Glass cord for drive belt reinforcement
advantages of glass fibre over other forms of fibrous reinforcement are many:
- prevents stretching
- high Young’s modulus
- good dimensional stability
- freedom from creep
- low extensibility
- good resistance to most forms of chemical and solvent attack
- moisture resistance
- good weathering properties
- high strength
- good fatigue resistance when impregnated
- low hysteresis

Weight for weight, glass is stronger than steel, and has better stress/strain properties than many other reinforcement media.

Glass cord uses the unique properties of glass fibres to give strength and dimensional stability to polymeric products, particularly automotive timing belts, where there is a need for synchronous transfer of power from crankshaft to overhead camshaft without loss of inertia.

NGF has developed a manufacturing process to improve the fatigue life of multi-strand cords, extending cord life by a factor of ten.

The above tables represent a typical range of constructions but others are available on request. Full product specifications are also available on request.

All figures are nominal values.
Different glass cords and yarns are usually described by one of the two widely acknowledged nomenclature systems: the SI System or the US Customary System. These systems describe the type of glass, the nature of the filament, and the linear density or yardage of glass which makes up a basic strand. They also describe the construction of the finished cord i.e. the number of twisted strands in the yarn, the number of plied yarns, the level of twist and the final direction of the twist.

For example, the same cord can be described using the two systems as follows:

**SI System**
- Glass cord construction EC9 34.3/13 80 S
  - E Electrically resistant
  - C Continuous filament
  - 9 micrometres
  - 34 Weight in g/1000m of a bundle filaments
  - 3 Number of twisted strands
  - 13 Number of twisted yarns plied together
  - 80 Number of turns per metre in the twist
  - S Final twist direction

**US Customary System**
- Glass cord construction ECG 150.3/13 2.0 S
  - E Electrically resistant
  - C Continuous filament
  - G Filament designation
    - (Average diameter of 0.00036")
  - 150 Strand count (x 100 = yds/lb)
  - 3 Number of twisted strands
  - 13 Number of twisted yarns plied together
  - 2.0 Number of turns per inch in the twist
  - S Final twist direction

### Filament Diameter Designation

<table>
<thead>
<tr>
<th>SI Micrometres</th>
<th>US Customary Letter</th>
<th>SI tex (g/1000m)</th>
<th>US Customary System</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>E</td>
<td>22</td>
<td>225</td>
</tr>
<tr>
<td>9</td>
<td>G</td>
<td>34</td>
<td>150</td>
</tr>
<tr>
<td>9</td>
<td>G</td>
<td>68</td>
<td>73</td>
</tr>
<tr>
<td>9</td>
<td>G</td>
<td>110</td>
<td>45</td>
</tr>
<tr>
<td>9</td>
<td>G</td>
<td>140</td>
<td>35</td>
</tr>
<tr>
<td>11</td>
<td>H</td>
<td>330</td>
<td>15</td>
</tr>
</tbody>
</table>

### Conversions

- **Yards per lb** is obtained by dividing 496,053 by the tex stand count.
- **Grams per 1000m** is obtained by dividing 496,053 by the yards per pound.

### Physical Characteristics

#### Tensile Strength of 11 Ended Cord

<table>
<thead>
<tr>
<th>Force to Break, N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500</td>
</tr>
<tr>
<td>1400</td>
</tr>
<tr>
<td>1300</td>
</tr>
<tr>
<td>1200</td>
</tr>
<tr>
<td>1100</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>900</td>
</tr>
<tr>
<td>800</td>
</tr>
<tr>
<td>700</td>
</tr>
<tr>
<td>600</td>
</tr>
<tr>
<td>500</td>
</tr>
</tbody>
</table>

#### Specific Gravity – Variations with Glass Type

- **S.G.**
  - 2.7
  - 2.5
  - 2.4
  - 2.3

#### Elastic Modulus – Variations with Glass Type

<table>
<thead>
<tr>
<th>E, MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>800</td>
</tr>
<tr>
<td>600</td>
</tr>
<tr>
<td>400</td>
</tr>
</tbody>
</table>

#### Tenacity – Variations with Glass Type

<table>
<thead>
<tr>
<th>Tenacity mN/tex</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>85</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>75</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>65</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>55</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>45</td>
</tr>
</tbody>
</table>

### Key to Glass Types

- **E Glass**
- **U Glass**
- **K Glass**

### Filament Diameter and Tensile Strength

<table>
<thead>
<tr>
<th>B2O3</th>
<th>Al2O3</th>
<th>CaO</th>
<th>SiO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500</td>
<td>1400</td>
<td>1300</td>
<td>1200</td>
</tr>
<tr>
<td>1100</td>
<td>1000</td>
<td>900</td>
<td>800</td>
</tr>
<tr>
<td>600</td>
<td>500</td>
<td>400</td>
<td>300</td>
</tr>
</tbody>
</table>

