Glass cord for drive belt reinforcement

Creating Reinforcement for a Sustainable Future

characteristics of glass fibre

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

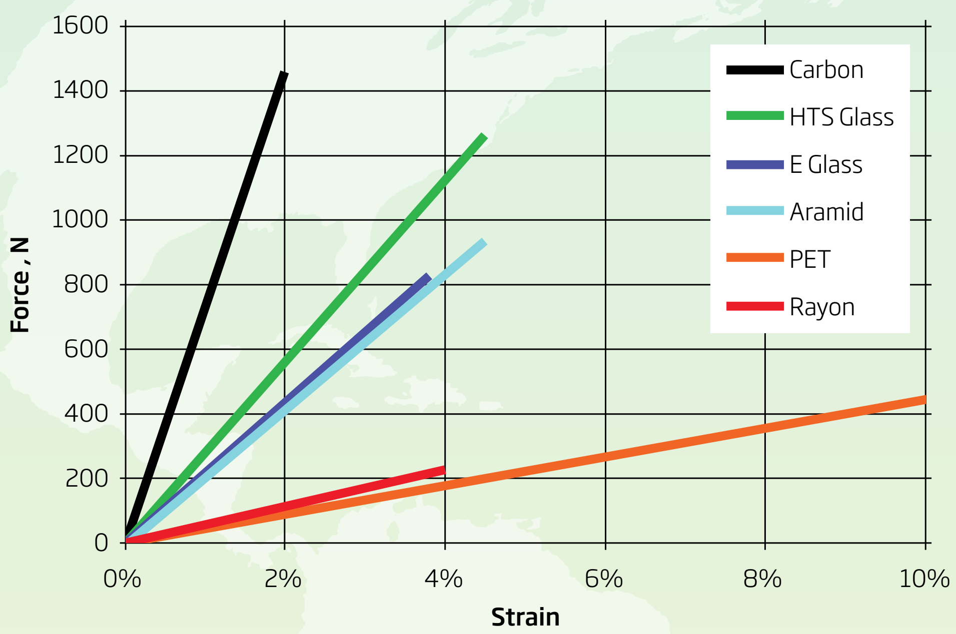
Glass cord uses the unique properties of glass fibres to give strength and dimensional stability to polymeric products, particularly automotive timing belts, where there is a need for synchronous transfer of power from crankshaft to overhead camshaft without loss of inertia.

advantages of glass fibre over other forms of fibrous reinforcement are many:

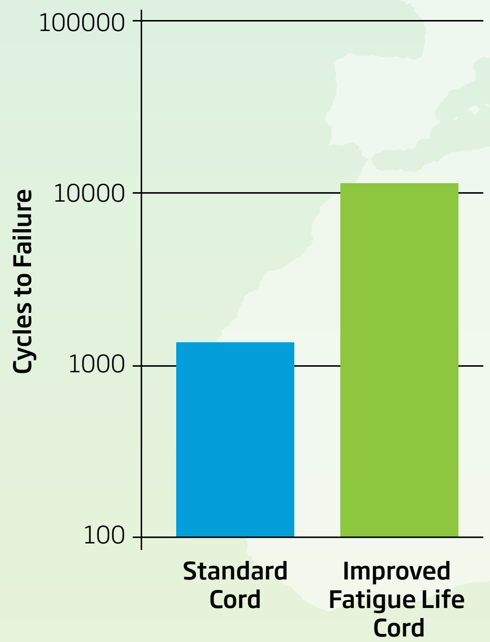
- prevents stretching
- high Young's modulus
- good dimensional stability
- freedom from creep
- low extensibility
- good resistance to most forms of chemical and solvent attack
- moisture resistance
- good weathering properties
- high strength
- good fatigue resistance when impregnated
- low hysteresis

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

Typical Tensile Curves for 1.05mm Cords



Cord Tensile Fatigue



cord products: physical characteristics

Glass Cord Construction strand tex	Initial Twist TPI	Initial Twist TPM	Final Twist TPI	Final Twist TPM	Cord Weight g/1000m	Diameter mm	Tensile Strength N	Adhesion N/mm
EC9 34. 3/0	-	-	3.6	142	135	0.23	78	-
EC9 34. 3/3	2.0	80	3.6	144	380	0.56	27	-
EC9 34. 3/8	2.0	80	2.0	80	1075	0.85	736	-
EC9 34. 3/11	2.0	80	2.0	80	1480	1.12	932	-
EC9 34. 3/13	2.0	80	2.0	80	1750	1.22	1128	-
EC9 34. 9/13	2.0	80	1.1	44	4900	2.20	2800	-
EC9 34. 9/24	2.0	80	1.1	44	9200	3.0	4300	-
EC9 110. 1/2	3.6	142	3.6	142	270	0.45	177	15
EC9 110. 1/3	3.6	142	6.0	236	410	0.55	245	23
EC9 110. 1/6	2.1	83	2.1	83	800	0.80	491	25
EC9 110. 1/13	2.1	83	2.1	83	1775	1.20	1030	40

