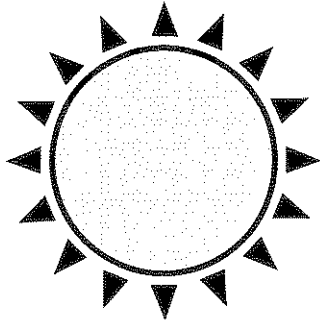


The Effects of Weathering on Fiberglass Reinforced Plastic (FRP) Ladders



Fiberglass ladder rail will weather, as will most materials, when exposed to an outdoor environment. The degree of degradation of surface appearance will be accelerated by warm, moist climates; areas of high humidity; and high solar ultraviolet (U.V.) radiation. Humidity has the greatest effect on the degree of weathering.

VISUAL CHANGES THAT MAY OCCUR TO FIBERGLASS FROM WEATHERING ARE:

1. **Surface fiber appearance change** — The increase in fiber prominence due to resin erosion, fiber blooming, etc.
2. **Apparent color change** — The total effect in color change as a result of resin yellowing, pigment fading, fiber whitening, etc.
3. **Gloss loss** — The change in glossiness or light reflection of the sample.

Ultraviolet light will cause oxidation of the polyester resins generally used in Fiberglass Reinforced Plastic (FRP) ladders just as the oxidation of aluminum affects the metal's surface. The oxidation damage will result initially in loss of surface gloss and gradually in a chalky appearance. After a period of time, which will vary by heat, humidity and chemical atmosphere in the local environment, and without a surface veil, the reinforcing fibers may become exposed to the surface, resulting in a condition commonly known as "**fiber bloom**". Without a surface veil, this could occur in two to five years depending on the severity of conditions.

ULTRAVIOLET (U.V.) DAMAGE (FROM SUNLIGHT)

Ultraviolet light will attack the polyester resin of an FRP ladder and will definitely influence the aesthetic and, to a much lesser degree, the physical and electrical properties. The degree to which each of these characteristics is influenced should be a key consideration.

"**Fiber bloom**" is mainly an aesthetic condition — not a structural one. Exposed glass fibers due to UV damage do not reflect a significant loss in physical properties. Test programs instituted by producers to review structural property loss due to U.V. exposure as a function of time show only small losses of strength. In programs of 10-15 years duration, losses of 5%-10% in physical properties were noted. These losses cannot be attributed to weathering only. It has been estimated that the maximum estimated loss in physical properties due to U.V. damage approaches 1% per year.

Surface weathering that occurs early in the life of a ladder can be a continuing phenomenon that may result in "fiber blooming". Should "fiber blooming" occur, the fiberglass will continue to show a worsening appearance until the end user takes some action to alleviate this condition. "Bloomed" fibers however, tend to shadow and protect the surface of fiberglass ladder rails against direct U.V. action to some degree.

If "fiber blooming" results from U.V. attack it can influence the **electrical properties** of an FRP ladder rail. The roughened surface of a ladder rail is now free to pick up contamination such as dirt or grease that can form an "electrical track". Furthermore, exposed fibers can now provide access for water or water vapor to penetrate the laminate. Absorbed water lowers the insulation resistance of the rail and hence its value as an insulator.

If "fiber blooming" occurs, it may also cause the user some discomfort if exposed fibers penetrate the skin. This is not serious, since it is only a temporary discomfort, but it is very annoying and the bloomed rail should be coated to eliminate the problem. Washing and applying skin lotion can relieve the discomfort, as long as repeated exposure is not encountered.

In an effort to combat resin degradation in the ladder rail, Werner Co. uses a U.V. inhibitor in the resin system to retard this weathering phenomenon. This inhibitor alone cannot eliminate "fiber bloom," but does extend the potential service life. Coating materials used on a ladder rail extend the period before fiber exposure is evident.



ULTRAVIOLET (U.V.) DAMAGE (FROM SUNLIGHT) (CONTINUED)

Werner Co. uses polyester fiber fabric surfacing materials (surface veils) on all its fiberglass ladder rail. These polyester fiber fabrics provide a barrier between the outer layer of glass mat and the surface of the rail.

These surface veils do not eliminate the weathering of the side rail from the ultraviolet rays of the sun. What they do is give a smooth, non-irritating outer surface to the rail, provide added resistance to UV degradation, and isolate the outermost glass layer which could irritate a user's skin once the resin becomes eroded. A fiberglass ladder with a surface veil can be comfortably used even after the resin has eroded without the itching sensation. The ladder can then be recoated with acrylic, polyurethane, or epoxy paint to restore the appearance and surface finish. (See page 4 for recommended coatings.)

STEPS THAT WERNER CO. HAS TAKEN TO IMPROVE OUTDOOR WEATHERING CHARACTERISTICS OF FRP LADDER RAIL INCLUDE:

1. Use of isophthalic polyester resin with superior weathering resistance.
2. Use of improved pigments with more resistant characteristics.
3. Use of improved monomer systems.
4. Use of U.V. inhibitor to reduce solar radiation effects.
5. Use of aluminum silicate filler.
6. Use of polyester surface veil to yield a higher resin rich surface.

