

Technical Service Department
Engineering Resin Applications

Technical Report

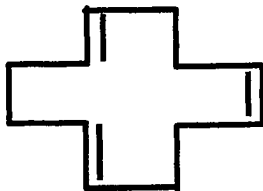
Nylon 12 versus Nylon 11

Polyamide 12

Butadiene (from crude oil via benzene)

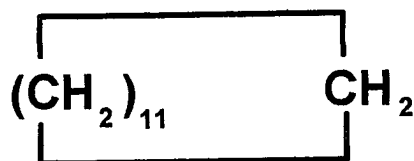


Catalyst



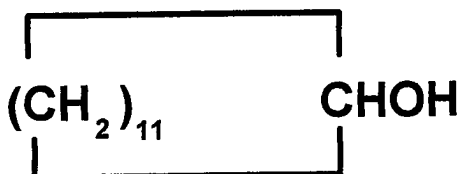
Cyclododecatriene

H_2



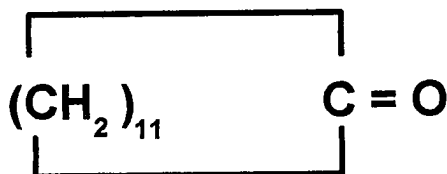
Cyclododecane

Oxidation



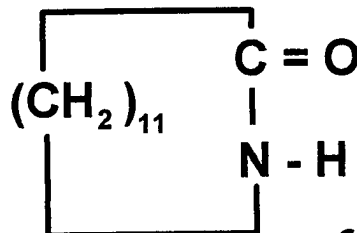
Cyclododecanol

$-\text{H}_2$



Cyclododecanone

H_2NOH
 H_2SO_4

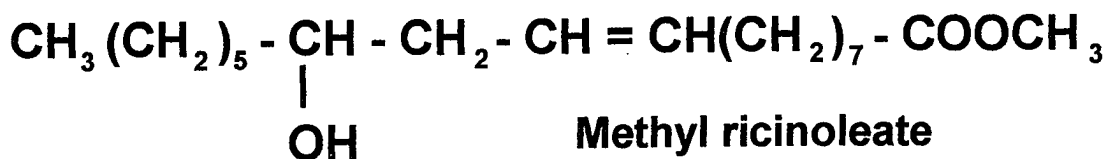


Dodecanolactam
(Laurinlactam)

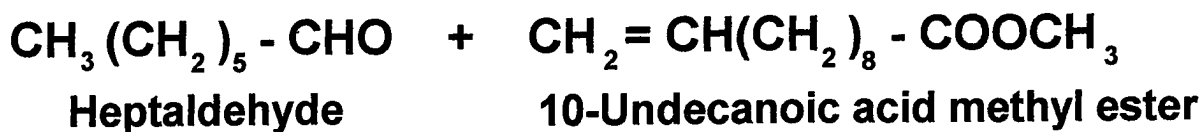
Catalyst
Polymerization

PA 12

Polyamide 11



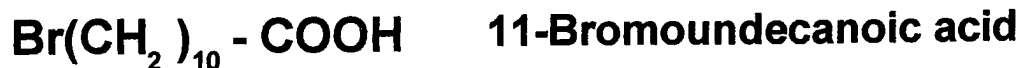
550°C
Water



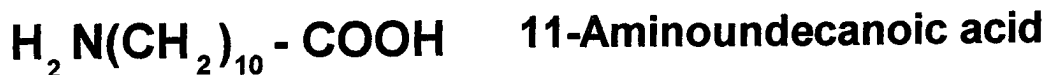
Hydrolysis



Air
HBr



NH₃
Water



Catalyst
Polymerization

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PA 11

PA12 vs. PA11

Both nylon 12 and nylon 11 are "higher number" polyamides; with nylon 12 having an extra methylene group as shown below:

Nylon 11: $-(\text{CH}_2)_{10}-\text{CO}-\text{NH}-$

Nylon 12: $-(\text{CH}_2)_{11}-\text{CO}-\text{NH}-$

This chemical difference renders nylon 12 with several physical property advantages over nylon 11. Due to its lower moisture absorption, nylon 12 has much lower linear swelling, resulting in the most dimensionally stable nylon, which permits tighter design tolerances. With lower specific gravity and lower melting range, nylon 12 extrusion requires less material at lower processing temperatures. This equates to faster processing at lower cost.

