Zytel® GRZ

glass-reinforced nylon resin

General Information

How do you make a great glass-reinforced nylon? Start with a great nylon . . . Zytel nylon resin. Skillfully add selected glass fibers . . . and chemical bond in a very special way . . . and you've got GRZ glass-reinforced nylon resin from DuPont.

Since the introduction of thermoplastic polyamides by DuPont over 40 years ago, nylon resins have been the most widely used of all engineering plastics. DuPont has added a uniform dispersion of glass fibers to the nylon base. The fibers, which provide a minimum average length in the finished part and optimum mechanical properties, are bonded to the nylon using coupling agents that were developed to ensure retention of physical properties under various environmental conditions. The result is GRZ, as the trade has come to know glass-reinforced Zytel nylon resin. GRZ is manufactured to give optimum strength combined with excellent injection molding performance. The three basic types of GRZ resins are:

Zytel 70G for high strength. This series is based on nylon 66. Zytel 70G13L, 70G33L, and 70G43L have glass loadings of 13, 33, and 43%, respectively. All are lubricated for improved feed and mold release, as are all GRZ nylons. As might be expected, stiffness and tensile strength increase with higher glass content in the Zytel 70G series. Other members of this series are Zytel 70G13HS1L and 7033HS1L, which are 13 and 33% glass-reinforced heat stabilized nylons and have particularly good heat-stability for long-term service at high temperatures. Zytel 70G33HRL is a 33% glass-reinforced nylon that has unusually high resistance to hydrolysis in hot water and to oxidation.

Zytel 71G for high impact strength. This series is based on a modified nylon 66. It has outstanding impact resistance with only moderate reduction of the mechanical and load carrying properties found in the 70G series. The two glass loadings available are 13 and 33%.

Zytel 77G for dimensional stability. This series is based on nylon 612 and consequently absorbs less water than the other two groups. These resins offer significant property advantages compared with those using other base resins. Of major importance is the outstanding retention of key physical and electrical properties over a wide humidity range. Maximum dimensional stability is achieved by combining the excellent low moisture absorption characteristics of the base resin with glass fiber reinforcement.

So, what industrial designers have now is a diversified family of GRZ glass-reinforced Zytel nylon resin engineering plastics, which combine the properties of the native nylons—toughness, ability to withstand repeated impact, and good resistance to abrasion and most chemicals—with the high strength and additional toughness afforded by glass reinforcement. In particular, specific products might well offer advantages over such metals as aluminum and zinc because of lower cost, weight savings, and less energy consumption. In general, GRZ nylon resins offer these advantages over unreinforced nylons:

- superior tensile strength (over two times greater)
- greater stiffness (three times greater)
- higher impact strength
- excellent fatigue endurance
- enhanced creep resistance
- excellent retention of tensile strength and stiffness at high temperature
- dimensional stability better than unreinforced nylon 66
- superior retention of physical properties when exposed to high temperature, hot oils, greases, and lubricants
- low thermal expansion (similar to metals)

The accompanying data show that GRZ nylons feature mechanical properties, chemical properties, and dimensional stability that literally put them in a class by themselves.

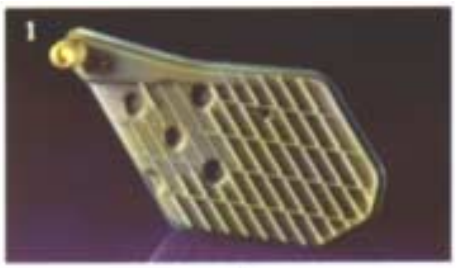
General handling and processing techniques for GRZ resins are discussed in the "Molding Manual for Glass-Reinforced Zytel Nylon Resins," which is available from your DuPont representative.

