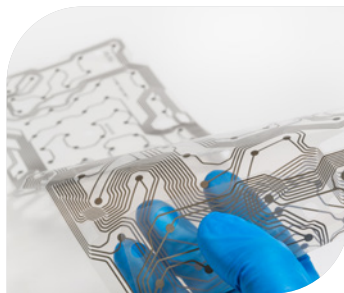


IncroMax™



High
Performance
Additives for
Engineering
Polymers



High Performance Additives for Engineering Polymers

A range of high performance additives that have been specially developed to enhance performance in engineering polymers.

This range of products has been specially designed to deliver reduced friction and easier processability, improved mold release, and enhanced scratch resistance.

This in turn ensures that processes are more energy efficient, and produce fewer rejected parts and less waste, therefore helping you to achieve your sustainability goals.

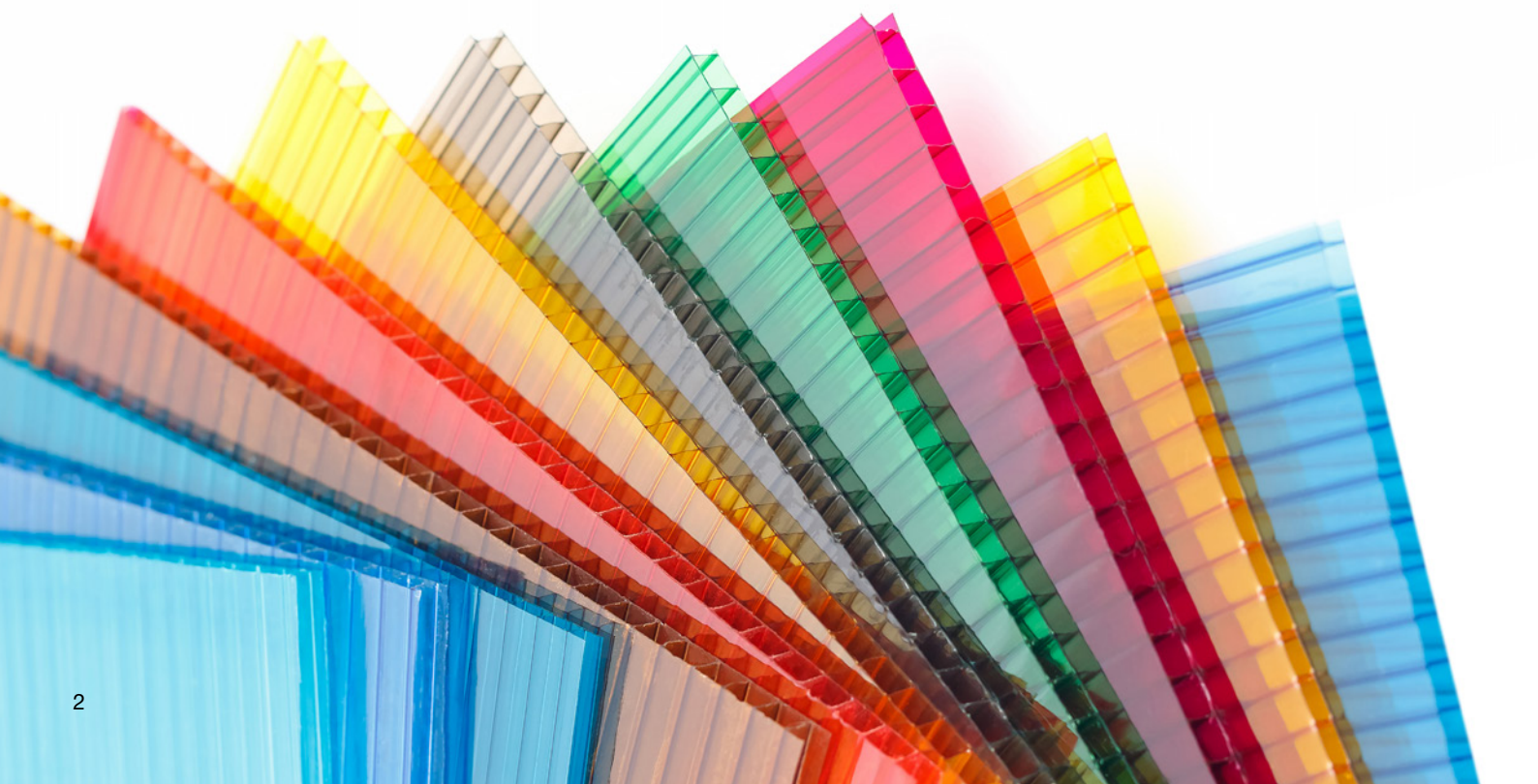
Why are additives needed?

