

VYDYNE[®]**NYLON**

Monsanto Data Sheet No 6490C

21, 21X, 21SP

(G.P. High Productivity)

Product Description

Vydyne[®] 21, 21X, and 21SP resins comprise a family of unreinforced general purpose nylon 66 resins designed principally for injection molding fabrication. These resins offer a well balanced combination of engineering properties characterized by high strength, rigidity, good toughness in use, high melt point, good surface lubricity, abrasion resistance, and resistance to many chemicals, solvents, gasoline, and machine and motor oils. Vydyne 21 nylons permit production of molded parts with good initial color plus good property and color retention when using regrinds. These resins are recognized by Underwriters Laboratories and conform to the requirements of many industrial, federal, and military specifications for premium quality general purpose nylon 66 resins.

This family of nylon 66 resins include:

Vydyne 21—An unlubricated resin for use in applications which do not require modification for machine feed or mold release and where parts are to be kept free of lubricants. It can also be considered a candidate for extrusion applications which do not require use of high viscosity nylon 66 resins.

Vydyne 21X—Externally lubricated for improved machine feed and mold release. This formulation is designed to provide easy release of parts from molds using standard molding conditions.

Vydyne 21SP—Internally and externally lubricated for improved machine feed and exceptional mold release. Vydyne 21SP is intended for use in high productivity applications. In many applications, the molding cycle can be reduced due to faster part release as the molded parts may be removed from the cavity at higher temperatures. In difficult molds where parts have a tendency to stick in the cavity, Vydyne 21SP can reduce or eliminate the need for mold release sprays in many applications. Critical molded part dimensions should be checked against specifications before implementing shorter molding cycles on a routine production basis.

These nylon resins are supplied in natural color, diced pellets having nominal dimensions of a $\frac{3}{32}$ " cube.

Typical Applications/End Uses

Vydyne 21 has been used in many molding applications such as terminal blocks, bearings, bushings, cams, electrical connectors and housings, electrical cable ties/tie straps and many other hardware and general industrial parts. Although designed for low viscosity in the melt stage to facilitate injection molding, Vydyne 21 resins are successfully extruded in selected applications which do not require high melt strength, such as in monofilament and bristle products.

Monsanto

Typical Values*

	ASTM Test Methods ¹	Test Temp °F (°C)	Dry as Molded ² (0.2% Moisture)	2.5% Moisture ³
Mechanical Properties				
Tensile Strength at Yield, psi (MPa)	D-638	-40 (-40) 73 (23) 170 (77)	15,500 (107) 12,000 (83) 9,000 (62)	15,000 (104) 9,000 (62) 6,000 (41)
Tensile Elongation at Fail, %	D-638	-40 (-40) 73 (23) 170 (77)	20 80 300	20 200 300
Tensile Elongation at Yield, %	D-638	-40 (-40) 73 (23) 170 (77)	5 10 30	6 20 30
Secant Tensile Modulus, psi (GPa)	D-638	73 (23)	430,000 (3.0)	190,000 (1.3)
Secant Flexural Modulus, psi (GPa)	D-790	-40 (-40) 73 (23) 170 (77)	470,000 (3.2) 400,000 (2.8) 100,000 (0.7)	490,000 (3.5) 190,000 (1.3) 90,000 (0.6)
Flexural Strength, psi (MPa)	D-790	73 (23)	13,000 (90)	6,000 (41)
Notched Izod Impact ⁴ Strength at 0.010" radius of notch ft lb/in (J/m) 1/2" x 1/2" bar (12.7mm x 3.2mm)	D-256	-40 (-40) 73 (23)	0.6 (32) 1.0 (53)	0.5 (27) 3.0 (159)
Tensile Impact Strength, Type S Specimen ft lb/in (kJ/m)	D-1822	73 (23)	80 (162)	100 (210)
Deformation Under Load, % at 2,000 psi (13.78 MPa)	D-621	122 (50)	1.4	-
Taber Abrasion Resistance, CS-17 Wheel, 4kg Load, mg Loss/1,000 cycles	D-1044	73 (23)	f	7
Rockwell Hardness M Scale R Scale	D-785	73 (23)	85 120	60 105
Compressive Stress at 1% Deformation, psi (MPa)	D-695	73 (23)	5,000 (34)	-
Creep Strain, % at 2,000 psi (13.78 MPa) Stress and 1,000 hrs	D-2922	73 (23)	f	3
Shear Strength, psi (MPa)	D-732	73 (23)	10,000 (69)	-
Thermal Properties				
Melting Point, DSC (°C)	D-3417	-	500 (263)	-
Deflection Temperature Under Load, °F (°C) at 66 psi (455kPa) 264 psi (1820kPa)	D-648	-	450 (232) 180 (80)	430 (221) 160 (70)
Coefficient of Thermal Expansion, 10 in/in (°C)	D-695	73 (23)	4.5 (8.1)	-
Specific Heat, BTU/lb °F (kJ/kg °C)	Monsanto Test	73 (23)	0.4 (1.7)	-
Thermal Conductivity, BTU/in (°F/in) (W/m (°C/m))	Monsanto Test	73 (23)	1.7 (9.25)	-
Brittleness Temperature °F (°C)	D-746	-	-10 (-75)	-90 (-67)
Electrical Properties				
Dielectric Strength, psi/mil (kV/mm) Short Time Step by Step	D-149	73 (23)	570 (23) 540 (22)	550 (22) 480 (19)
Dielectric Constant at 10 Hz 10 Hz 40 Hz	D-150	73 (23)	3.7 3.6 3.1	6.0 6.0 3.5
Volume Resistivity, ohm-in.	D-257	73 (23)	6.0 x 10 ¹¹	2.0 x 10 ¹¹
Dissipation Factor at 10 Hz 10 Hz 10 Hz	D-150	73 (23)	0.02 0.02 0.03	0.04 0.04 0.08
Flammability Properties⁴				
Flammability Classification at 1/32", 1/16", 1/8" Thickness	UL-94	73 (23)	V-2	-
Limiting Oxygen Index, % O ₂	D-2863	73 (23)	30	31
Physical Properties				
Specific Gravity	D-792	73 (23)	1.14	-
Mold Shrinkage, in Flow Direction in/in, 1/8" Thickness	D-955	-	0.015 - 0.020	-
Water Absorption, % 24 hrs Saturation	D-570	73 (23)	1.2 8.0	-

