



Engineering Plastics and Composites



Railway



Marine



Construction



Electrical



Aerospace



Off Shore



General



Space

## TUFNOL Grades 10G/40, 10G/41, 10G/42 and 10G/44

Epoxy Glass Fabric laminate

Glass fibre/epoxide resin laminated plastic

(SRBGF - Synthetic Resin Bonded Glass Fabric)



### Top quality materials for mechanical and electrical applications.

The TUFNOL range of high quality epoxy resin bonded glass fabric laminates offer very high mechanical strength and low moisture absorption, combined with excellent electrical properties, under both dry and humid conditions. They are rigid materials with good dimensional stability and good resistance to a wide range of working environments.

Four standard grades are available:

- **TUFNOL Grade 10G/40** – The most widely used grade, suitable for continuous use at temperatures up to approximately 130°C. (Class B).
- **TUFNOL Grade 10G/41** – Similar to 10G/40, but with controlled flammability
- **TUFNOL Grade 10G/42** – Made with an epoxy resin which offers increased mechanical strength at higher temperatures. Suitable for uses up to 155 °C (Class F).
- **TUFNOL Grade 10G/44** – Similar to Grade 10G/42, but with improved retention of strength after heat ageing.



What are TUFNOL epoxy glass fabric materials used for?

## Trebor Mints

Tufnol is so versatile, reliable, durable and an ideal material for machining that many unconventional and innovative uses are found for it in a variety of sectors.

Trebor mints are precision-cut in order to reduce waste and maintain uniformity. Tufnol is used to make the backing plate for the 20 circular cutting knives that perform this process. It is ideal because of its high impact resistance, accuracy and dimensional stability which allow high repeatability giving the maximum yield.



## Materials

With over 80 years of experience in continually moving forward with the technology of materials development, Tufnol still finds thousands of new uses each year. Development is ongoing and our range of materials covers all grades and forms of laminated plastics, composites and resin bonded materials for engineering

These high performance materials are used for a very wide variety of applications where high strength, rigidity dimensional stability and electrical performance are required. Applications such as insulation in large turbine generators, components for cryogenic superconducting magnets, high strength bolt insulation in structures, jigs for electro-chemical machining and structural insulation for high performance electronic equipment, these are typical of the many uses to which this material is put. However, due to the abrasive nature of the high glass fibre content, epoxy glass grades are not normally selected for wearing or bearing applications.

| TYPES AVAILABLE               | Sheets | Rods | Tubes | Other sections |
|-------------------------------|--------|------|-------|----------------|
| Grade 10G/40 – Natural colour | Yes    | Yes  | No    | No             |
| Grade 10G/41 – Natural colour | Yes    | No   | No    | No             |
| Grade 10G/42 – Natural colour | Yes    | No   | No    | No             |
| Grade 10G/44 - Natural colour | Yes    | No   | No    | No             |

[Click here for TUFNOL Epoxy Glass Grade STANDARD SIZES](#)

## SPECIFICATIONS for TUFNOL Epoxy Glass Fabric Laminates

| BRITISH STANDARDS                         | Current Standards  | Recent Standards (now obsolete)         |
|---|--|---|
| Grade 10G/40 Sheet                        | BS EN 60893-3-2 Type EP GC 201   | BS 3953 Type EP-3                       |
| Grade 10G/40 Round Rod (Rolled & moulded) | BS EN 61212-3-3 Type EP GC 41 & BS 6128 Part 2 Type EP GC 21 <sup>42</sup> |   |
| Grade 10G/41 Sheet                        | BS EN 60893-3-2 Type EP GC 202   | BS 3953 Type EP-4                       |
| Grade 10G/42 Sheet                        | BS EN 60893-3-2 Type EP GC 203   | BS 3953 Type EP-5                       |
| Grade 10G/44 Sheet                        | BS EN 60893-3-2 Type EP GC 203 & BS 3953 Type EP-7                         | (BS 3953 will shortly become obsolete.) |

### NEMA\*

|                          |                         |
|--------------------------|-------------------------|
| Grade 10G/40 Sheet & Rod | NEMA LI-1-1983 Type G10 |
| Grade 10G/41 Sheet       | NEMA LI-1-1983 Type FR4 |
| Grade 10G/42 Sheet       | NEMA LI-1-1983 Type G11 |

applications.



## Development

We continually invest in the newest technologies, for example

- Our new co-ordinate measuring CMM machine
- Bearing Materials
- Resin infusion process
- Laminated plastics for ballistic protection
- Many examples of bespoke materials developed to customers' requirements



## Our Customers

Tufnol laminated plastics and resin materials are selected by blue chip companies the world over because of their reliability, durability and versatility. They are indispensable to most branches of engineering with approvals from:

- Mass transit customers such as Bombardier Rail Control Solutions, Alstom, London Underground
- Prestigious aerospace companies including BAE Systems, Rolls Royce, Agusta Westland, Airbus UK
- Major energy management corporations such as Schneider Electric

Tufnol is committed to quality and customer satisfaction.

Grade 10G/44 Sheet NEMA LI-1-1983 Type G11

\*Testing and certification to these standards is subject to special enquiry. Standard quality testing is to British Standards.