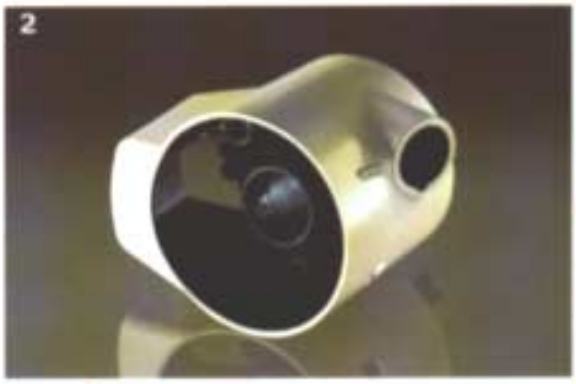
Compositions

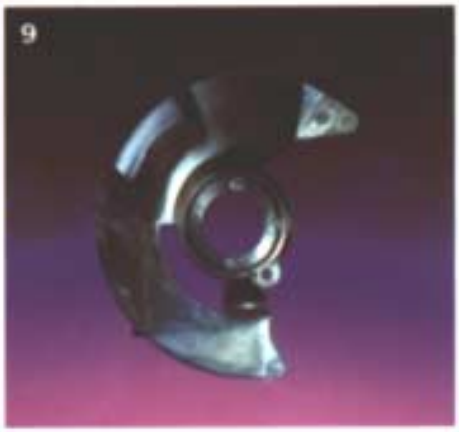
Designation	Description, Characteristics, and Major Uses
High Strength 70G Series Based on Nylon 66	
Zytel 70G13L	General purpose with 13% glass reinforcement. Lubricated for improved machine feed and mold release.
Zytel 70G13HS1L	Contains 13% glass reinforcement. Heat stabilized for long-term service at high temperatures. Lubricated for improved machine feed and mold release.
Zytel 70G33L	Contains 33% glass reinforcement. High strength. Lubricated.
Zytel 70G33HS1L	Contains 33% glass reinforcement. High strength. Lubricated. Heat stabilized.
Zytel 70G43L	Contains 43% glass reinforcement. Maximum strength. Lubricated.
Zytel 70G33HRL	Contains 33% glass reinforcement. High strength. Has unusually high resistance to hot water and oxidation. Lubricated.
High Impact 71G Series Based on Modified Nylon 66	
Zytel 71G13L	Contains 13% glass reinforcement. Lubricated. Used where shock loading is encountered and maximum toughness is required.
Zytel 71G13HS1L	Contains 13% glass reinforcement. Lubricated. Is heat stabilized and used where shock loading is encountered, especially at elevated service temperature.
Zytel 71G33L	Contains 33% glass reinforcement. Lubricated. Has an outstanding resistance to impact with only moderate reduction of the mechanical and load carrying properties found in the 70G series.
Low Moisture Absorption 77G Series Based on Nylon 612	
Zytel 77G33L	Contains 33% glass reinforcement. Lubricated. Lower moisture absorption than comparable members of the 70G and 71G series, resulting in higher dimensional stability. Excellent electrical properties.
Zytel 77G33HS1L	Contains 33% glass reinforcement. Heat stabilized. Lubricated. Lower moisture absorption than comparable members of the 70G and 71G series.
Zytel 77G43L	Contains 43% glass reinforcement. Lubricated. Highest dimensional stability in the glass-reinforced nylons. Excellent electrical properties over a wide range of relative humidities.

GRZ for optimum strength with excellent injection molding properties

1. **Transmission Oil Filter Housing**
   • resistance to automotive fluids
2. **Steering Column Lock Housing**
   • strength and dimensional stability
3. **Sprinkler**
   • weatherability and fatigue strength
4. **Industrial Ball Valve**
   • chemical and corrosion resistance
5. **Railway Insulator**
   • weatherability and insulating capability
6. **Conveyor Hanger**
   • strength and weight reduction
7. **Diverter Valve**
   • heat resistance and reduced weight
8. **Irrigation Valve**
   • weatherability and corrosion resistance
9. **Disc Brake Shield**
   • stiffness and heat resistance







These commercial applications of GRZ glass-reinforced Zytel nylon resins have the advantages of nylon combined with glass fibers chemically bonded in a very special way.