*Typical values represent an average of samples tested based on commonly used procedures unless otherwise specified. Typical values are intended as guides only and do not reflect the specification range for a particular property.
 1. All data taken on unannealed injection molded test specimens per ASTM D-1897
 2. Samples sealed in moisture barrier packages immediately after molding
 3. Equilibrium moisture at 50% relative humidity, 73°F conditioned per ASTM D-618
 4. See footnote on page 5
 †Impractical to measure on dry as molded sample

Specifications and Regulations

- ASTM Conforms to ASTM D-4066 callout of "PA111"
- Federal Conforms to Federal Specifications LP-410a.
Classification polyhexamethylene adipamide
(Nylon 66)
- Military Certifiable to meet MIL-M-20693B, Composition
A, Type I (replaced by ASTM D-4066).
- FDA Complies with 21 CFR 177-1500

Underwriters Laboratories Recognized Component Ratings
Yellow card file number E70062
21, 21X, 21SP

Color	Minimum Thickness (Inches) (mm)	Temperature Index (°C)			Hot Wire Ignition (Sec.)	UL94* Flam. Class	High Amp Arc Ign. (#Arcs)	High Volt Track Rate (in./min.)	D-495 ARC Resistance (Sec.)	IEC Track Rate (CTI) (Volts)
		Electrical	Mechanical With Impact	Mechanical Without Impact						
All	1/32 0.71	130	75	85	12	94V-2	200+	—	—	—
	1/16 1.47	130	75	85	15	94V-2	200+	0.0	—	—
	1/8 3.05	130	75	85	32	94V-2	200+	0.0	123	600+

*All numerical flame spread ratings appearing in this data sheet are not intended to reflect hazards presented by this or any other material under actual fire conditions. Each end user should determine whether potential fire hazards are associated with the finished product and whether Vydne resin is suitable for the particular use. **Products made from Vydne resins should not be exposed to open flames. In the case of direct exposure to open fire, Vydne resins and products made therefrom can ignite and burn. Always store and use finished products in locations well away from open flames and other sources of ignition.**



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DATA SHEET

HEALTH AND SAFETY AT WORK ACT, 1974

NYLON 6.6

As the condition under which our products may be used are beyond our control, any statement or recommendation is made without warranty or guarantee.

CHEMICAL NAME - Polyamide.

NORMAL STATE - Moulded Components/Extruded Rods.

NORMAL COLOUR - Natural. **ODOUR** - None.

REACTION WITH WATER - None. Water Absorption 24 hour 1/8" thick to A.S.T.M. D 570.

REACTION WITH OTHER CHEMICALS - Data on request.

STABILITY - Heat distortion temperature 182 degrees C at 66 p.s.i. to A.S.T.M. D 648. Melting Point 260 degrees C to A.S.T.M. D 569.

TOXICITY - Unsuitable for use in direct contact with food.

FLAMABILITY - Self extinguishing to A.S.T.M. D 635.

FIRE FIGHTING - Small fires - dry chemical or CO2 extinguishers. Large fires - foam or water.

Use breathing apparatus in presence of smoke/fumes.

PERSONNEL PROTECTION - No special precautions.

WASTE DISPOSAL - Do not incinerate. Use dry waste disposal.

Form HS04

THERMOPLASTIC FASTENERS • CUSTOM INJECTION MOULDERS • STOCKISTS ENGINEERING PLASTICS

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Data listed if for informational purposes only shall not be used to establish specifications limits or used alone as the basis of design.