## PHYSICAL PROPERTIES

### TUFNOL Epoxy Glass Sheet

| PROPERTY   | Grade          | Grade          | Grade          | Grade          | UNITS             |
|--|----------------|----------------|----------------|----------------|-------------------|
|  | 10G/40         | 10G/41         | 10G/42         | 10G/44         |                   |
|  | TYPICAL RESULT | TYPICAL RESULT | TYPICAL RESULT | TYPICAL RESULT |                   |
| Cross breaking strength  | 490            | 470            | 490            | 490            | MPa               |
| Cross breaking strength at 150°C<br>– (after 1 hour at 150°C)    | -              | -              | 350            | 360            |                   |
| Cross breaking strength at 150°C<br>– (after 100 hours at 200°C) | -              | -              | -              | 250            |                   |
| Impact strength, notched, Charpy                                 | 60             | 60             | 60             | 60             | kJ/m <sup>2</sup> |
| Compressive strength, flatwise                                   | 415            | 415            | 415            | 415            | MPa               |
| Compressive strength, edgewise                                   | 300            | 300            | 300            | 300            | MPa               |
| Tensile strength   | 355            | -              | -              | -              | MPa               |
| Young's modulus  | 17.7           | -              | -              | -              | GPa               |
| Water Absorption   |                |                |                |                |                   |
| - 1.6mm thk.   | 5              | 5              | 5              | 5              | mg                |
| - 3mm thk.   | 7              | 7              | 7              | 7              | mg                |
| - 6mm thk.   | 10             | 10             | 10             | 10             | mg                |
| - 12mm thk.  | 15             | 15             | 15             | 15             | mg                |
| Electric strength, flatwise in oil at 90°C                       |                |                |                |                |                   |



### Marine



Tufnol serves an international market in the marine sector. Resin materials are unaffected by sea water, are water lubricated, capable of very precise design and highly accurate stress calculation. Our materials are approved by:

- Det Norske Veritas
- Lloyd's Register of Shipping
- The American Bureau of Shipping

### Electrical

Tufnol materials are synonymous with the electrical industry and have always played a key part in ensuring safety in the critical operation of low, medium and high voltage electrical equipment. All materials in the Tufnol range have electrical insulating properties to varying degrees. However these grades all possess superior dielectric strength:

- paper based phenolic,
- fine weave cotton epoxy,
- woven glass epoxy



### Offshore

|  |         |                    |                    |                    |                       |
|--|---------|--------------------|--------------------|--------------------|-----------------------|
| - 1.6mm thk.   | 17      | 17                 | 17                 | 17                 | MV/m                  |
| - 3mm thk.   | 15      | 15                 | 15                 | 15                 | MV/m                  |
| - 6mm thk.   | 12      | 12                 | 12                 | 12                 | MV/m                  |
| Electric strength, edgewise in oil at 75<br>90°C                     |         | 75                 | 70                 | 70                 | kV                    |
| Insulation resistance after immersion 1x10 <sup>11</sup><br>in water |         | 5x10 <sup>10</sup> | 5x10 <sup>10</sup> | 5x10 <sup>10</sup> | ohms                  |
| Relative density   | 1.90    | 1.95               | 1.90               | 1.90               | -                     |
| Loss tangent at 1 MHz  | 0.017   | 0.017              | 0.017              | 0.017              |                       |
| Permittivity at 1 MHz  | 5.0     | 4.9                | 5.2                | 5.2                |                       |
| Comparative tracking index   | 285     | 260                | 290                | 290                |                       |
| Maximum working temperature**  |         |                    |                    |                    |                       |
| - continuous   | 130     | 130                | 140                | 140                | °C                    |
| - intermittent   | 150     | 150                | 155                | 155                | °C                    |
| Thermal classification   | Class B | Class B            | Class F            | Class F            | -                     |
| Thermal conductivity through laminae 0.42                            |         | 0.42               | 0.45               | 0.45               | W/(mK)                |
| Thermal expansion in plane of 1.1<br>laminae                         |         | 1.0                | 1.2                | 1.2                | x 10 <sup>-5</sup> /K |
| Test methods as BS EN 60893-2, where applicable.                     |         |                    |                    |                    |                       |

## TUFNOL Grade 10G/40 Round Rod

| PROPERTY  | Grade 10G/40 UNITS |                    |
|---|--------------------|--------------------|
|   | TYPICAL RESULT     |                    |
| Flexural strength   | 600                | MPa                |
| Water absorption  | 0.5                | mg/cm <sup>2</sup> |
| Insulation resistance after immersion in 5x10 <sup>9</sup><br>water |                    | ohms               |
| Axial electric strength in oil at 90°C                              | 70                 | kV                 |
| Relative density  | 1.90               | -                  |

The unique properties of Tufnol's high resin content materials and cotton fabric laminates are in great demand for bearings and other components on floating platforms and offshore drilling platforms etc. Operating both under and above water, Tufnol has a 40 year proven track record in the offshore marine field.



## Quality

Our Quality systems are an integral part of our culture. We hold registration to ISO 9001:2008 and our Quality Management System complies AS/EN 9100:2009. We are Signatory to SC 21, the British Aerospace industry programme promoting Supply Chain Excellence in the 21st century and hold many major company approvals.



## Surgical Chisel Handles

Tufnol's versatility and durability are legendary and it is an ideal material for machining so that many unconventional and innovative uses are found for it in a variety of sectors.

**Surgical chisel handles** are made from Tufnol because it is unaffected by continual sterilising in autoclaves. It is also shatterproof so that no flakes or chips from it can break off from it during use and contaminate a wound.

Test methods as BS EN 61212-2, where applicable.

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



## Hidden Camera

Tufnol is adaptable and extremely robust, two qualities which lend it specifically to many unconventional uses in a variety of sectors.

A **hidden camera** for recording TV footage at test cricket matches was mounted inside an epoxy glass Tufnol tube which then replaced the middle stump. The tube is almost indestructible and can therefore withstand strikes from the ball and reliably protect the technology.



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