Many engineering polymers, such as styrenics, polyesters and polyamides, have inherently high surface friction and poor mold release properties that make them difficult to process. Therefore, additives are needed to aid with processability to decrease surface friction and mold release force.

How can additives add value?

The IncroMax™ range of additives has been specially developed for engineering polymers and can offer the following benefits:

- Reduced friction and easier processing
- Improved packing and de-nesting of molded parts
- Fewer rejected parts and less waste
- Improved appearance of the end product
- Reduced energy consumption
- Easier stretching (BOPET)



Product Range

The IncroMax™ range provides friction reduction and mold release for different engineering polymers. Products in this range can be added via masterbatch or directly to molding or extrusion processes at levels between 0.1 and 1% depending on the application.

Product Information

PRODUCT	PHYSICAL FORM AT 25°C	PRIMARY EFFECT	APPLICATION	RENEWABLE CARBON	FOOD CONTACT APPROVALS*	
					EU	FDA
IncroMax™ PS	Bead/Powder	Friction reduction, mold release and anti-scratch	Styrenics & PMMA	100%	✓	✓
IncroMax™ 100	Pastille	Friction reduction, improved processing efficiency, mold release, anti-scratch and easier stretching of BOPET	PET & other polyester polymers (incl. PLA)	100%	✓	✓
IncroMax™ 300	Liquid	Friction reduction, mold release and anti-scratch	PC & polyester polymers	48%		
IncroMax™ 400	Bead	Friction reduction, anti-tack	EVA copolymers, styrenics, polar polymers & polyamides	100%	✓	✓

* A tick indicates that a product complies with EU10/2011 and/or with specific FDA paragraphs. Individual statements are available upon request. The user is responsible for ensuring suitability for their intended application

IncroMax™ PS

IncroMax™ PS is a food contact approved slip additive that has been specifically designed for styrenics and acrylics. It instantly decreases surface friction and mold release force leading to a range of product and efficiency improvements.

Key Benefits

- Decreases surface friction and mold release force
- Improves packing and de-nesting of molded parts
- Reduces scratch and scuffs, and enhances surface quality
- Fewer rejected parts and less waste
- Easier processing and reduced manufacturing noise
- No adverse effects on the physical properties of the polymer

Key Applications

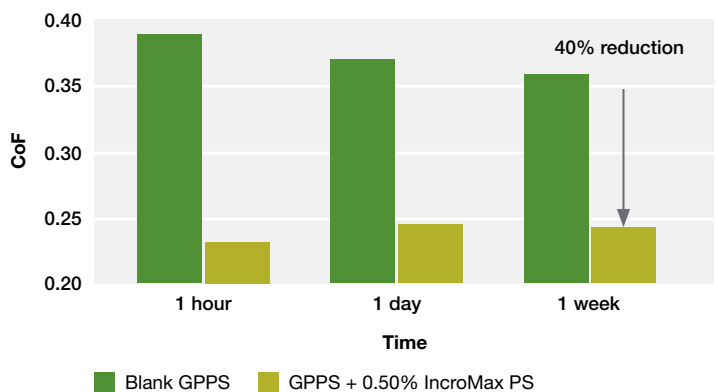
- Cosmetic bottles and jars
- Food containers and trays
- Plastic furniture
- Plastic housewares

Reduced Surface Friction

IncroMax PS acts as a slip agent, rapidly reducing the static and kinetic Coefficient of Friction (CoF) at the surface of the polymer. For example friction reduction is 36% in HIPS and as shown in figure 1, 40% in GPPS. Performance is long lasting and achieved by adding as little as 0.50% of the additive.

Easier Mold Release

IncroMax PS delivers a reduction in mold release force of typically 20% in HIPS and 32% in GPPS. By allowing mold release at higher injection temperatures, the cycle time of production is reduced, and the number of shots per hour increased. IncroMax PS enables increased productivity and reduced waste.



