WHY CHOOSE **OWENS CORNING**?
ASIA PACIFIC SCIENCE & TECHNOLOGY CENTER, SHANGHAI, CHINA

TANK **PROTOTYPING**

Our filament winding lab is capable of prototyping high pressure pipes, T4 LPG cylinders, CNG cylinders, PU filament winding, and other filament winding applications. The key capabilities include 4-axial & 2-axial filament winding machines, burst pressure testing, and long-term hydrostatic pressure machine to evaluate the pressure resistant performance of pipes.

MECHANICAL PROPERTY TESTING

Our mechanical testing lab is a GL certified lab, and can provide different kinds of property testing including impregnated strand property, NOL ring interlaminal shear, unidirectional composite panel strength/compression/flexural/impact test, etc.

COMPOSITE DESIGN & **MODELING**

The capabilities of our CAE modeling lab can provide customers with conceptual design, material evaluation, cost appraisal, structure and process optimization.

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GLASS REINFORCEMENT SOLUTIONS
for High Pressure Tank Industry

OWENS CORNING PRODUCT RANGE FOR LIQUEFIED PETROLEUM GAS (LPG) TANK INDUSTRY

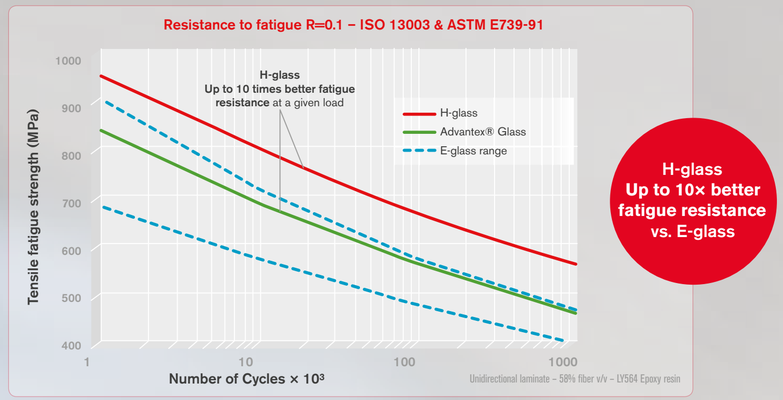
Traditionally, LPG cylinders are made with steel, weighing up to 10kg more. New composite Type 4 LPG tanks are made using a plastic liner, filament wound glass fiber structure, and epoxy resin. With the guarantee of same service life, the weight of new T4 LPG cylinder can be reduced more than 50% compared to traditional steel LPG cylinders*, and provides excellent corrosion resistance. In China, the LPG tank certification process is changing which will allow the market to readily adopt composite tanks and take full advantage of the benefits. In 2017, Owens Corning estimates that over 1 million composite cylinders have been produced in the market. Main applications include automotive installations, as well as household use.

*Owens Corning internal estimates available upon request.

Cylinder design	Glass reinforcement	Type & characteristics
Type 4, high-density polyethylene (HDPE) body wrapped in an epoxy impregnated continuous glass fiber 	**Advantex® 158B** single-end roving for filament winding	› **Excellent processing**: Low fuzz properties resulting in smooth parts and less downtime for clean up, helping improved manufacturing efficiency and costs. Patented Tack-Pak® packaging provides virtually 100% transfer efficiency. › **Outstanding burst strength**: Excellent glass/resin bonding providing high strength and high strength retention in demanding applications. › **Excellent strand wet out**: Enabling optimized part manufacturing speed, efficiency and costs. › **Outstanding corrosion resistance**: compared to standard E-glass, Advantex® E-CR glass helps with enhanced service life and strength of part over time in applications facing corrosion.

OWENS CORNING PRODUCT RANGE FOR COMPRESSED NATURAL GAS (CNG) TANK INDUSTRY

Cylinder design	Glass reinforcement	Type & characteristics
Type 2, metal liner reinforced with resin impregnated continuous glass fiber (hoop wrap) 	**Advantex® 158B** single-end roving for filament winding	› Developed for applications demanding **excellent burst strength** › **Approved for use in high pressure vessels**, suitable for epoxy and phenolic resins › Very good **aesthetic cylinder surface**
Type 3, metal liner reinforced with resin impregnated continuous glass fiber (full wrap) **Type 4**, resin impregnated continuous glass fiber with a non-metallic liner (full wrap) 	**H-glass** single-end roving for filament winding	› **Provide significantly enhanced fiber properties** for finished part performance › **Offer significantly high thermal performance** and excellent corrosion resistance for all major polymers › Meets Chinese GB standard GB24160