Nylon 12 has the following advantages over nylon 11:

- * **Lower density**
- * **Better chemical resistance**
- * **Lower moisture absorption**
- * **Less linear swelling**
- * **Better dimensional stability**
- * **Tighter design tolerances**
- * **Easier processing**
- * **Several suppliers**

EMS American Grilon, Inc.
Technical Service Department

Property Comparison: Extrusion Nylons

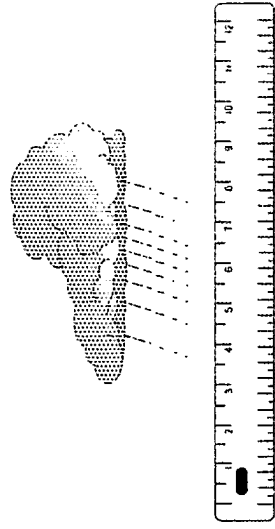
Properties	Method	Units	Nylon 11	Nylon 12
Melting Range	D.S.C. (max)	°C °F	185-193 365-380	170-178 340-350
Specific Gravity	ASTM D792	-	1.06	0.98-1.03
Flammability	UL94		HB	HB
Heat Deflection @ 66 psi @ 264 psi	ASTM D648	°C °F °C °F	140 284 48 118	135 275 48 118
Tensile Strength @ Yield	ASTM D638	psi	3,500- 7,500	3,500- 7,500
Elongation @ Yield @ Break	ASTM D790	% %	30 300	30 300-370
Flexural Strength @ Yield	ASTM D790	psi	-	1,900- 3,500
Flexural Modulus	ASTM D790	psi	50,000- 70,000	47,000- 70,000
Notched Izod Impact	ASTM D256	ft-lb/in	no break	no break

Summary

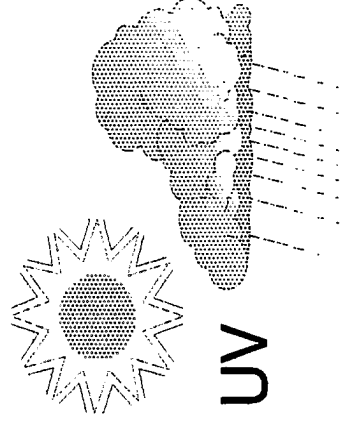
Grilamid PA12 exhibits the typical polyamide properties like high strength, toughness, hardness and resistance against oil and gasoline. Polyamide 12 also has the lowest water absorption and best chemical resistance of any commercially available nylon. In addition, the use of laurilactam as monomer makes Grilamid suitable for applications with food contact and even for medical applications such as cardiac catheters.

Nylon 12 has these advantages over nylon 11:

- ✱ **Lower density**
- ✱ **Easier processing**
- ✱ **Better chemical resistance**
- ✱ **Lower water absorption**
 - Less linear swelling**
 - Better dimensional stability**
 - Tighter design tolerances**



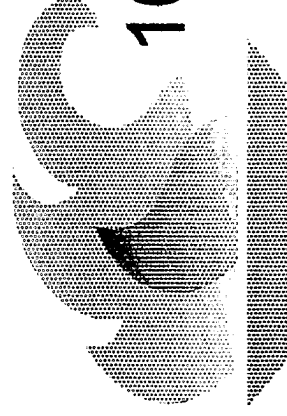
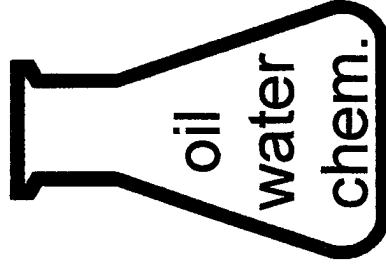
Dimensional Stability



UV

Weathering Resistance

Key Properties of Grilamid

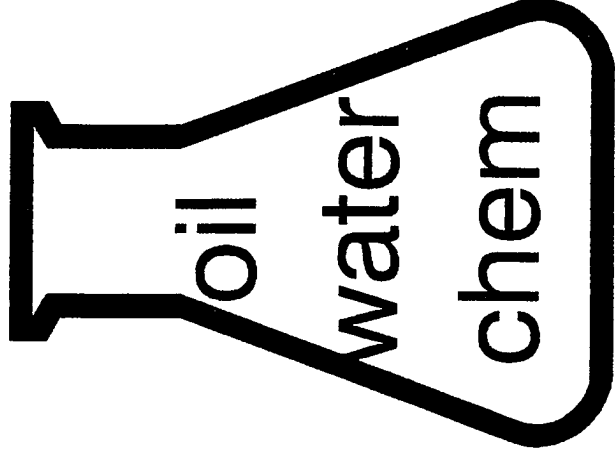


100 - 140°C

Continuous
Service Temperature

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Grilamid ... best chemical resistance
of all Polyamides



