POWERTRUSION
INTERNATIONAL, Inc.

Pole Usage Guide

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MATERIAL INTRODUCTION

Fiber Reinforced Composite (FRC) materials and their use are common to the electric power industry. Many products used by the industry that are fabricated of FRC materials include ladders, grating, construction tools, lift-truck booms, transformer pads, hot sticks, bus bar supports, insulators, pole line hardware, and crossarms. Over the years, pole structure design advancements utilizing FRC materials have become the material of choice for usage in lighting, telecommunication and power distribution systems. PFRC (Pultruded Fiber Reinforced Composite) materials are used widely in many applications because they can be engineered to offer important advantages over traditional materials. Such advantages include reduced weights, a high strength-to-weight ratio, low maintenance, dimensional stability, high dielectric strength, non-toxic handling & service life, resistance to rot, corrosion, chemicals, pest damage and non-toxic disposal. PFRC materials and processing also offer product design much flexibility. Engineers can choose from a wide range of material fiber and resin systems to configure a product to the end use specifications. This degree of flexibility distinguishes PFRC materials from "traditional" materials such as wood, steel or concrete. The benefits and limitations of PFRC products depend on the materials selection, manufacturing processes, fabrication techniques and handling procedures of the product from the manufacturer's factory to the field installation. This document discusses such topics to assure a Powertrusion PFRC Pole is safely installed to service with much success.

POLE STRUCTURE DURABILITY

PFRC poles are more resistant to many environmental factors than poles made of other materials. The most common environmental factors include wind, rain and sunlight. Other conditions, such as soil type, area maintenance (weed-trimming, etc.), human and animal interaction, chemicals and vandalism, can affect the durability of the structure. Described below are various actions taken with PFRC material systems to maximize the capability of structures to withstand the affects of prolonged exposure to the environment.

Chemical Exposure & Biodegradation

PFRC products are naturally resistant to most chemicals found in subterranean and outdoor environments. PFRC pole materials are not biodegradable. They are not susceptible to termite, woodpecker, or other biological attack. The material is inert and can be disposed of in normal non-hazardous landfills. PFRC poles are inherently resistant to long-term degradation effects of soil conditions, fungi, insects, and bird attack, and corrosive environments. If the user has a concern with a specific chemical used in conjunction with the pole, please notify Powertrusion for addition confirmation.

Ultra-Violet Light Protection

Ultra-violet light could possibly cause color fading and degradation to the pole materials. Advances in material science have produced very effective life-extending protective systems. The POWERTRUSION pole uses three levels of protection against ultra-violet light to enhance the service life of the structure. The most effective systems include resin UV inhibitors, a resin-rich non-structural surface veil, and an exterior UV-resistant coating as described below. In order to protect the fiber - resin composite system from elemental deterioration, extra protective measures are taken with the surface of the fiberglass composite. The pultrusion process efficiently provides a resin-rich surface on the product loaded with UV inhibitors. In addition, the exterior surface of the pole is enveloped with a synethic corrosive resistant veil material to enhance the resin rich pole surface. By doing this, the actual structural fibers are buried beneath a layer of non-structural resin. Because the resin itself is loaded with a UV inhibitor, the load-carrying fiberglass is afforded significant protection. An exterior topical coat with UV inhibitors provides an extra concentration of UV protection to the surface of the pole.

Due to the nature of the PFRC materials and the importance of the pole surface to provide longevity to its design and function, reasonable care needs to be taken with attention to shipping and handling procedures from the manufacturing facility to time of pole's installation to service. Listed below are procedures and practices to be followed in handling PFRC products.

TRANSPORATION and HANDLING

Shipping & Receiving

PFRC poles can be transported in the same manner as poles made of other materials. Over long distances, flatbed and LTL haulers can be used. There is a need to limit road hazard damage to a very minimum. The user should review Powertrusion's methods and procedures for packaging and shipping of PFRC products as shown in drawing specification PT-3-10-08 (two pages). This specification explains the bundling of multiple poles to a single shipping crate and the loading & securing of multiple bundles to transportation equipment. The PFRC poles are tubular and NOT solid cross sections; care must be given to the tightness of the tie-down straps securing the bundles to the transportation trailer. Poles bundles will be shipped to facilitate loading & unloading with a forklift. Any special customer requirements for method of packaging, delivery mode, destination or notification should be clearly defined in the purchase order agreement. It is the practice of Powertrusion to photograph material after it is loaded, secured to the transportation equipment and ready for over-the-road travel. It is strongly recommended that user (or responsible party receiving the material) follow the same practice of photographing the material upon receipt for documentation and record keeping.

When receiving products per order agreements, the user is also responsible for ensuring that all materials, hardware and fittings are accounted for as listed on bill of lading and / or packing sheet. When a discrepancy occurs, both the carrier and the manufacturer should be notified.