1. Kinetic CoF vs blank in GPPS when adding 0.50% IncroMax PS



Excellent Color & Clarity

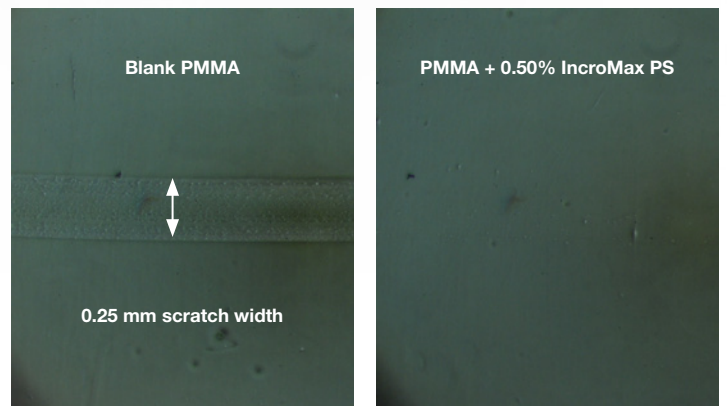
As shown in figures 2 and 3, IncroMax PS does not effect the color or clarity of the polymer. The color and clarity is also maintained over the lifetime of the polymer.

Scratch resistance

IncroMax PS also improves the scratch resistance of the polymer. For example, as shown in figure 3, scratch resistance is improved in PMMA at up to 15N.



2. Visual aspects of molded GPPS plaques containing no IncroMax PS and 0.50% IncroMax PS for color comparison



3. Transparent PMMA plaques containing no IncroMax PS and 0.50% IncroMax PS scratched at up to 15 N with no effect on color or clarity

IncroMax™ 100 for PET Processing

IncroMax™ 100 is a unique additive that was specially designed for PET, but also has beneficial effects in other polyesters. This unique additive reduces surface friction to provide improved processing in addition to easier mold release and increased scratch resistance.

Key Functions

- Improved flow (Internal lubrication effect)
- Mold release (External lubrication effect)
- Reduced surface friction
- Scratch resistance
- Easier stretching

Key Benefits

- Up to 40% reduction in injection pressure or 10°C lower processing temperature
- Continuous production and improved output
- Fewer rejected parts and less waste
- Reduces kinetic CoF in injection molded articles
- Improved packing density of molded preforms by up to 10%
- Reduced scratches and scuffs, and enhanced surface quality
- Excellent transparency of the PET – the same as virgin PET
- Good organoleptic properties
- Wide range of food contact approvals

Manufacturing Processes

- Injection molding
- Cast film extrusion
- Compression molding
- Injection stretch blow molding (ISBM)*
- Thermoforming*
- Biaxial film orientation

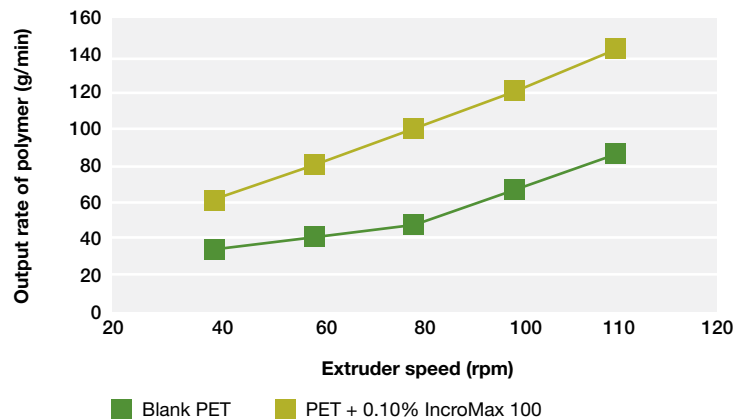
* Processing aid effect only

Easier Processing

The processing aid effect can be seen in melt processing techniques such as extrusion, injection molding and compression molding. IncroMax 100 allows molding at lower temperatures and more difficult geometries. The use of IncroMax 100 allows the required injection pressure to be reduced by up to 40%.

Easier Mold Release

IncroMax 100 delivers a reduction in mold release force of up to 60%. By promoting release between the mold surfaces and the molded part, it ensures all parts will come off the molding tool easily with less damage. Processing temperature can be reduced to improve the quality of the part post-molding with effective release.