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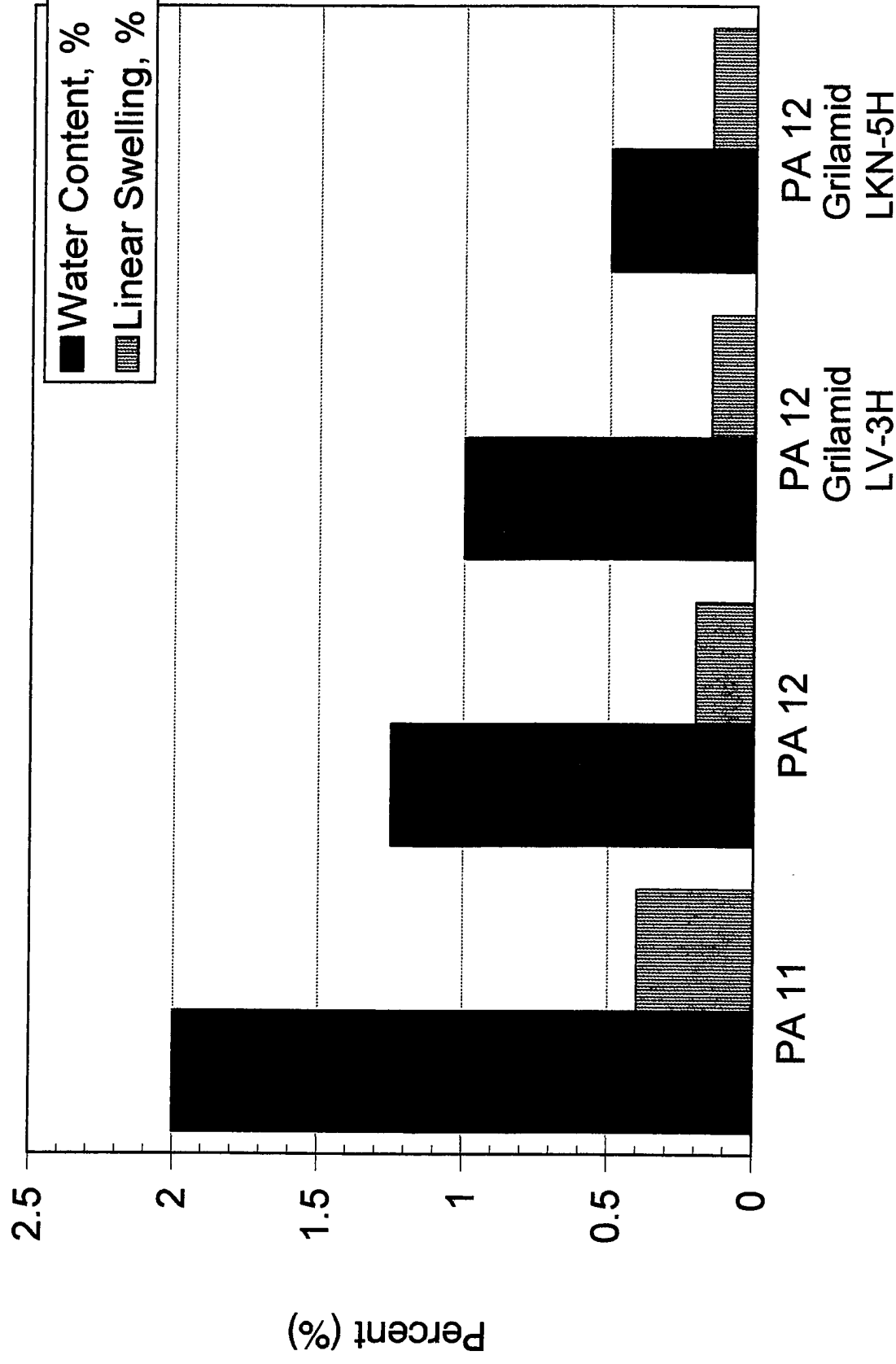
EMS American Grilon, Inc.
Technical Service Department

**Property Changes in % After 1,000 Hours
Storage in Methanol @ 60°C (140°F)**

Properties	Grilamid L25W40	Rilsan Besno P40TL
Weight Change	-1	+3
Length Change	+0.6	+1.2
Tensile Strength @ Break	-25	-40
Elongation @ Break	0	-10
Notched Impact Strength	No Break	No Break