### Tenacity – Variations with Glass Type

- **E, MPa**
  - 1200
  - 1000
  - 800
  - 600
  - 400

### Filament Diameter and Tensile Strength

- **B2O3**: 1500
- **Al2O3**: 1400
- **CaO**: 1300
- **SiO2**: 1200

### High Tensile Strength Glass Cord (HTS)

High tensile strength glass cord (HTS) is manufactured from either K or U glass filament as opposed to E glass. The difference in formulation of the glass produces glass fibre with improved physical characteristics. NGF is the only company to operate a fully integrated manufacturing process from HTS fibre forming to finished cord production.
New cords for improved performance

Hybrid cord patented technology

Hybrid cords have a different inner portion to the outer portion. The simplest hybrid is one where the inner strands of plied structure have different (strand) twist to those of the outer strands. The inner and outer strands do not have to be made with the same fibre material. One example is to use glass strands for the centre of the cord and aramid strands for the outside of the cord. Another example is to use high modulus material in the middle and lower modulus glass around the outside. The last combination has been demonstrated to give good performance for rubber adhesion and flex fatigue life. Some of these property improvements are shown below.

Timing belts with hybrid cords can be produced for enhanced performance in hot, cold, dry and wet (including oil) environments. This gives the potential for high modulus narrow timing belts with good environmental performance to replace equivalent metal parts such as timing chains.

NSG patented reactive impregnation technology

Traditionally, glass cord is manufactured by the impregnation of glass filament with resorcinol-formaldehyde latex. The latex is cured as the strand is passed through an oven. The strand is then twisted. Several strands can be plied together into a cord. During the rubber moulding process the rubber matrix reacts with the cord to enhance the adhesive bond. There is no bonding between strands they are simply pulled together. This can lead to weakness within the cord structure and areas of fatigue due to crack formation.

Reactive impregnation technology - a process patented by the NSG Group - does not use resorcinol-formaldehyde. Instead a mixture of reactive chemicals is used. These are dried not cured around each glass filament. When the cord is moulded inside a rubber article, the impregnation inside the cord reacts at the same time as the external rubber. The net result is to create one network throughout the cord of both rubber inside the cord and the bulk rubber matrix. The individual strands are now fully bonded.

Features

- Impregnation crosslinks form during rubber vulcanisation
- Can be used without an external adhesive overcoat
- Allows use of latex with high temperature and strong chemical resistance
- Can be applied to any filament material or hybrid
- Family of reactive impregnations are available for different applications
- Enhance belt integrity

Benefits available for rubber articles:

- Longer life
- Better heat resistance
- Better chemical oil resistance
- Lower growth
- Lower pop-out

These new cords give belt designers greater opportunities to overcome the ever-increasing demands of automotive engines and to progress the technology of synchronous belts in a cost-effective manner.

Polyurethane cords

High Performance polyurethane belts are used in high torque industrial applications. This belt (right) is reinforced with a carbon fibre cord from NGF.

High load, high torque industrial belts

NGF is able to supply specialised cords for high load/torque industrial belts. These belts (far right) use cords reinforced with carbon fibre, aramid and HTS glass.
NGF is a global business manufacturing in Canada, Europe, China and Japan

This technical specification relates specifically to the products manufactured by NGF.
For more specific details and to enquire if we have a product to meet your application’s needs contact:

**NGF Canada Limited**
255 York Road
Guelph, Ontario
N1E 3G4
Canada
Telephone #: 519-836-9228
Main Contact: Jason Martin
Main Contact: Colin Hamand
Main Contact: Gu Xuefei

**Nippon Sheet Glass Co., Ltd.**
4902 Komori cho
Takachaya
Tsu City
Mie Prefecture
514-0817
Japan
Telephone #: 0081-59-238-1169
Main Contact: Kenji Saito
Main Contact: Setsuhi.Ko@nsg.com

**NGF Europe Limited**
Lea Green Road
St Helens
Merseyside
England
WA9 4PR
Telephone 01744 853065
Main Contact: Colin Hamand
Main Contact: Gu Xuefei
Main Contact: Setsuhi.Ko@nsg.com

**Suzhou NSG Electronics Co., Ltd.**
No. 121 Hongxi Road
New district
Suzhou
China
Telephone #: 0512-66160200
Main Contact: Gu Xuefei
Main Contact: Setsuhi.Ko@nsg.com

**NGF Poland**
Miedniewice 75F
Skierniewice
96-100
Poland

MICROGLAS® is the registered trademark of NGF fibre products in Japan, USA, Europe, Singapore, Malaysia and China.