Glass Cord Construction	Initial Twist TPI	Initial Twist TPM	Final Twist TPI	Final Twist TPM	Cord Weight g/1000m	Diameter mm	Tensile Strength N
EC10 330. 1/0	-	-	1.5	60	420	0.5	255
EC10 330. 3/0	-	-	1.5	60	1200	1.0	667
EC10 330. 1/3	3.0	120	2.0	80	1200	1.0	667
EC10 330. 1/4	3.0	120	2.0	80	1600	1.2	893
EC10 330. 3/5	1.5	60	1.0	40	6000	2.5	2943
EC10 330. 5/5	1.5	60	1.0	40	10000	3.0	4905

Special Cord Construction	Initial Twist TPI	Initial Twist TPM	Final Twist TPI	Final Twist TPM	Cord Weight g/1000m	Diameter mm	Tensile Strength N	Cord Modulus MPa
KC7 22. 3/11	2.0	80	2.0	80	1000	0.92	970	20
UC7 22. 3/18	2.0	80	2.0	80	1500	1.16	1530	20
CF / E hybrid					1630	1.14	1100	30
CF / E hybrid					5540	2.20	4474	30
CF 400.1					530	0.7	710	40
CF 800. 1					990	1.15	1460	40

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.

notes:

1 Glass cord constructions are available in S or Z final twist.

2 Glass cord can be supplied compatible with CR, EPDM, NBR, PU and HNBR compounds and thermoplastic elastomers.

3 34 strand tex constructions are NBR compatible and should be used for higher flex conditions such as HNBR timing belts.

4 34, 68 110 and 140 strand tex cords are normally black but can be supplied brown.

5 Glass cords consist of continuous glass fibres of various constructions, with a nominal latex content from 11% to 24%, depending on cord application.

6 Catenary: Glass cords are manufactured to give low catenary values, nominally less than 2%.

7 Tensile strength: values quoted are an indication of breaking strength only, and do not take into account different cord cross-sectional areas.

8 Tensile properties are test speed dependent and are given as example data.

9 E glass elongation to break is 3.5 to 4%. HTS elongation to break is 4 to 4.5%. CF elongation to break is approximately 2%.

10 Special cord constructions are designed for high performance automotive engines and high powered, high torque industrial applications.

11 Adhesion: values are measured by the 'T' test (pull through method) using a 10 mm square block of polychloroprene rubber compound.

12 Bobbin size and type will be confirmed at time of quotation.

glass cord nomenclature

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		US Customary System Glass cord construction ECG 150.3/13 2.0 S	
Glass type	E	Electrically resistant	E	Electrically resistant
Type of glass filament	C	Continuous filament	C	Continuous filament
Filament diameter	9	9 micrometres	G	Filament designation (Average diameter of 0.00036")
Strand tex	34	Weight in g/1000m of a bundle filaments	150	Strand count (x 100 = yds/lb)
Yarn	3	Number of twisted strands	3	Number of twisted strands
Cord	13	Number of twisted yarns plied together	13	Number of twisted yarns plied together
Twist level	80	Number of turns per metre in the twist	2.0	Number of turns per inch in the twist
Twist direction	S	Final twist direction	S	Final twist direction

S Twist: When twisted together, the yarns have a descending configuration from left to right as in the letter S.

Z Twist: When twisted together, the yarns have an ascending configuration from left to right as in the letter Z.