MACHINE SCREWS

SIZE	ULTIMATE TORQUE	BEFORE DEFORMATION	TENSILE TEST		DOUBLE SHEAR	
			YIELD LBS.	BREAK LBS.	YIELD LBS.	BREAK LBS.
M2 X .4	NO TEST	NO TEST	7.12 N.	N/B	89 N.	116 N.
M2.5 X .45	NO TEST	NO TEST	8.9 N.	N/B	156 N.	169 N.
M3 X .5	.32 Nm.	.2-.26 Nm.	22 N.	N/B	294 N.	329 N.
M3.5 X .6	.43 N.	.28-.34 Nm.	53 N.	N/B	378 N.	405 N.
M4 X .7	.45Nm.	.36-.43 Nm.	214 N.	N/B	600 N.	636 N.
M5 X .8	.93 Nm.	.73-.79 Nm.	271 N.	N/B	1081 N.	1134 N.
M6 X .1	1.83 Nm.	1.41-1.47 Nm.	845 N.	912 N.	1806 N.	1877 N.
M8 X 1.25	3.39 Nm.	2.45-2.82 Nm.	1.677 N.	1744 N.	2980 N.	3034 N.
M10 X 1.50	5.31 Nm.	4.52 - 4.86 Nm.	2749 N.	N/B	5026 N.	5280 N.

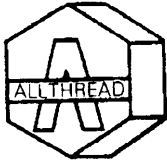
HEX NUTS

SIZE	TENSILE	ULTIMATE TORQUE
M2	NO TEST	NO TEST
M2.5	135.23 N.	NO TEST
M3	142.34 N.	NO TEST
M3.5	369.20 N.	2.3 CM/KG
M4	451.94 N.	4.5 CM/KG
M5	940.35 N.	8.3
X M6	1556.65 N.	17.6 CM/KG
M8	2597.76 N.	56.2 CM/KG
M10	6283.11 N.	89.93 CM/KG

NYLON 6/6 MECHANICAL PROPERTIES (73° F / 23° C)

Tensile Strength	D638	12,000psi	82.7 MPa
Elongation	D638	60%	60%
Shear Strength	D732	9,600psi	66.2 MPa
Flexuural Modulus	D790	410,000psi	2,287 MPa
Impact Strength	D256	1.0 ft/lb/in	5.5 kg/cm ²
Hardness	D785	R121	M79
Specific gravity	D792	1.13	1.13
Melting Point	D789	500 F	260 °C
Dielectric Strength	D149	600 v/mil	10 OHM-CM
Underwriters Laboratory Rating	BUL. 94	94V2	94V2

PLASTIC INJECTION MOULDERS • CUSTOM COMPONENT MANUFACTURERS
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QUALITY, TOLERANCES AND GENERAL INFORMATION OF INJECTION MOULDED NYLON FASTENERS.

ALLTHREAD PLASTICS LIMITED manufacture a comprehensive range of Thermoplastic Fasteners using the Engineering grade of NYLON type 6.6. in a Natural Colour, although Fasteners can be produced in other colours using a Masterbatch additive. The material is tough, light weight, resists corrosion and is a good electrical insulator. Nylon 6.6 Fasteners conform to irregular surfaces, resist vibration and offer an inexpensive alternative to Metal counterparts. Nylon does, however, absorb moisture from the environment and this causes flexibility and significant changes in its dimensions and whilst parts can be moisture conditioned, they can then lose moisture, causing dimensional problems. If the overall length of the Screw grows, then it can obviously effect the threads per inch, thus causing a tight fit. Changes in moisture content can effect the outside diameter and pitch.

TOLERANCES are generally held to +/- .015" or fractional dimensions and +/- .005" on 3 place decimals. Metric are generally held to +/- .13mm on a 2 place decimal and +/- .26mm on a 1 place decimal. Since Nylon Fasteners are not held to such close tolerances as Metal, a slight mismatch or minor flashing is not as serious. End users submitting Nylon Screws to go-no go gauges without actually trying the Fasteners in its proposed function/application will generally cause unnecessary difficulties for both themselves and for their supplier. Nylon Screws and Nuts are simply not **measurable** by the same methods as **Metal** ones.

QUALITY is dependent upon the method of manufacture and does vary. Mouldings often have small amounts of flashing, knockout pin marks, gates, sinkeage and slight imperfections. Screws and Bolts are gated on the threaded end and it is possible for the gate to leave an extra projection of up to .025". Injection Moulded Nylon Screws are produced using mould cavities parted along the length of the Screw and the two halves must be matched exactly to produce a perfect part. The cavities come together with ejector pins and other locking devices are used to hold the mould in alignment. In the course of production however, the pins, locks and base suffer some wear. The Injection Moulding Machine also suffers wear and can cause platen misalignment. Any dirt on the mould also causes slight mismatch and the entire process must be constantly monitored in order to avoid misalignment. Mould temperatures change from room temperature to production temperature and this also causes some misalignment. Moulding tools must be re-furbished after a certain period of use and in some cases it is necessary to have the mould completely re-worked to bring it back to its original condition.

ALLTHREAD PLASTICS LIMITED is totally committed to producing top quality Thermoplastic Fasteners and we are constantly up-dating Injection Moulding Machinery and Tools in order to provide our valued customers with High Quality Products.

FormQTG1

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