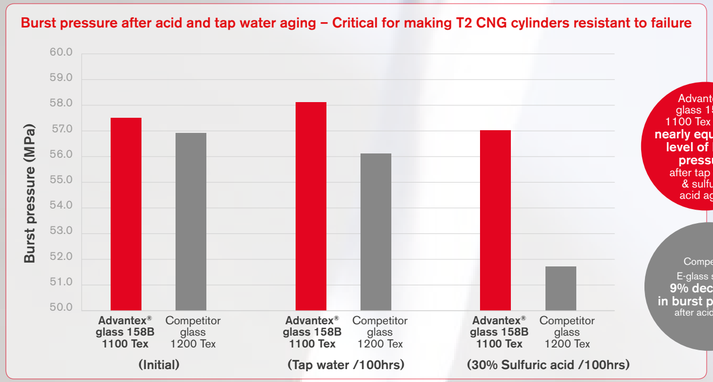


H-glass Up to 10× better fatigue resistance vs. E-glass

ADVANTEX® (& 158B) GLASS FIBER PROPERTY

Property	Test method	Unit	Advantex® E-CR Glass
Fiber density	Proprietary	g/cm³	2.63
Refractive index	Proprietary	-	1.567
Pristine fiber tensile strength, 22°C	Based on ASTM D3822, using an extension rate of 2%/min	MPa	4050
Young's modulus, 22°C	Proprietary	GPa	82
Elongation at break	Based on ASTM D3822	%	3
Coefficient of thermal expansion, 50-300°C	ASTM E228	×10⁻⁶cm/cm·°C	6.6
Specific heat @23°C	ASTM C832	KJ/Kg·K	0.79
Conductivity	ASTM C177	watts/m·k	1.22
Fiber weight loss	@96°C,10%H2SO4, 24h	%	6.9
Impregnated Strand Properties[1]			
Tensile strength	ASTM D2343	MPa	2400
Tensile modulus	ASTM D2343	GPa	83
NOL Ring Properties[2]			
Interlaminal shear strength	ASTM D2344, @22°C	MPa	57
Interlaminal shear strength	ASTM D2344, @-40°C	MPa	76
Interlaminal shear strength	ASTM D2344, @65°C	MPa	42
Ring tensile strength	GB/T 1458	MPa	970
Unidirectional composite properties			
0° Tensile strength	ISO 527-5	MPa	1260
0° Tensile modulus	ISO 527-5	GPa	46
0° Tensile strain	ISO 527-5	%	3
90° Tensile strength	ISO 527-5	MPa	46
90° Tensile modulus	ISO 527-5	GPa	11
0° Compression strength	ISO 14126	MPa	880
0° Compression modulus	ISO 14126	GPa	40
90° Compression strength	ISO 14126	MPa	145
90° Compression modulus	ISO 14126	GPa	9.5
Fiber weight fraction	ASTM D2734	%	74

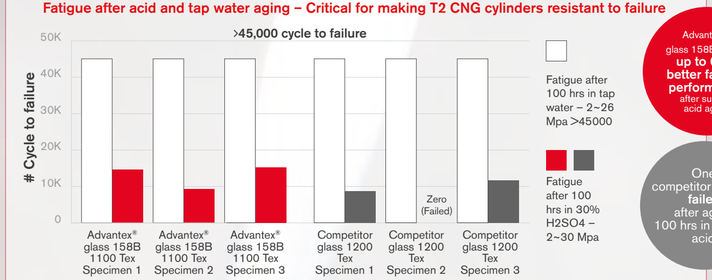
[1] Data based on DOW TW103 epoxy resin + TW152 hardener. Impregnated strand fiber weight fraction is 65%. [2] NOL Ring fiber weight fraction is 72%.



Advantex® glass 158B 1100 Tex shows **nearly equivalent level of burst pressure** after tap water & sulfuric acid aging

Competitor E-glass shows **9% decrease in burst pressure** after acid aging

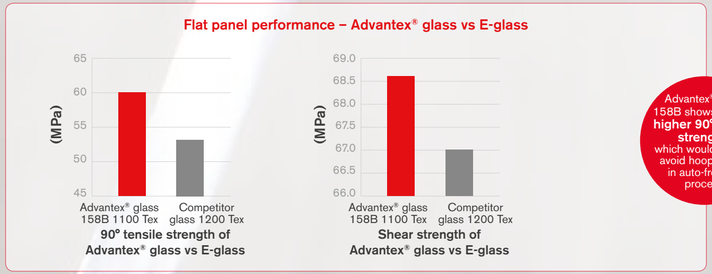
Test done Chongqing CNG inspection institute, Nov. 2014. Burst pressure test method: GB 15385; aging condition: tap water for 100hrs, 30% sulfuric acid for 100 hrs.



Advantex® glass 158B shows **up to 60% better fatigue performance** after sulfuric acid aging

One competitor E-glass **failed** after aging 100 hrs in sulfuric acid

Test done Chongqing CNG inspection institute, Nov. 2014. Fatigue test method follows GB 14260.



Advantex® glass 158B shows **+13% higher 90°tensile strength,** which would help to avoid hoop cracks in auto-frottage process

Test done Chongqing CNG inspection institute, Nov. 2014. 0°/90° Tensile strength method: ISO 527-5; Shear strength method: ISO 14130.