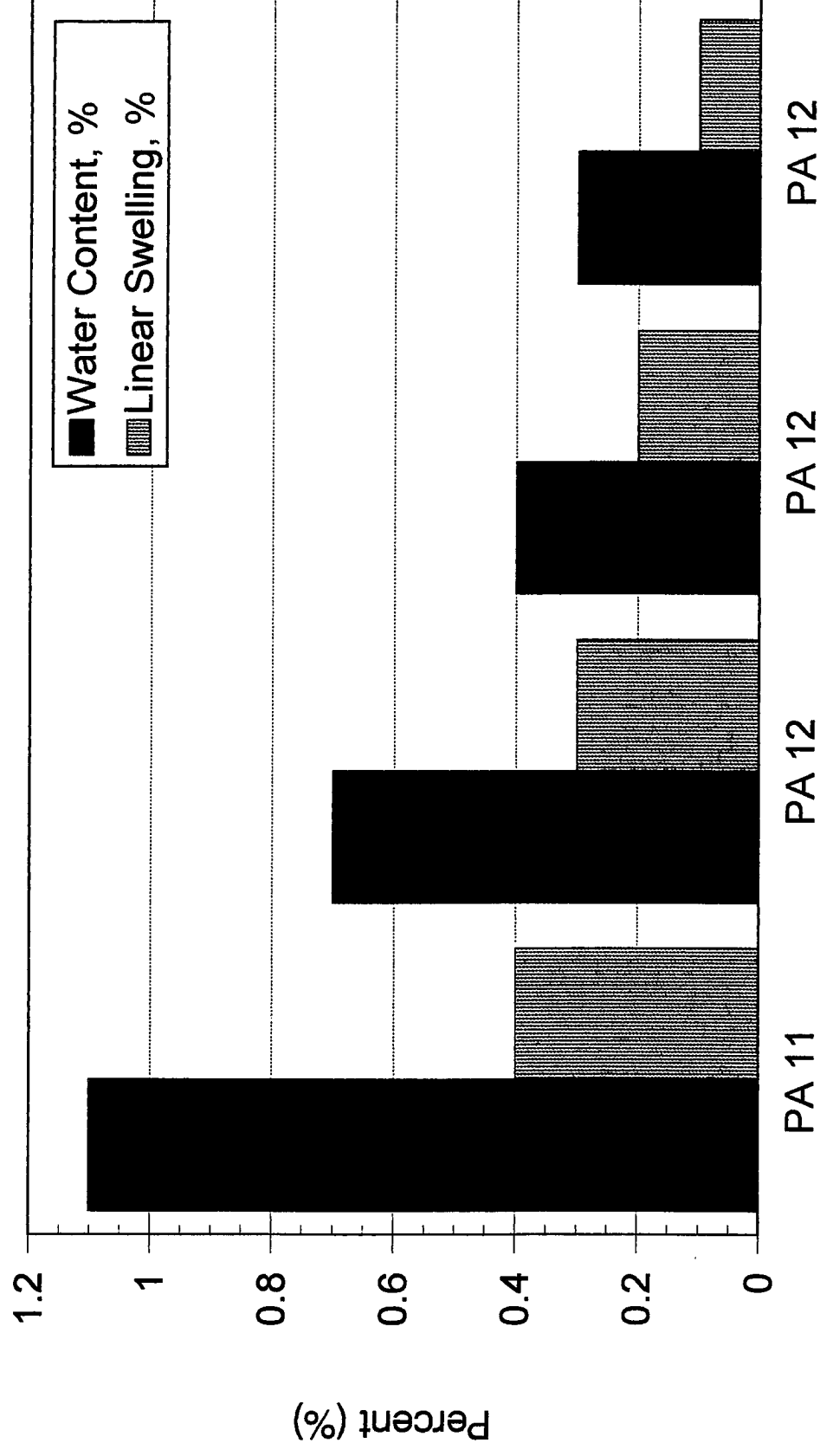
Remarks: Properties measured on molded DIN Tensile Bars.
Original values = 100%

