

**Long Term Strength and Stiffness of Fiberglass**

Glass-reinforced plastics’ strength properties decrease with time. Many experiments have shown that glass-reinforced plastic under load will lose much of their strength.

This is yet another way that glass-reinforced plastic differs from more traditional structural materials.

The following table shows the data acquired by various researchers.

**Loss of Strength with Time of Glass-Reinforced Plastics**

Time, hours	Boller Study Percent Strength	Steel Study Percent Strength	Kabelka Study Percent Strength	Kabelka Study2 Percent Strength
1		55%	70%	
10		46%	65%	60%
100	88%	40%	50%	54%
1000	79%	30%	53%	47%
10000	69%	22%	50%	36%

Figure 84: Reduction of strength of fiberglass composites with time

This table shows that glass-reinforced plastics are susceptible to environmental effects. The most conservative research found a 68% reduction of short-term strength after 10,000 hours of use, which translates to 417 days of use.

**Effect of Temperature on Strength**

The strength of reinforced plastics is reduced when exposed to elevated temperatures. The exact amount of strength reduction will vary between different glass-reinforced plastic composites. Changes in the Modulus of Elasticity correspondingly drop with increases in temperatures. The following chart, reproduced from Reinforced Plastics – Theory and Practice, Gaylord, pp. 90-91, shows this.

Temperature	Ultimate Tensile or Comp. Strength	Modulus of Elasticity
75 degrees Fahrenheit	20 kips/in. <sup>2</sup>	2.3 X 10 <sup>6</sup> psi
125 degrees Fahrenheit	16 kips/in. <sup>2</sup>	1.8 X 10 <sup>6</sup> psi
175 degrees Fahrenheit	12 kips/in. <sup>2</sup>	1.4 X 10 <sup>6</sup> psi
200 degrees Fahrenheit	10 kips/in. <sup>2</sup>	1.2 X 10 <sup>6</sup> psi

**Design Factor of Safety for Reinforced Plastics**

Many products and materials have allowable working stresses that are specified by Codes, Standards, or recognized authorities. Allowable working stress is the amount of stress that a design can withstand over an extended period of time. Allowable working stress takes into account factors that can affect the strength of a design including environmental effects, average loading, and maximum loading. Besides all of the known factors that affect the stress in a design, a design factor of safety must be included to ensure a design that will not fail. A product cannot be designed to incur stress right up to the maximum allowable stress. Despite the most vigorous design procedures that try and account for any and all variables, there must be a margin of safety left in any design. The design factor of safety for conventional materials such as steel has been backed up with decades of experience. Reinforced plastics is a relatively new material, and there is not this benefit of extensive experience.