When receiving PFRC products, all items should be inspected for damage prior to acceptance. If damage has occurred, the user should immediately notify the delivering carrier or the manufacturer, whichever is specified by the purchase order agreement prior to any actions taken to unload the material from the transport equipment. The user should notify the manufacturer of any damage and then cooperate in filing damage claims with the carrier. The damage report should also indicate what types and level of damage that has occurred to the material. Powertrusion must to be notified to discuss the reported damage to make assessments to the structural integrity of the material for its intended use.

Rejection

It is important that rejection criteria be established and agreed to by both the user and the manufacturer prior to fabrication and delivery of the order. A clear and concise definition of what will constitute ground for rejection of PFRC products should be included in the purchase order agreement.

Storage

PFRC poles can be stored outdoors or indoors. Poles are delivered in bundles to assist in yard storage and minimize pole handling and movement prior to actual deliver to job location. To avoid unnecessary damage to the pole coating, use a similar cribbing plan to store poles so that they are separated from one another if it is necessary to unpack the poles from the original shipping crates. The timber or cribbing should also keep the pole high enough above the ground to allow lifting straps to be easily slipped under and around the pole. If stacking poles in more than two layers, consideration should be given to the potential mass of the cribbing and stacking weight to oval the bottom poles. FRC poles that are stored horizontally for long periods and allowed to sag will return to their original shape when erected as the resin material is a thermosetting chemistry and does not creep.

Handling Instructions

Powertrusion PFRC poles are lightweight and an important consideration is that poles are much lighter in weight than poles made of other materials. However, the user should have a general understanding of the weight of the structure and ensure that proper equipment is available for installation. Contact Powertrusion to verify any weight issues on specific products. This weight differential means the user may be able to use lighter duty equipment and anticipate minor adjustments in lift balance points.

PFRC poles can be loaded/moved/unloaded using a forklift positioned perpendicular to the longitudinal axis of the pole and with the load in balance. Care should also be taken in handling to prevent puncturing or cracking a pole with the forklift and to prevent damaging the UV surface. It is important to fully position the forklift under the load and lift the pole(s) rather than “slide” the forklift across the flat surface of the pole while in a lifting action. All fiberglass poles can be handled utilizing single pick points. The center of gravity on an unframed pole is typically at mid-point of the overall length due to its non- taper design. Significant hardware installations will affect the balance and location of pick when moving a pole, the user should evaluate these weights and adjust the pick point accordingly. Nylon slings should always be used in lieu of chains, cables or other metal hardware when lifting PFRC poles. Poles may also be handled with a crane using a two-point pickup system with nylon slings or combination spreader bar with nylon slings attached to the pole(s). The minimal weight of the pole should eliminate the need to drag or skid the pole for any significant distance. If dragging of the pole is necessary for extended lengths due to difficult terrain, the butt of the pole should be protected to avoid excessive damage to PFRC materials and butt plate. PFRC poles are NOT solid cross sections. Care should be taken in the lowering of the pole to the ground to facilitate the removal of the handling slings. Poles should not be dropped from distances or freely dumped from transportation trailers. Poles should be rested to a firm surface with clearance allowed to easily remove the supporting slings.

For short distances, pole dollies and other pole handling vehicles can be used. If pole dollies are used, nylon straps should be used in lieu of metal chains to secure the pole. Because FRC poles are lightweight, some distribution size poles can be manually carried short distances between the staging area and the installation site. Craft persons using shorter nylon slings utilizing the sling openings as handles can carry PFRC poles. Attached climbing hardware is also a means of “handling” a pole for manual carry.

Framing

Most standard, non-cleat line hardware can be used on PFRC poles with conventional fasteners and practices. In general, the POWERTRUSION pole will accept most of the hardware that is used on a wood, steel, or concrete pole. However, washers that conform to the pole surface should be used beneath the bolt head and nut. Powertrusion recommends flat washers be used for all installations at minimum dimension of 2" x 2" to enhance the load bearing surface of the hardware to PFRC materials. The preferred method of attachment is with through bolts. The maximum torque applied to through-bolts is recommended not to exceed 50 ft-lbs. However, the pole has been tested to withstand torque in excess of 80 ft-lbs; results causing an oval effect to the profile but without fiber damage to the pole. Because the pole is not tapered, it may be necessary to place a through-bolt either through or beneath a cluster-mounting bracket that encircles the pole.

The following hardware features are <u>not</u> compatible with the POWERTRUSION pole:

- **Lag bolts**: Use a through bolt instead.
- **Teeth**: Hardware that is drawn into a wood pole should not be used on a PFRC pole. In almost every case, a similar piece of hardware exists that does not have teeth.
- **Nails and Staples**: Use self-tapping screws.