Equilibrium Moisture Content at Room Temperature **Saturated in Water**



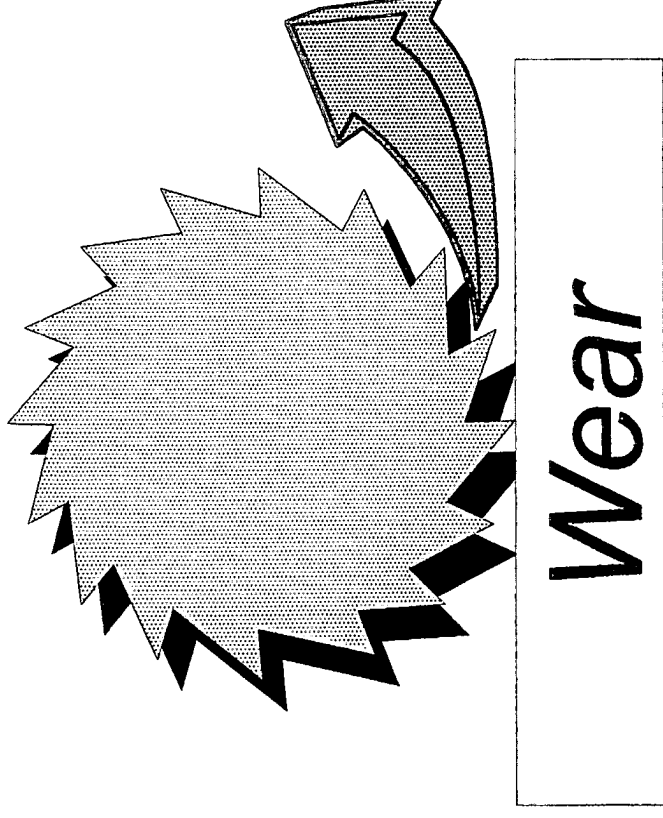
Equilibrium Moisture Content at Room Temperature

Conditioned in Air @ 23C, 50% Rel. Humidity



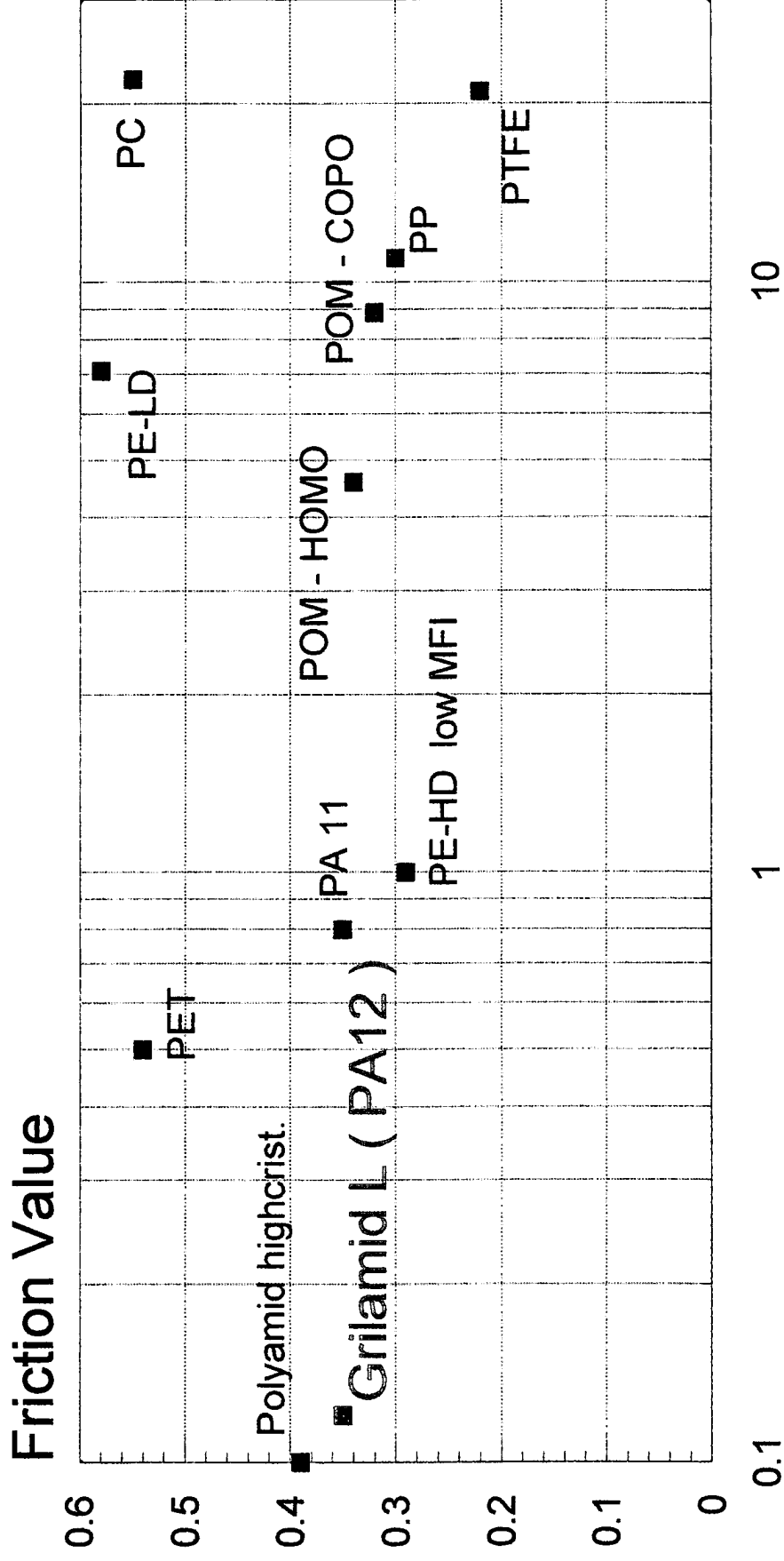
Grilamid ...

