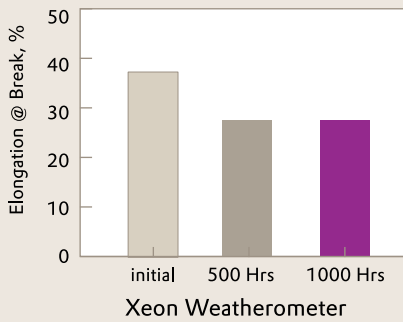
**Spiral Flow  
CYREX Alloys vs. Polycarbonate**



**Spiral Flow**

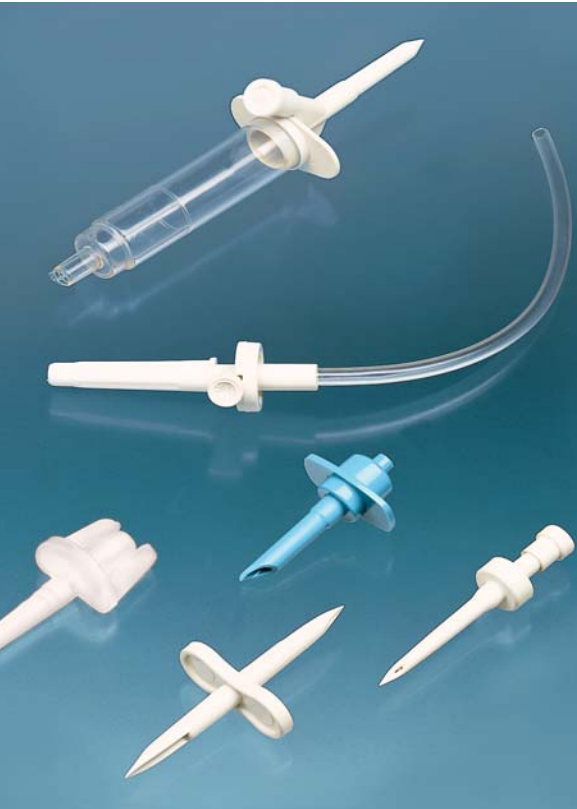
CYREX alloys and polycarbonate are tested at different conditions for melt flow rate. CYREX alloys are heated to 446°F and their flow measured at that temperature, while polycarbonate is heated to 572°F and its flow is measured at this much higher temperature. When temperature increases so does flow. A better way to compare flow between CYREX alloys and polycarbonate is to review the spiral flows of the respective materials which clearly demonstrates that CYREX alloys flow better than polycarbonate at lower temperatures.

**Effect of Weathering  
CYREX 200-8000 Alloy**



**Weathering Data**

CYREX alloys are not considered continuously weatherable materials. Intermediate weathering will not result in significant losses in elongation at break or Charpy impact strength as shown in the graph above.



## CYREX<sup>®</sup> acrylic-polycarbonate alloys – processing characteristics

### Drying

CYREX alloys molding compounds are hygroscopic materials. This means they absorb moisture from the surrounding environment. Since moisture causes various problems including molecular weight deterioration when heating and meltprocessing, the materials must be dried before processing. But moisture in CYREX alloys is not nearly as critical as in polycarbonate since it is processed at much lower temperatures. CYREX can be molded without problems at a moisture level of 0.05%, whereas polycarbonate needs to be dried to below 0.01%. It is recommended that a desiccant dryer be used. CYREX alloys should be dried for 3 - 4 hours at 180°F.

### Regrind

Evonik Cyro's materials can all be reground and reprocessed without adversely affecting physical properties. The primary effect of using reground material is a shift in color. To avoid a significant color change it is recommended that 25% regrind is used. It is also important to avoid contamination and remove all fines in the regrounding process. Due to the increased surface to volume ratio, the regrind may require additional drying.

### Purging

Given its good thermal stability, temporary interruptions in production usually will not cause degradation problems in CYREX alloys. Prolonged interruptions, or when temperatures are unusually high (above 500°F), may lead to a slight yellowing of material in the molding machine's barrel. If yellowing occurs, purging may be required.

### Runner Systems

The best cross section for a runner is a full round. "S" runners with large cold slug wells are recommended. Cold slug wells should be located at each turn on runners with long flow paths. The runners must distribute the melt in the same state and at the same pressure to all cavities. The pressure loss in sprue, runner and gate systems must be kept to a minimum. The maximum recommended melt pressure to fill an entire part is 15,000 psi.

