

Fiberglass Compositions and Their Comparative Properties

Fiberglass composition – Description, definition and characterization. A Typical soda-lime silica glass, limited for reinforcement owing to poor resistance to water. C Chemical glass—possesses improved durability, making it preferred composition for applications requiring corrosion resistance. D Glass with improved dielectric strength and low density, developed for improved electrical performance. E Borosilicate type, used for major share of all reinforcement applications. E-CR Modified “E” glass having superior long term resistance to strain crack corrosion in acid conditions. R High-strength, high-modulus glass at a lower cost than “S”. S & S2 Glass with high tensile strength and modulus, developed for aerospace applications

| Chemical Properties | A | C | D | E | E-CR | R | S & S2 |
|--|-----------|------------|-------------------------|----------------------|------------|------------|------------|
| Chemical Composition % | | | | | | | |
| SiO ₂ | 72 | 65 | 74 | 52-56 | 58-63 | 60 | 65 |
| CaO | 10 | 14 | 0.5 | 16-25 | 21-23 | 9 | - |
| Al ₂ O ₃ | 0.6 | 4 | 0.3 | 12-16 | 10-13 | 25 | 25 |
| MgO | 2.5 | 3 | - | 0-5 | 2-4 | 6 | 10 |
| B ₂ O ₃ | - | 6 | 22 | 5-10 | - | - | - |
| TiO ₂ | - | - | - | 0-1.5 | 1.0-2.5 | - | - |
| Na ₂ O | 14.2 | 8 | 1.0 | 0-2 | 0-1.2 | - | - |
| K ₂ O | - | - | 1.5 | 0-2 | 0-1.2 | - | - |
| Fe ₂ O ₃ | - | 0.2 | tr | 0-0.8 | 0-0.4 | - | - |
| ZnO | - | - | (Li ₂ O-0.5) | - | 0-3.5 | - | - |
| SO ₃ | 0.7 | 0.1 | - | - | - | - | - |
| F ₂ | - | - | - | 0-1.0 | - | - | - |
| Chemical resistance—14 m m fiber; % weight loss after 1 hr boil in | | | | | | | |
| H ₂ O | 11.1 | 0.13 | - | 1.7 | 0.2 | - | - |
| 1.04 N H ₂ SO ₄ | 6.2 | 0.10 | - | 48.2 | 0 | - | - |
| 0.1 N NaOH | 15.0 | 2.28 | - | 9.7 | 0.2-0.6 | - | - |
| Physical Properties | | | | | | | |
| Specific gravity (bare fiber) | 2.50 | 2.49 | 2.16 | 2.52-2.61 | 2.63 | 2.55 | 2.49 |
| Pristine tensile strength, psi | 350,000 | 400,000 | 350,000 | 500,000 | 510,000 | 640,000 | 665,000 |
| Tensile elastic modulus, psi | 9,800,000 | 10,000,000 | 7,500,000 | 10,500,000 | 10,500,000 | 12,475,000 | 12,670,000 |
| Elongation at 72 °F, % | - | - | - | 3-4 | - | - | 5.4 |
| Poisson's ratio | - | - | - | 0.22 | - | - | - |
| Thermal Properties | | | | | | | |
| Softening Point, °F | 1300 | 1380 | 1420 | 1540-1555 | 1635 | 1481 | 1778 |
| Coefficient of thermal expansion - in/in/ °F x 10 ⁻⁷ | 90 | 40 | 17 | 28-33 | 29 | 74 | 31 |
| Specific heat at 72 °F [(k) BTU-in/hr/ft ² / °F | - | - | - | 7.2 | - | 6.9 | - |
| BTU/lb/ °F | - | - | - | 0.197 | - | - | - |
| Optical Properties | | | | | | | |
| Index of refraction | 1.512 | 1.541 | 1.47 | 1.55-1.56 (a 550 nm) | 1.57 | - | 1.523 |
| Electrical Properties | | | | | | | |
| Dielectric constant, 72 °F, 10 ⁶ Hz | 6.90 | 6.24 | 3.56 | 6.1-6.7 | 7.01 | 6.2 | 5.34 |
| Loss tangent, 72 °F, 10 ⁶ Hz | 0.0085 | 0.0052 | 0.0005 | 0.001 | 0.002 | 0.0015 | 0.002 |