Table 1
Properties of GRZ

Property[1]	ASTM Method	Unit	70G13L 70G13HS1L	70G33L 70G33HS1L 70G33HRL	70G43L	71G13L 71G13HS1L	71G33L	77G33L 77G33HS1L	77G43L
Tensile Strength	D 638								
73°F, DAM[2]		**kpsi**	**17.5**	**27**	**30**	**15**	**22**	**24**	**28**
23°C, DAM		MPa	121	186	207	103	152	165	193
73°F, 50% RH[3]		**kpsi**	**12**	**18**	**21**	**9**	**16**	**20**	**24**
23°C, 50% RH		MPa	83	124	145	62	110	138	165
73°F, 100% RH		**kpsi**	**7.5**	**11**	**15**	**5.5**	**11**	**17**	**20**
23°C, 100% RH		MPa	52	76	103	38	76	117	138
Elongation at Break	D 638								
73°F (23°C), DAM		**%**	**3**	**3**	**2**	**4**	**3**	**3**	**3**
73°F (23°C), 50% RH		**%**	**8**	**4**	**3**	**11**	**4**	**4**	**5**
73°F (23°C), 100% RH		**%**	**11**	**5**	**3**	**25**	**5**	**6**	**5**
Shear Strength	D 732								
73°F, DAM		**kpsi**	**11**	**12.5**	**13.5**	**9**	**10.5**	**11**	**12**
23°C, DAM		MPa	76	86	93	62	72	76	83
Flexural Modulus	D 790								
73°F, DAM		**kpsi**	**700**	**1,300**	**1,600**	**550**	**1,000**	**1,200**	**1,500**
23°C, DAM		MPa	4,830	8,965	11,030	3,790	6,900	8,270	10,340
73°F, 50% RH		**kpsi**	**400**	**900**	**1,200**	**300**	**800**	**900**	**1,250**
23°C, 50% RH		MPa	2,760	6,205	8,270	2,070	5,520	6,200	8,620
73°F, 100% RH		**kpsi**	**250**	**600**	**800**	**200**	**500**	**800**	**1,100**
23°C, 100% RH		MPa	1,720	4,140	5,520	1,380	3,450	5,520	7,580
Flexural Strength	D 790								
73°F, DAM		**kpsi**	**24**	**38**	**41**	**21**	**33**	**37**	**39**
23°C, DAM		MPa	165	262	285	145	228	255	269
Heat Deflection Temp.	D 648								
264 psi		**°F**	**470**	**480**	**485**	**450**	**475**	**410**	**410**
1.8 MPa		°C	243	249	252	232	246	210	210
Izod Impact Strength, ⅛ in (3.2 mm) notched bar	D 256								
73°F, DAM		**ft·lb/in**	**0.9**	**2.2**	**2.5**	**2.3**	**2.4**	**2.4**	**2.9**
23°C, DAM		J/m	48	117	133	123	128	128	155
73°F, 50% RH		**ft·lb/in**	**1.0**	**2.5**	**3.5**	**2.3**	**2.4**	**2.5**	**3.0**
23°C, 50% RH		J/m	53	133	187	123	128	133	160
73°F, 100% RH		**ft·lb/in**	—	**4.0**	**5.5**	—	**3.4**	**3.0**	**3.5**
23°C, 100% RH		J/m	—	212	292	—	182	159	186
Melting Point	D 3418	**°F**	**504**	**504**	**504**	**504**	**504**	**423**	**423**
		°C	262	262	262	262	262	217	217
Coefficient of Linear Thermal Expansion	D 696	**in/in/°F**	**1.5×10^{-5}**	**1.3×10^{-5}**	**1.2×10^{-5}**	**1.3×10^{-5}**	**1.0×10^{-5}**	**1.3×10^{-5}**	**1.2×10^{-5}**
		m/m/°C	2.7×10^{-5}	2.3×10^{-5}	2.2×10^{-5}	2.3×10^{-5}	1.8×10^{-5}	2.3×10^{-5}	2.2×10^{-5}
Dielectric Strength	D 149								
DAM		**V/mil**	—	**530**	—	—	**630**	**520**	**500**
100% RH		**V/mil**	—	—	—	—	—	**440**	**460**
Dielectric Strength (step by step)	D 149								
DAM		**V/mil**	—	**440**	**410**	—	**510**	**490**	**480**
100% RH		**V/mil**	—	—	—	—	—	**390**	**360**

Table 2
Properties of GRZ (continued)

Property[1]	ASTM Method	Unit	70G13L 70G13HS1L	70G33L 70G33HS1L 70G33HRL	70G43L	71G13L 71G13HS1L	71G33L	77G33L 77G33HS1L	77G43L
Dielectric Constant	D 150								
DAM at 1 kHz			—	4.5	—	—	4.2	3.7	4.0
100% RH at 1 kHz			—	25.0	—	—	—	7.8	7.8
DAM at 1 MHz			—	3.7	—	—	3.4	3.4	3.6
100% RH at 1 MHz			—	10.7	—	—	—	4.0	4.2
Dissipation Factor	D 150								
DAM at 1 kHz			—	0.02	—	—	0.02	0.02	0.03
100% RH at 1 kHz			—	—	—	—	—	0.14	0.13
DAM at 1 MHz			—	0.02	—	—	0.02	0.02	0.02
100% RH at 1 MHz			—	—	—	—	—	0.10	0.10
Volume Resistivity	D 257								
DAM		Ω·cm	—	1015	—	1014	1014	1015	1015
100% RH		Ω·cm	—	109	—	109	109	1012	1012
Surface Resistivity	D 257								
DAM		Ω/sq	—	—	—	—	—	1015	1015
100% RH		Ω/sq	—	—	—	—	—	1012	1012
Specific Gravity	D 792		1.22	1.38	1.51	1.18	1.35	1.32	1.46
Relative Density			1.22	1.38	1.51	1.18	1.35	1.32	1.46
Water Absorption 24 hr immersion	D 570								
73°F (23°C)		%	—	0.7	0.6	—	0.5	0.16	0.14
Water Absorption Saturation	D 570								
73°F (23°C)		%	7.1	5.4	4.7	6.1	4.6	2.0	1.7
Hardness, Rockwell M	D 785								
DAM			M95	M101	M103	M82	M96	—	—
50% RH			M84	—	—	M66	M90	—	—
Hardness, Rockwell R	D 785								
DAM			R122	—	—	R117	R122	R118	R118
50% RH			R113	—	—	R110	R118	—	—
Taber Abrasion CS-17 Wheel, 1 kg, 50% RH		$\frac{mg}{10^3 \text{ cycles}}$	12	14	—	34	36	—	—
Mold Shrinkage $5 \times ½ \times ⅛$ in ($127 \times 12.7 \times 3.2$ mm) bar (flow direction)		%	0.5	0.2	0.2	0.6	0.3	0.2	0.1

[1] These values are for Natural Color (NC010) resins only. Colorants or other additives of any kind may alter some or all of these properties. The data listed here fall within the normal range of product properties, but they should not be used to establish specification limits or used alone as the basis for design.

[2] DAM—dry-as-molded.

[3] RH—relative humidity of environment.

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[Replaces: E-71042-1]
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