## Recommended Gating

All types of gating have been used successfully with CYREX alloys. It is recommended that the gate be 80% of the nominal wall thickness. If the gate is too small it will restrict the filling speed which in turn prevents the mold from being adequately filled. When using a restricted gate, the diameter should not be less than 0.036 inch (0.9 mm) for parts of average weight and 0.028 inch (0.7 mm) for smaller parts with a uniform wall thickness. A tab gate is used in situations where a weak area around a restricted gate must be avoided. The wall of the tab should not be thicker than the wall of the part to avoid excessive cooling time. A fan gate is used for flat, thin moldings such as scales, covers, or rulers where one does not wish to inject on the large, flat faces. Umbrella-type gating is recommended for tubular articles. Submarine gating allows the molding to be automatically separated from the runner upon removal from the mold. Center gating was one of the first types of gates used in injection molding and is considered to be one of the best. It provides a balanced fill for the molded part which reduces stress and minimizes weldlines. Center gating requires adequate cooling around the gate area for hot runner molds.

## Weld Line Strength

Weld lines and meld lines can create a weakness in a molded part. The weld and meldline strength of parts molded with CYREX alloys is affected in the same manner as in all multiphase materials (alloys and blends) and fiber reinforced materials. Melt and mold temperature have the greatest effect on weld line strength. A mold temperature of 200°F is preferable to a mold temperature of 140°F. Mold designs that incorporate overflow tabs, flow diverters that shift the flow front, or mechanisms that promote local mixing all improve with weld line strength. Molds must have 0.002" vent openings.

## Thin Wall Molding

CYREX alloys may be molded into thin wall geometries. Small parts with wall thicknesses between 0.025" (0.64mm) and 0.050" (1.3mm) can be molded using very fast injection speeds and high injection pressures. CYREX 953 alloy was designed specifically for thin wall applications. For example, a 2" x 3" CYREX 953 alloy single cavity part with a 0.025" wall is molded with an injection speed of 6" per second (3.6 cu inches/second) and 27,000 psi melt pressure at the nozzle. This is accomplished with 0.030" sub gate, 30% of the parting line vented at 0.0015", 40 tons/square inch adjusted clamp pressure on a 50ton machine. Machine size will vary depending on the part being molded.



## Technical Support

Visit the TechKnowlogy Center at [www.cyrolite.com](http://www.cyrolite.com) where visitors have immediate access to FAQs, technical information, tips, and hundreds of other facts about Evonik Cyro acrylic polymers.

**Important Notice:**

This information and all technical and other advice are based on Evonik's present knowledge and experience. However, Evonik assumes no liability for such information or advice, including the extent to which such information or advice may relate to third party intellectual property rights. Evonik reserves the right to make any changes to information or advice at any time, without prior or subsequent notice. EVONIK DISCLAIMS ALL REPRESENTATIONS AND WARRANTIES, WHETHER EXPRESS OR IMPLIED, AND SHALL HAVE NO LIABILITY FOR, MERCHANTABILITY OF THE PRODUCT OR ITS FITNESS FOR A PARTICULAR PURPOSE (EVEN IF EVONIK IS AWARE OF SUCH PURPOSE), OR OTHERWISE. EVONIK SHALL NOT BE RESPONSIBLE FOR CONSEQUENTIAL, INDIRECT OR INCIDENTAL DAMAGES (INCLUDING LOSS OF PROFITS) OF ANY KIND. It is the customer's sole responsibility to arrange for inspection and testing of all products by qualified experts. Reference to trade names used by other companies is neither a recommendation nor an endorsement of the corresponding product, and does not imply that similar products could not be used.

CYREX® is a registered trademark of Evonik Cyro LLC, an Evonik Degussa Corporation group company.

©2011 Evonik Cyro LLC. All rights reserved. Printed in USA.

**Evonik Cyro LLC**

379 Interpace Parkway  
Parsippany, NJ 07054  
United States

**PHONE** +1 973 541-8000  
+1 800 225-0172

[cyro-polymer@evonik.com](mailto:cyro-polymer@evonik.com)  
[www.cyrolite.com](http://www.cyrolite.com)  
[www.evonik.com](http://www.evonik.com)

**Evonik. Power to create.**