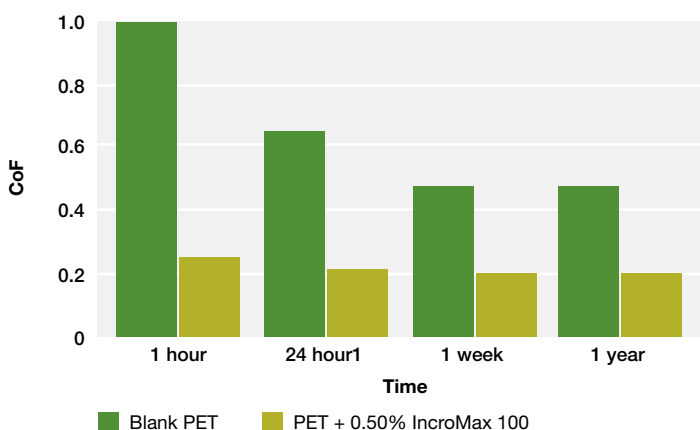
4. Laboratory rheology studies showing output rate of PET at different extruder speeds with blank PET vs. the addition of 0.10% IncroMax 100



Easier Stretching

For applications where orientation is used such as stretch blow molding of bottles, thermoforming, and BOPET films, IncroMax 100 acts as a processing aid and allows the material to be stretched more easily.

IncroMax 100 decreases the load required for stretching. This effect allows an energy reduction due to a decrease in stretching load, or a reduction in operating temperature to achieve the desired amount of orientation. Extended necking is also observed, showing the potential for more stretching with less stress-whitening.



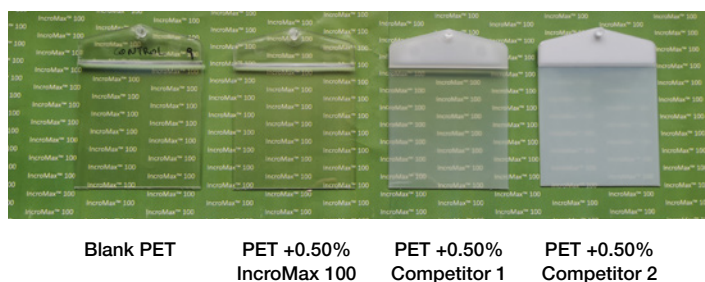
5. Kinetic CoF vs. blank in PET when adding 0.50% IncroMax 100

Reduced Surface Friction

IncroMax 100 acts as a slip agent in injection molded articles rapidly reducing the static and kinetic friction on the surface of the PET, as shown in figure 5. Friction has shown to be reduced by up to 60%. This performance is long lasting and can be achieved by adding as little as 0.10% IncroMax 100.

Excellent Color & Clarity

Results show that there is no visible difference between the color of the blank PET and that containing the IncroMax 100 additive. Color and clarity are retained over the lifetime of the polymer.



6. Haze and color comparison of control PET compared with PET containing 0.50% IncroMax 100 and competitor products

IncroMax™ 100 for Biopolymers



IncroMax™ 100 has been shown to offer key benefits such as improved slip and scratch resistance in a range of biopolymers, such as PLA, PLA blends and PBAT.

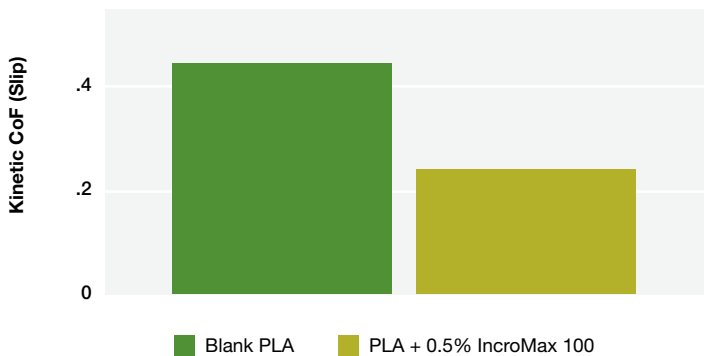
Slip Performance

IncroMax 100 provides excellent slip performance in PLA. With just 0.50% additive, the kinetic CoF on the surface is reduced by almost 50%.