For test purposes, several different types of accelerated artificial weathering devices are used such as:

1. Carbon Arc units such as the Atlas® Twin Carbon Arc¹, and Sunshine Carbon Arc (ASTM G23-90).
2. Xenon Arc type unit (ASTM G26-90).
3. Q-U-V®, Fluorescent, Ultraviolet, and Condensation unit² (ASTM G53-88).

For reference, 1000 hours at a cycle of 6 hours U.V. exposure at 130°F followed by 6 hours condensation at 100°F in the Q-U-V® accelerated weathering unit represents about one year of south Florida exposure; 2000 hours is about two years; and 3000 hours is about three years. This is based upon early development experience of other laboratories. An accelerated weathering test is only an approximation of real life weathering experience.

In all cases, a high humidity cycle is employed.

FACTORS AFFECTING THE SERVICE LIFE OF FRP LADDERS

An FRP ladder will be affected by:

1. Geographical location.
2. Type of handling given.
3. Whether or not a regular maintenance program is followed.

FOOTNOTES:

¹ Atlas Electric Devices Co.
4114 N. Ravenswood Avenue
Chicago, Illinois 60613

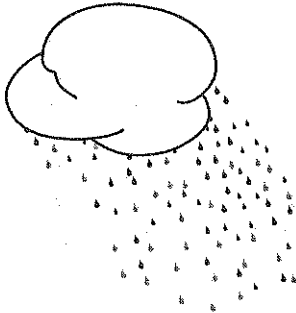
² Q-Panel Company
26200 First Street
Cleveland, Ohio 44145

Geographical location: An FRP ladder in Miami (high solar, high humidity) will generally weather much faster than one in Chicago; and, therefore, requires a more frequent maintenance program.

Handling: Care should be taken to minimize impact loading to FRP ladders. Avoid dropping or stepping on ladders and dropping materials onto FRP ladder rails. Proper restraining of ladders during transit will prolong the useful life.

Maintenance: The maintenance cycle should be determined by local experience rather than by a national average. This requires the end user to use his/her best judgment in determining when an FRP ladder requires maintenance due to the effects of weathering.

MOISTURE ABSORPTION



FRP ladders are frequently exposed to moisture. FRP can absorb some moisture although it will never absorb as much moisture as wood. Wood is very porous by nature, which is not true of FRP since there is a bond between the reinforcement and polymer system.

A small amount of moisture can find its way into an FRP ladder by a wicking action at the surface through exposed fibers or at either end of the rails. This moisture reduces the insulation resistance of the ladder but does not reduce any physical properties.

Moisture is not visible in a laminate and requires an electrical confirmation test. Electrical tests such as a D.C. insulation resistance test can be used to determine the electrical safety of a ladder.

If there is reason to believe a ladder has absorbed considerable moisture, it should be placed in a circulating heat chamber at 120°F from four to twelve hours. Following this, the ladder should be coated with a highly pigmented polyurethane resin.

MAINTENANCE

The end user shall use his/her best judgment to determine when a ladder requires maintenance.

FRP ladders require less maintenance than wood ladders. A good, general maintenance program should include the following:

1. All ladders should be cleaned of any build-up of dirt, grime, dust, grease, carbonaceous and other conductive materials. The cleaning effort ensures retention of the original electrical insulating characteristics and precludes a surface tracking condition. Regular washing and waxing will also greatly reduce the degree of surface degradation and potential fiber bloom. Wax slows down the entry of water but is invisible to U.V.
2. If the ladder is used indoors, there are fewer environmental concerns unless it is in a chemical environment. In that case, periodic inspection and possible coating may be warranted. Maintenance in a chemical environment requires specific consultation.
3. Ladders stored out-of-doors for extended periods of time can have the effect of weathering decreased by semi-annual waxing of the rails. Normally a good commercial non-slip paste wax, such as Trewax³, clear paste wax, will reduce the possibility of glass fiber prominence.
4. Ladders employed in geographic locales with high U.V. ray exposure can have extended life and reduced potential for glass fiber prominence by periodic coating with certain acrylic lacquers, polyurethane coatings or similar materials. The U.V. additive employed in the resin formulation is gradually consumed during sunlight exposure. These subsequent coatings replace the U.V. screen or barrier.
5. A spot coating with a highly pigmented polyurethane resin is highly recommended when the ladder surface has been damaged by localized impact or abrasion. If there is any structural damage consult Werner Co. on repair or replacement or discard the ladder.
6. Ladders in service out-of-doors, where high humidity or high humidity coupled with intense U.V. ray exposure exists, may have their service life increased by applying a lacquer or paint coating and waxing.

FOOTNOTES:

³ Trewax
Division of Chemifax
A Blue Coral, Inc. Company
City of Commerce, California 90040