Field Drilling Holes

POWERTRUSION will pre-drill holes per customer specifications. Holes can be drilled in the field with either hardened high-speed steel (HSS) twist drills, carbide tipped twist drills or self-centering hole-saws. Diamond coated hole saws, carbide tipped twist drill bits and brad-point HSS twist drills perform best. The number of holes needed determines drill selection. Carbide or diamond type drills are recommended for quantities above 20.

POWERTRUSION recommends primary holes for equipment, climbing steps or any load bearing application be drilled on the octagonal NON-SEAM side. The die parting lines on (4) of the (8) sides determine a SEAM side. It is necessary that the exposed fibers from drilling operations be sealed to assure proper performance of the pole. It is recommended that a polyester, acrylic, or polyurethane resin solution be applied to the finished hole prior to installing attachments.

Spacing of holes should be drilled on centers at least four hole diameters apart when drilled on the same plane. For example: three-quarter inch holes should have a minimum separation between hole centers of three-inches. Holes located in opposing planes need enough separate for clearance of bolt hardware.

Any dust particles generated by a drilling or cutting process are non-toxic and classed a nuisance dust; however, it is recommended that user personnel adhere to the same safety practices used when drilling and cutting other materials. Contact Powertrusion for any further information.

Climbing

Climbing provisions are available but vary depending upon manufacturer of the climbing hardware. Climbing positions are usually vertically spaced every 15 to 18 in. and are oriented at 180 degrees (each side of a pole) to each other. Stepping positions and "working" positions (steps at the same elevation) can be specified by the users and holes factory drilled by Powertrusion prior to delivery of poles. Contact Powertrusion for information and recommendations on climbing.

Erection

PFRC poles are generally easier to erect than traditional poles that are heavier due to their lightweight character. Conventional equipment and practices can be used as required for the terrain and site conditions. They can be erected using a single pick-up point as determined by the weight of the pole and any framed hardware depending upon the intended application. Nylon slings should used by the method of "choking the sling" to secure the pole to the lifting cable; this practice avoid scratching and gouging the pole finish. Care should also be taken to ensure that the top and bottom caps and all joints and connections are secure before erecting the structure.

Direct Embedment

Powertrusion pole design is to be directly embedded in the ground. Because PFRC material is inert, poles do not adversely affect the environment and do not require special protective coatings or treatments before being embedded. PFRC poles can be direct embedded using the same burial depth as would be used for most other types of poles unless special loading or soil conditions dictate otherwise. Once the pole is placed in the hole, the hole can be backfilled with any material normally used, such as native soil, crushed aggregate, concrete, or structural foam. Backfill tools and techniques for Powertrusion poles are typically the same as those used for poles made of other materials. Care should be taken to avoid impacting the pole wall with tools during backfill and tamping operations. Similar to all tubular poles, a bottom plug is provided to prevent further settling after the PFRC pole is installed.

Pole Grounding

Ground wires can be fastened to the pole with copper ground clips and self-tapping screws. Plastic wire molding strips can also be used to secure the ground wire to the pole. These strips contain the ground wire and are easily secured to the pole with the appropriate fastener and a self-tapping screw. Ground wires can also be run inside of the pole to discourage theft.

INSPECTION

Visual

Visual inspection is a reliable method for surface damage assessment of a PFRC material. It can roughly map out an area of surface damage, but will not necessarily reveal information about any underlying damage. Visual inspection of PFRC structures by maintenance personnel should include inspection for the following:

- Tracking on material surface
- Lightning damage
- Vandalism damage
- Mechanical impact damage
- Coating damage
- Delamination or cracking evidence

Items such as removed coating and discoloration may be visually evident, but are not considered to have a significant impact on the structural integrity of the structure.

Tap Test

The tap test can be used as a routine test to further check for any suspected localized damage. The test requires an inspector to use a small hammer to tap all around the area of suspected damage. This is a fast, inexpensive and easy way to roughly evaluate the condition of the material and locate delamination, large voids and cracks. Any area of the PFRC pole that has suffered an impact and has internal damage will be evident by a low – shallow sound given off by a tap test. Adversely, areas that are unaffected and structurally sound will be evident by a high pitch sound given by a tap test.

Repairing A Damaged Pole

Minor surface scrapes and gouges can be repaired with surface repair paint available from Powertrusion. Fiberglass wrap systems can repair more severe damage such as delamination caused by vehicle impacts. Products are available in the market place especially developed for this type of structural and cosmetic repair. These systems are composed fiberglass & resin materials that are very compatible with PFRC materials of the Powertrusion pole. Repair ability of the POWERTRUSION damaged pole needs to be assessed prior to major repairs undertaken to assure structural integrity for continued use.