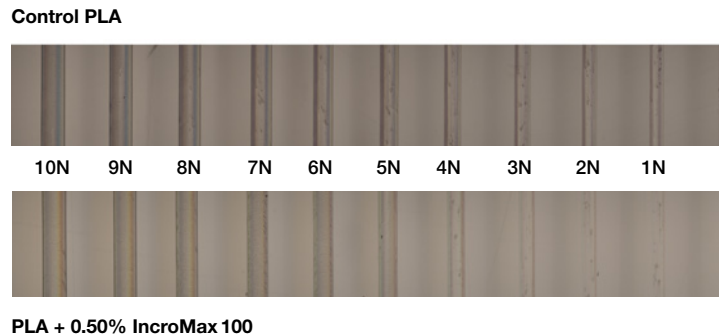
Scratch Resistance

IncroMax 100 provides enhanced surface quality by reducing scratch visibility. With IncroMax 100, scratches cause less damage in PLA, even under a 10 N scratch force.

7. Kinetic CoF vs. blank in PLA when adding 0.50% IncroMax 100



8. Comparison of scratch resistance between control PLA vs. PLA +0.50% IncroMax 100



IncroMax™ 100 for Sustainable Injection Molding

IncroMax™ 100 in injection molding of PET increases energy efficiency of the process by 4.5% by reducing the injection pressure and the ejection force needed. It also increases the output rate by enabling a smoother production process which reduces the energy use per unit by 20%.

Sustainable Injection Molding of PET Preforms

PET preforms are often injection molded and ejected directly into a crate, which is then transported from the preform manufacturing site to the bottle blowing plant. In order to reduce transportation costs, it is therefore advantageous to fit more parts into the crates.

At a 0.5% addition level, IncroMax 100 reduces friction of the molded part allowing the preforms to slide past each other, which leads to a 10% increase in the number of preforms that can fit in each box.

These combined energy saving benefits and better packing density add up to a potential CO₂ saving of 463kg per metric tonne of PET produced.



Energy efficient



Increased output rate



Reduced transport emission

IncroMax™ 300 for Polycarbonate

IncroMax™ 300 is a friction reduction additive designed specifically for easier processing of polycarbonate in sheet and glazing applications. IncroMax 300 increases output rate in extrusion, and also improves mold release and therefore efficiency during injection molding.

Key Benefits

- Offers a lower CoF in extrusion during and after production
- Aids with quick de-molding of complex parts without build up or residue left on the part or mold
- No compromise in clarity and performance
- Available as Atmer 7650, a 50% concentrate for easier processing

Key Applications

- Automotive & transportation
- Glazing & glass replacement
- Construction & infrastructure
- Electronics & electrical

Processing Improvements

The addition of IncroMax 300 at low concentrations provides a processing aid effect by improving the output rate of the polymer or allowing a reduction in processing temperature. IncroMax 300 also improves the surface quality of the extruded product.

Easier Mold Release

IncroMax 300 has been shown to deliver a reduction in mold release force by up to 40% when 0.50% of additive is used in polycarbonate. Reducing the processing temperature and therefore the cooling time allows for shorter cycle times, helping manufacturers increase productivity by maximizing the number of shots per hour.

Reduced Surface Friction

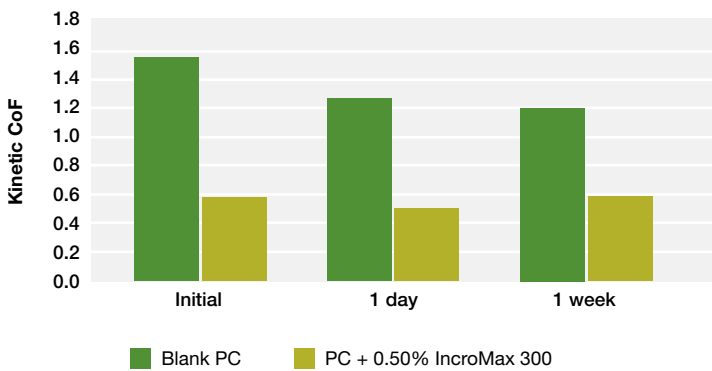
IncroMax 300 acts as a long-lasting internally added lubricant, rapidly reducing and maintaining low friction on the surface of polycarbonate. As shown in figure 9, a reduction in friction of 50% can be achieved after one week at levels as low as 0.50% of additive.