Product Nomenclature Comparison

Filament Diameter Designation		Strand Count		
			US Customary System	
SI Micrometres	US Customary Letter	SI tex (g/1000m	100yd cuts/lb	yds/lb
7	E	22	225	22,500
9	G	34	150	15,000
9	G	68	73	7,300
9	G	110	45	4,500
9	G	140	35	3,500
11	H	330	15	1,500

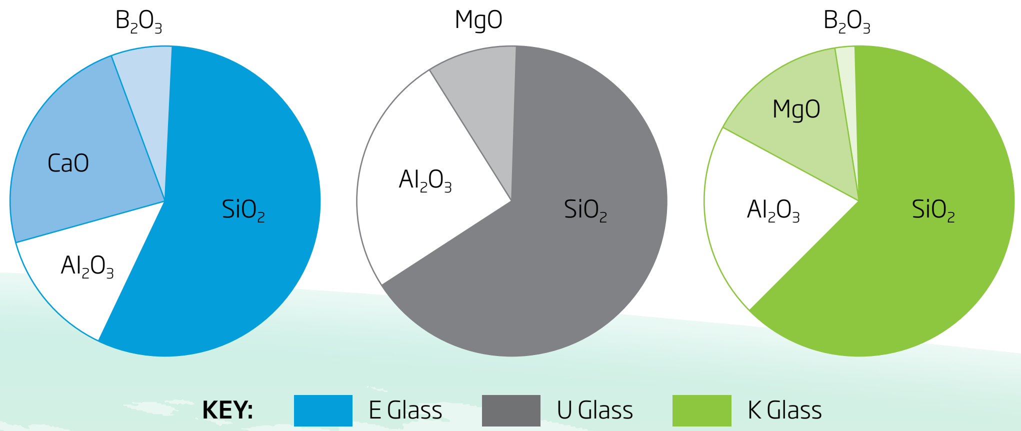
conversions

Yards per lb is obtained by dividing 496,053 by the tex strand count.

Grams per 1000m is obtained by dividing 496,053 by the yards per pound.

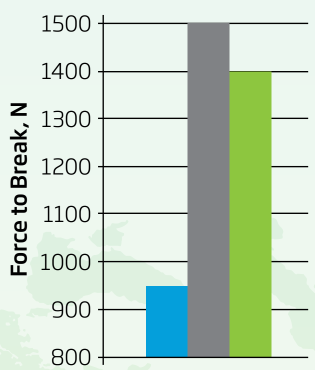
high tensile strength glass cord (HTS)

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.

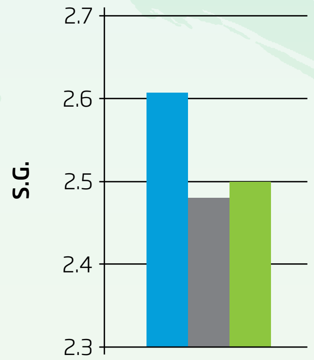


physical characteristics

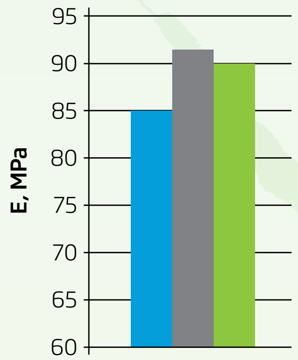
Tensile Strength of 11 Ended Cord



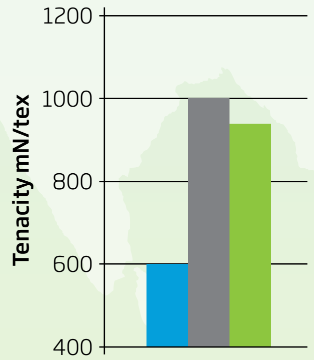
Specific Gravity – Variations with Glass Type



Elastic Modulus – Variations with Glass Type



Tenacity – Variations with Glass Type



new cords for improved performance

concept

Inside and outside of the cord have different functions:

Inside:

- Load bearing tension member
- Controls elastic extension
- Controls viscous extention

Outside:

- Sees high strain during bending
- Protects the central fibres
- Adhesion to external matrix

Example of untwisted cord.

hybrid cord patented technology

Hybrid cord allows the use of:

- Strands twisted in opposite directions
- Materials of different strengths
- By using two materials each may be used in the environment where it will perform best

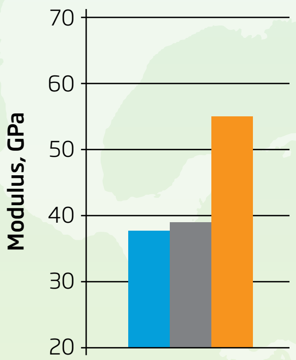
Hybrid cord benefits:

- Longer belt life
- Stronger belts
- Stiffer belts
- Narrower belts

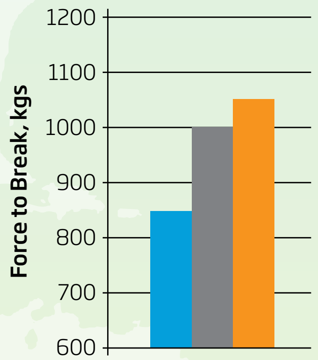
Hybrid cords have a different inner portion to the outer portion. The simplest hybrid is one where the inner strands of plied structure have different (strand) twist to those of the outer strands. The inner and outer strands do not have to be made with the same fibre material. One example is to use glass 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.