Excellent Slip- and
Wear Properties



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Slip Wear / Friction Value



Slip Wear (abrasion) * [$\mu\text{m}/\text{km}$]

* ECN 35: abrasion against steel, $p = 0.05 \text{ N}/\text{mm}^2$, $v = 8 \text{ m/s}$

... whenever you make ...

" High Demands on a Polymer "

... *Grilamid L, Polyamide 12*

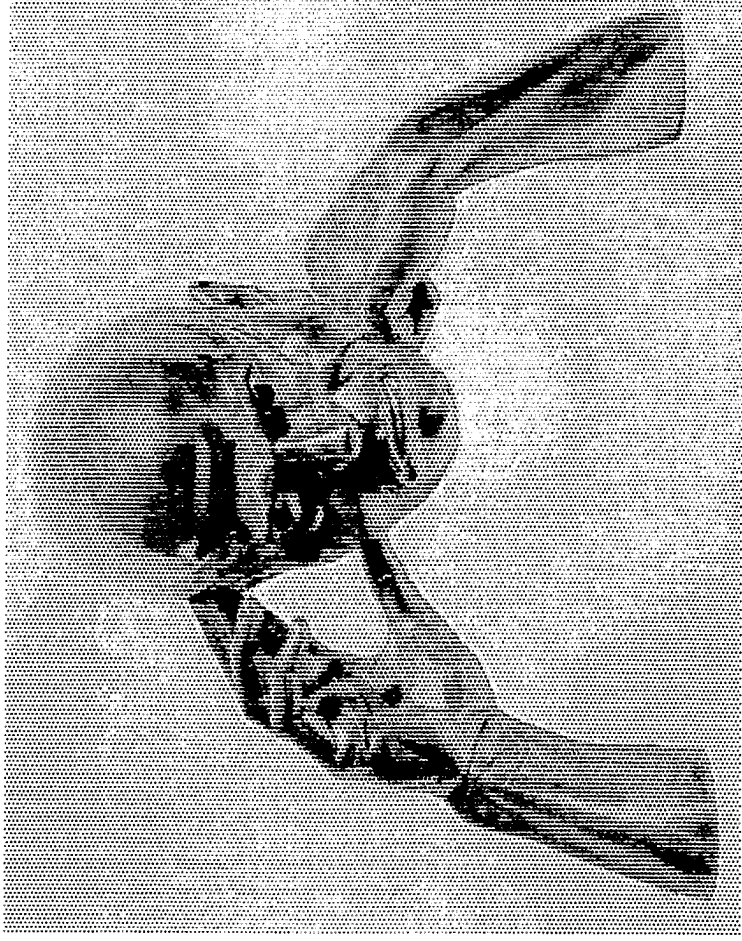
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Grilamid Product Range

- ✓ **Viscosity:** 16, 20, 25
- ✓ **Unreinforced:** G, M, H, L, NZ, W20, W40
- ✓ **Reinforced:** LV, LKN, LC, Bronze
- ✓ **Transparent:** TR 55: LX, LY, LZ
- ✓ **Elastomer:** ELY
- ✓ **Colors:** RAL etc.
- ✓ **Additional:** FR, low friction, W, XE

EMS

Think *Grilamid* !



EMS