

Whale Brand TUFNOL

Cotton fabric based laminate

Resin:	Phenolic resin.
Reinforcement:	Cotton fabric (medium weave)
Description:	A good general purpose grade for mechanical applications. Excellent all round physical properties. Strong, good toughness and wear resistance. Electrical insulation for low voltages only.
Typical uses:	Most popular grade for a wide range of mechanical applications and general uses, e.g. gears, spacers, jigs and fixtures, wear resistant components, low voltage insulation and many others.
Types available:	Natural colour is available in all sections. Graphite impregnated is available in all sections and black is available in sheet only, both subject to minimum order quantities.

SHAPES AND SIZES

Sheet

Thickness:	0.4 to 228.6mm (1/64" to 9")
Sheet Sizes:	1220 x 1220mm approx. 1600 x 1220mm approx.
	For guaranteed minimum sheet sizes, refer to TUFNOL Ltd. For 1600 mm long sheets, minimum order quantities may apply.

Round Rod

Diameter:	3.2 to 228.6mm (1/8" to 9")
Lengths approx:	1200mm for dia. 3.2 to 120.6mm 584mm for dia. 104.8 to 228.6mm

Round Tube

Inside diameter:	6.3 to 203.2mm (1/4" to 8")
Outside diameter:	9.5 to 228.6mm (3/8" to 9")
	Wall thickness must be less than inside diameter.
Length approx	584 for o.d. up to 15.1mm 1200 for o.d. 9.5 to 120.6 584 for o.d. 101.6 to 228.6

Rectangular Bar

Sizes	4.8 x 4.8mm to 76.2 x 88.9mm (3/16" x 3/16" to 3" x 3 1/2")
Length approx:	1200mm

Rectangular Tube

Internal size:	4.8 x 4.8mm to 69.8 x 69.8mm (3/16" x 3/16" to 2 3/4" x 2 3/4")
Lengths approx:	584mm for size 9.5 x 9.5 or smaller 1200mm for sizes larger

Channel

Cut from rectangular tube. Deduct 3.2mm from relevant internal dimension to allow for tool cut.

Angle

Outside size:	6.3 x 9.5mm to 149.2 x 149.2mm (1/4" x 3/8" to 5 7/8" x 5 7/8")
Wall thickness	1.6 to 9.5mm (1/16" to 3/8")
Length approx	1200mm

Hexagon Bar

Across flats :	0.445" to 1.100" (11.3 to 28.0mm)
	The across flats dimensions are machined to suit Metric, Whitworth or other standard hexagon sizes.
Length approx:	1200mm

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SPECIFICATIONS

BRITISH STANDARDS

Sheet	BS EN 60893 Type PF CC 203
Round Rod	BS EN 61212-3-3 Type PF CC 42
Rectangular Bar	BS6128 Part 4 Type PF CC 43
Hexagon Bar	BS6128 Part 6 Type PF CC 63
Round Tube	BS EN 61212-3-2 Type PF CC 33
Rectangular Tube	BS6128 Part 13 Type PF CC 132

NEMA*

Sheet	Nema LI-1-1983 Type CE
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MIL*

Sheet	MIL-I-24768
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DIN*

Round Rod and Tube	DIN 7735 TYPE Hgw 2088
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*Certification to these standards is subject to special enquiry.
Standard quality testing is to British Standards.

APPROXIMATE WEIGHTS

Sheets

Sheet size 1220 x 1220 approx.
Approx. weight in kg = 2.10 x thickness in mm

Sheet size 1600 x 1220 approx.
Approx. weight in kg = 2.76 x thickness in mm

Due to slight variations in density and nominal dimensions, weight cannot be calculated precisely.

Weight Formulae

Cut pieces:

Weight in kg = $\frac{1.40 \times \text{Length} \times \text{Width} \times \text{Thickness (all in mm)}}{1,000,000}$

Rod

Weight in kg = $\frac{1.07 \times \text{Dia}^2 \times \text{Length (all in mm)}}{1,000,000}$

Tube

Weight in kg = $\frac{1.07 \times (\text{o.d.}^2 - \text{i.d.}^2) \times \text{Length (all in mm)}}{1,000,000}$

PHYSICAL PROPERTIES OF WHALE BRAND

SHEET

PROPERTY	TYPICAL RESULT	UNITS
Cross breaking strength	130	MPa
Impact strength, notched, Charpy	11.5	kJ/m ²
Compressive strength, flatwise	310	MPa
Compressive strength, edgewise	200	MPa
Resistance to flatwise compression	1.5	%
Shear strength, flatwise	90	MPa
Water Absorption	1.6mm thk. 90	mg
	3mm thk. 105	mg
	6mm thk. 130	mg
	12mm thk. 160	mg
Electric strength, flatwise in oil at 90° C		
	1.6mm thk. 4.5	MV/m
	3mm thk. 2.6	MV/m
	6mm thk. 2.0	MV/m
Electric strength, edgewise in oil at 90° C	12	kV
Insulation resistance after immersion in water	1x10 ⁸	ohms
Relative density	1.36	-
Maximum working temperature**		
	continuous 120	°C
	intermittent 130	°C
Thermal classification	Class E	-
Thermal conductivity through laminae	0.32	W/(mK)
Thermal expansion in plane of laminae	2.2	x10 ⁻⁵ /K
Specific heat	1.5	kJ/(kgK)

Test methods as BS EN 60893, where applicable.

ROUND TUBES

PROPERTY	TYPICAL RESULT	UNITS
Axial compressive strength	170	MPa
Cohesion between layers	130	MPa
Water absorption	3.2	mg/cm ²
Insulation resistance after immersion in water	1x10 ⁷	ohms
Relative density	1.35	-

Test methods as BS EN 61212 - 2.

ROUND RODS

PROPERTY	TYPICAL RESULT	UNITS
Flexural strength	130	MPa
Water absorption	3.3	mg/cm ²
Insulation resistance after immersion in water	1x10 ⁷	ohms
Axial electric strength in oil at 90° C	4	kV
Relative density	1.35	-

Test methods as BS 61212 - 2 - 2.

**Users of highly stressed components at temperatures approaching the maximum are recommended to seek further advice from TUFNOL Ltd.

The information in this leaflet is believed to be correct, but completeness and accuracy are not guaranteed. The user shall be fully responsible for determining the suitability of products for the intended use. TUFNOL is a Registered Trade Mark.

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A full machining service is available for this and many other engineering plastics and composites.

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BS 5750 Part 2 (ISO 9002)

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