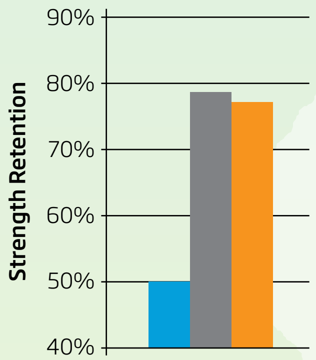
Cord Modulus Properties



Cord Tensile Properties



Flex Fatigue Resistance



Fatigue Test:
Load 20N, 10mm pully diameter, 100,000 cycles, 1.8 Hz, 140°C

KEY: E Glass U Glass Hybrid

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

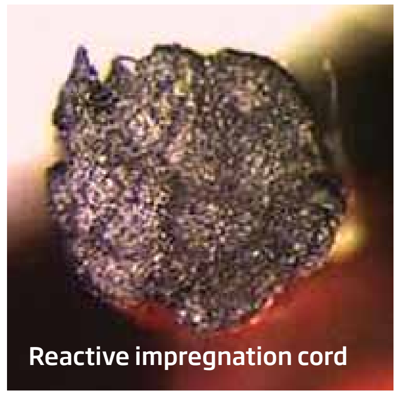
- Impregnation crosslinks form during rubber vulcanisation
- Can be used without an external adhesive overcoat
- Allows use of latex with high temperature and strong chemical resistance
- Can be applied to any filament material or hybrid
- Family of reactive impregnations are available for different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

Benefits available for rubber articles:

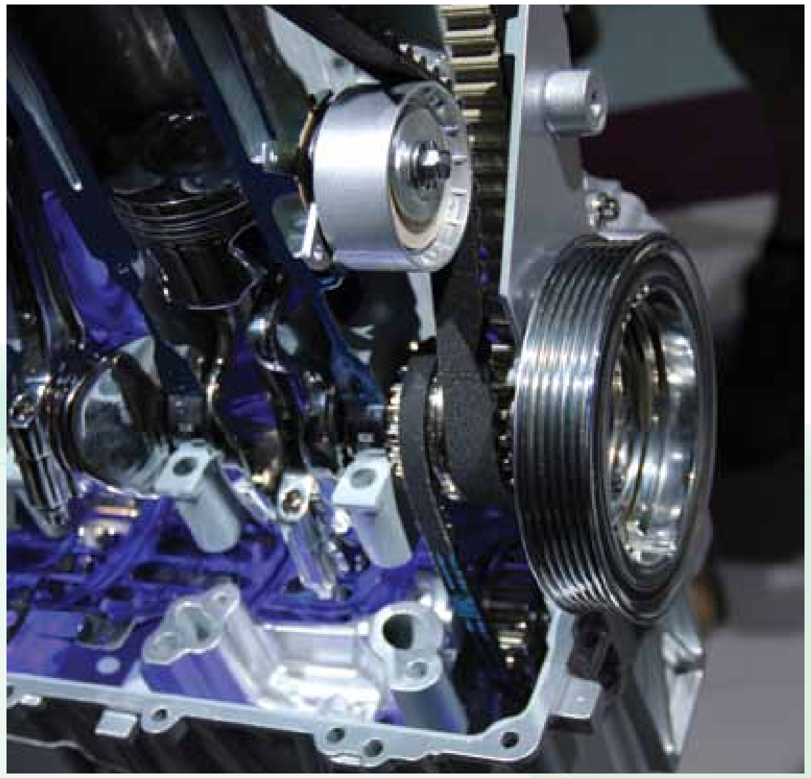
- Longer life
- Better heat resistance
- Better chemical oil resistance
- Lower growth
- Lower pop-out

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.

Standard cord with RFL



Reactive impregnation cord



Belt Classification	Pitch mm/inches	Glass Cord Construction
MXL	2.032/0.080	EC9 68.1/2, EC9 110.1/0
L, XL	9.525/0.375	EC9 110.1/3, EC11 330.1/0
H	12.7/0.5	EC9 110.1/13, EC11 330.1/4
XH	22.225/0.875	EC9 140.3/12, EC11 330.3/5
XXH	31.75/1.25	EC9 140.3/12, EC11 330.3/5

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.

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