Scratch Resistance

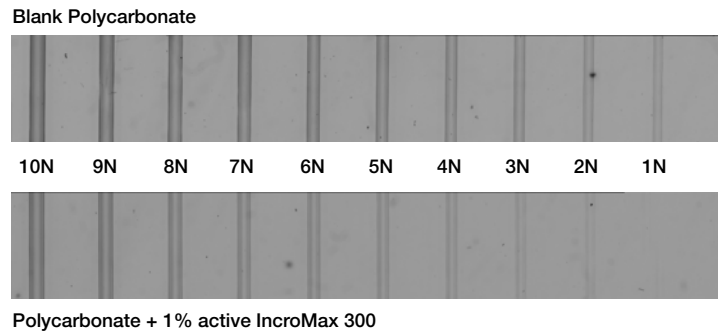
As seen in figure 10, IncroMax 300 offers enhanced scratch resistance. Without IncroMax 300, polycarbonate begins to show damage when a force of 4N is used. In comparison, when IncroMax 300 is incorporated into the polymer, the material only starts to show signs of damage when a 7N force is used. Even under a 10N force, scratch damage is visibly reduced when IncroMax 300 has been incorporated into the polycarbonate, shown by a lower contrast to the background.



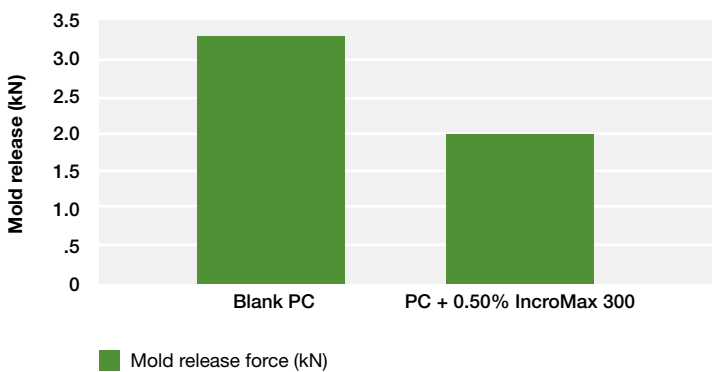
9. Kinetic CoF of blank PC and PC with 0.50% IncroMax 300



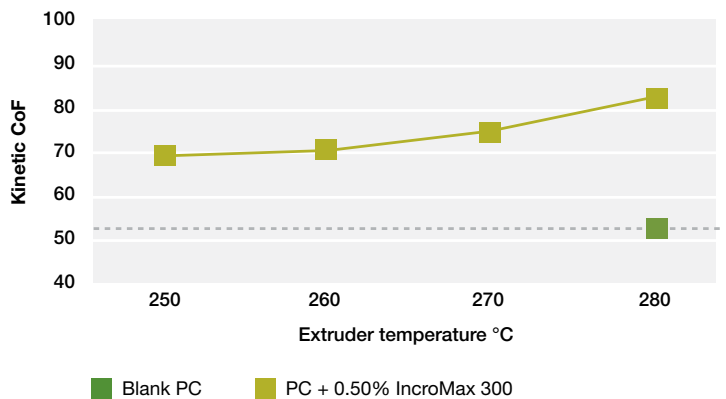
10. Polycarbonate +2% Atmer 7650 (1% active IncroMax 300)



11. Mold release of blank PC compared to PC with the addition of 0.50% IncroMax 300



12. Laboratory rheology studies showing output rate of PC at different extruder temperatures



Further Information

Cargill Bioindustrial sales and distribution are coordinated through an extensive worldwide network of technical and commercial experts. For further information or guidance please contact us:

polymeradditives@cargill.com

This document is provided for your information and convenience only. All information, statements, recommendations and suggestions are believed to be true and accurate under local laws but are made without guarantee, express or implied. WE DISCLAIM, TO THE FULLEST EXTENT PERMITTED BY LAW, ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE and FREEDOM FROM INFRINGEMENT and disclaim all liability in connection with the storage, handling or use of our products or information, statements, recommendations and suggestions contained herein. All such risks are assumed by you/user. The labeling, substantiation and decision making relating to the regulatory approval status of, the labeling on and claims for your products is your responsibility. We recommend you consult regulatory and legal advisors familiar with applicable laws, rules and regulations prior to making regulatory, labeling or claims decisions for your products. The information, statements, recommendations and suggestions contained herein are subject to change without notice.

